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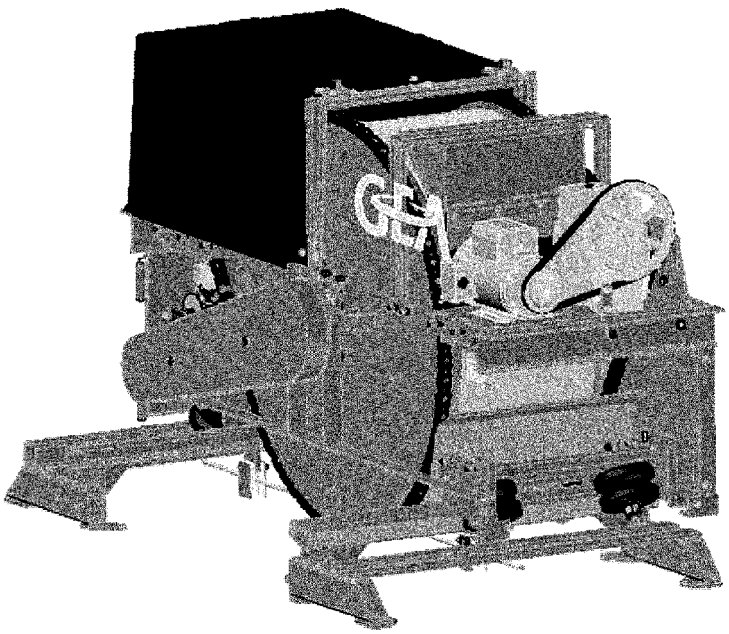
[Continued on next page]

(54) Title: CABLE DRIVE UNIT

FIG. 11



(57) Abstract: A cable drive unit (1) for use with a free stall cleaning system (101). The cable drive unit (1) includes a base frame (3), a support frame (5) being displaceable with respect to the base frame (3) via a corresponding displacement assembly (7), and a drum (9) pivotably mountable about the support frame (5) and displaceable therewith for receiving a cable (11) to be wound about said drum (9). Also described is a kit for assembling a cable drive unit (1) and a free stall cleaning system (101). Also described is a method of winding a cable (11) of a free stall cleaning system (101) about a drum (9) via the present cable drive unit (1).

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CABLE DRIVE UNIT

Field of the invention:

The present invention relates to a cable drive unit, hereinafter referred to also simply as a "drive unit". More particularly, the present invention relates to a cable drive unit, to a kit for assembling the same, to a plant (ex. a farm, a barn, etc.) provided with such a cable drive unit and/or resulting assembly, and to corresponding methods of assembling and operating associated thereto. The present application claims the priority of provisional patent application No. US 61/929,748 dated January 21st, 2014, the contents of which is incorporated herein by reference.

Background of the invention:

Free stall cleaner systems and corresponding cable drive units used therewith are well known in the art.

For example, free stall cleaners are typically used to clean the alleys of a free stall barn.

Indeed, taking cows as way of one possible example, as shown in Figure 1, they are typically free to walk in the barn and manure originating from the cows settles in the alleys.

The main components of a conventional free stall cleaner are typically as follows:

a) scraper(s) (exemplified in Figure 1);
b) at least one cable drive unit (exemplified in Figure 2);
c) wheel(s) and/or pulley(s) (exemplified in Figure 3); and

d) nylon rope(s) or steel cable(s) (exemplified in Figure 4).

As can be understood from Figures 1-8, and Figure 5 in particular, typically, the cable drive unit wraps a cable around the drum on one side and pulls one of the scrapers. At the same time, the cable on the other side of the drum unrolls. Thus, a scraper is typically going to the gutter to discharge manure while the other scraper returns to the drive unit to get back into position.

It is is also known that cable alignment during operation of a drive unit is very important during winding of the cable about the drum. One does not want the cable wrapping over itself (i.e. one row or segment cable wrapping over another such row or segment) because the friction between cable segments causes wear prematurely to the cable.

A conventional system known in the art and intended to ensure proper alignment is a "cable guide", as exemplified in Figure 6. Typically, the cable passes between two guides which are mounted on a worm shaft driven by a chain and sprockets. The pitch or feed rate is calculated carefully to ensure a good winding in order to avoid each cable wrap rubbing against each other.

Also known in the art are some of the disadvantages associated with such conventional cable drive units and/or chain guides. Namely, and unfortunately, the cable wears down when the cable guide applies pressure for alignment (that is, there is a considerable amount of rubbing between the chain guide and the cable when the chain guide is pushing against the cable to ensure that it is being wound about the drum at a desired location/row for each rotation of the drum, which could be several rotations in a given day, given that most cable drive units are operated 24/7, practically during the entire year, etc.).

In particular, the pressure between chain guide and cable is considerably increased when the scraper is at the end of its stroke (i.e. when there is a lot of tension in the cable, about 2500-3000 lbs, and when the cable is at a considerable "angle" with respect to the drum), as exemplified in Figure 8. This friction between chain guide and cable results in the premature wear of the cable, along with corresponding drawbacks (considerable time and costs associated with inspection and/or replacement, loss of production due to the downtime of the barn when replacement is required, etc.). In some cases/barns, the cable needs to be replaced every four months, which is very undesirable, for the obvious reasons briefly discussed hereinabove.

As can be easily understood from Figure 5, another substantial drawback associated with conventional cable drive units is that, when there is a long alley to be cleaned, a longer cable is required to be wound about the drum, which results in significant (i.e. large, wide, etc.) angles occurring at the end of the stroke due to the fact the presence of the corner wheel and the fact that a conventional cable drive unit has a fixed support frame and the cable must move forcefully with a cable guide along the entire and very long traversal span of the drum for winding thereabout. These significant angles that are required for ensuring normal operation of the cable drive unit, thus in turn require having to respect a certain minimal clearance (ex. 6 feet) in front of each side of the cable drive unit (i.e. between cable drive unit and corner wheel, as shown in Figure 5), to prevent an overly exaggerated or harsh angle of the cable, which in turn prevents farmers for using conventional cable drive units in other various different free-stall-cleaning layouts, especially in areas with restricted space, etc.

Another substantial drawback associated with conventional cable drive units is that the chain guide is meant to be very close to the ground, as shown in Figure 6, make it prone for accumulating unwanted debris and substances, such as manure from the barn for example, which is also undesirable for obvious reasons.

Hence, in light of the aforementioned, there is a need for an improved cable drive unit which would be able to overcome and/or remedy some of the aforementioned prior art problems. More particularly, it would be particularly useful to provide a cable drive unit that enables to eliminate friction with the cable while making sure to keep proper alignment of the cable during operation (ex. winding, pulling, etc.).

Summary of the invention:

An object of the present invention is to provide a cable drive unit which, by virtue of its design and components, satisfies some of the above-mentioned needs and which is thus an improvement over other related cable drive units and/or cable drive methods known in the prior art.

In accordance with the present invention, the above object is achieved, as will be easily understood from the present description, with a cable drive unit such as the one briefly described herein and such as the one exemplified in the accompanying drawings.

More particularly, according to one aspect of the present invention, there is provided a cable drive unit comprising:

a base frame;

a support frame being displaceable with respect to the base frame via a corresponding displacement assembly; and

a drum pivotably mountable about the support frame and displaceable therewith for receiving a cable to be wound about said drum.

According to another aspect of the present invention, there is also provided a cable drive unit comprising:

a base frame;

a support frame operatively mountable onto the base frame, and being laterally displaceable with respect to said base via a corresponding displacement assembly; and

a drum pivotably mountable about the support frame for receiving a cable to be wound about said drum.

According to another aspect of the invention, there is also provided an assembly (ex. free stall cleaner, etc.) and/or a plant (ex. farm, barn, etc.) provided with the above-mentioned cable drive unit.

According to yet another aspect of the invention, there is also provided a method of assembling the above-mentioned cable drive unit, assembly and/or plant.

According to yet another aspect of the invention, there is also provided a method of operating the above-mentioned cable drive unit, assembly and/or plant.

More particularly, according to a given aspect of the present invention, there is also provided a method of winding a cable about a drum of a cable drive unit, wherein the method comprises the step of displacing the drum with respect to a base frame while the cable is being wound about the drum. The method may further comprise the step of oppositely displacing the drum with respect to the base frame while the cable is being unwound from the drum. The method may comprise various other additional and/or sub-steps, as explained in greater detail hereinbelow when referring to the operation of the different components and features of the present cable drive unit.

According to another aspect of the invention, there is also provided a kit with corresponding components for assembling the above-mentioned cable drive unit, assembly and/or plant.

According to yet another aspect of the present invention, there is also provided a set of components for interchanging with components of the above-mentioned kit.

According to yet another aspect of the present invention, there is also provided a method of assembling components of the above-mentioned kit and/or set.

According to yet another aspect of the present invention, there is also provided a method of doing business with the above-mentioned cable drive unit, assembly, plant, kit, set and/or method(s).

The objects, advantages, and other features of the present invention will become more apparent upon reading of the following non-restrictive description of preferred embodiments thereof, given for the purpose of exemplification only, with reference to the accompanying drawings.

Brief description of the drawings:

Figures 1-8 are different views of a cable drive unit and/or of corresponding components/accessories thereof according to the prior art.

Figures 9-24 are different views of a cable drive unit and/or of corresponding components/accessories thereof according to possible embodiments of the present invention, certain views being shown with some of the outer components/panels of the cable drive unit having been removed to better illustrate inner components and features of the cable drive unit.

Detailed description of preferred embodiments of the invention:

In the following description, the same numerical references refer to similar elements. Furthermore, for sake of simplicity and clarity, namely so as to not unduly burden the figures with several references numbers, only some figures have been provided with reference numbers, and components and features of the present invention illustrated in other figures can be easily inferred therefrom. The embodiments, geometrical configurations, materials mentioned and/or dimensions shown in the figures are preferred, for exemplification purposes only.

Moreover, although the present invention was primarily designed for use with a cable cooperating with a cable drive unit, preferably such as the ones used for cleaning stalls in farms, barns and/or the like, it may be used with other objects and/or in other types of applications, as apparent to a person skilled in the art. For this reason, expressions such as "cable", "stall", "cleaner", "farm", "barn", "cow", etc., used herein should not be taken so as to limit the scope of the present invention and include all other kinds of objects and/or applications with which the present invention could be used and may be useful.

Moreover, in the context of the present invention, the expressions "unit", "cleaner", "device", "system", "assembly", "product", as well as any other equivalent expressions and/or compounds word thereof known in the art will be used interchangeably, as apparent to a person skilled in the art. This applies also for any other mutually equivalent expressions, such as, for example: a) "cable", "rope", "link", "connector", etc.; b) "displace", "travel", "move", "roll", "slide", "translate", "glide", etc.; c) "lateral", "traversal", "across", "angled", etc.; d) "worm", "gear", etc.; e) "row", "segment", "portion", etc.; f) "rail", "track", etc.; g) "plant", "farm", "barn", etc.; h) "traversal", "transversal", "perpendicular", "across", "crossing", etc.; i) "wind", "wrap", "roll", "coil", etc.; as well as for any other mutually equivalent expressions, pertaining to the aforementioned expressions and/or to any other structural and/or

functional aspects of the present invention, as also apparent to a person skilled in the art.

Furthermore, in the context of the present description, it will be considered that all elongated objects will have an implicit "longitudinal axis" or "centerline", such as the longitudinal axis of a shaft, or the centerline of a cable when in an extended configuration, for example (and as a result, there is a "transversal axis" being substantially "perpendicular" for each longitudinal axis, etc.), and that expressions such as "connected" and "connectable", or "mounted" and "mountable", may be interchangeable, in that the present invention also relates to a kit with corresponding components for assembling a resulting fully assembled and operational cable drive unit (and/or a resulting assembly and/or plant (ex. farm, barn, layout, etc.) including the same).

In addition, although the preferred embodiments of the present invention as illustrated in the accompanying drawings comprise various components, and although the preferred embodiments of the cable drive unit (1) and corresponding parts as shown consist of certain geometrical configurations as explained and illustrated herein, not all of these components and geometries are essential to the invention and thus should not be taken in their restrictive sense, i.e. should not be taken so as to limit the scope of the present invention. It is to be understood, as also apparent to a person skilled in the art, that other suitable components and cooperation thereinbetween, as well as other suitable geometrical configurations may be used for the cable drive unit (1) and corresponding parts according to the present invention, as will be briefly explained herein and as can be easily inferred herefrom by a person skilled in the art, without departing from the scope of the present invention.

Broadly described, and as better exemplified in the accompanying drawings, the present invention relates to a cable drive unit (1) with improved shape,

components and features enabling for better, easier, more convenient, more reliable and more durable cable driving/winding applications.

List of numerical references for some of the corresponding possible components illustrated in the accompanying drawings:

1. cable drive unit
3. base frame
5. support frame
7. displacement assembly
9. drum
11. cable
13. transmission assembly
15. shaft (of drum)
17. worn gear
19. fixed component (of base frame)
21. chain
23. first gear
25. second gear
27. chain tensioner
29. rail
31. wheel
33. circumferential groove (of wheel)
35. side edge (of rail)
37. V-shaped bar (of rail)
39. axis of rotation (of wheel)
41. bottom portion (of support frame)
43. peripheral surface (of drum)
45. toothed peripheral edge (of drum)
47. driving assembly

49. range-limiting assembly
51. plate (of range-limiting assembly)
51a. first plate (of range-limiting assembly)
51b. second plate (of range-limiting assembly)
53. switch
55. chain guide
57. panel(s)
59. accessory (of cable drive unit)
61. recessed row (of drum)
101. free stall cleaning system

As will be easily understood, the present cable drive unit (1) is particularly advantageous in that, by virtue of its design, components and features, exemplified in the accompanying drawings, it enables to eliminate (or at the very least, to substantially reduce) friction with the cable (11) while making sure to keep proper alignment of the cable (11) during operation (winding, pulling, etc.) of the cable drive unit (1).

Efforts of the Applicant have been focused on the longevity of the cable (11) due to the high cost of replacement part(s). Thus, an object of the present invention is to eliminate friction as much as possible to prevent cable wear, and to provide a new cable winding method that could avoid or at the very least substantially reduce friction.

As will be better understood when referring to the present description and accompanying drawings, namely Figure 9 for example, an important feature of the present cable drive unit (1) is that it is designed so that the drive unit frame, also referred herein as "support frame" (9), "moves" with respect to the base frame (3) via a corresponding displacement assembly (7), in order to align the cable (11) with respect to the drum (9) as the cable (11) is wound and/or unwound, instead of

having a "fixed frame" where the cable (11) moves continuously from "left" to "right" (and vice-versa) by means of a "cable guide", as is the case with conventional systems.

According to one possible embodiment, as exemplified in Figure 10, the base frame (3) is fixed on the floor and the drive unit (1) moves with respect to the base frame (3) by means of a displacement assembly (7) which may be driven by chain, sprocket and/or a worm shaft, for example. With this particular design, the friction between the cable (11) and other parts is eliminated and/or substantially reduced.

The cable drive unit (1) may come in the form of a cable drive unit (1) including one and/or several of the following possible components and features (and/or different combination(s) thereof):

According to one possible embodiment, the cable drive unit (1) may comprise a base frame (3), a support frame (5) being displaceable with respect to the base frame (3) via a corresponding displacement assembly (7), and a drum (9) pivotably mountable about the support frame (5) and displaceable therewith for receiving a cable (11) to be wound about said drum (9).

According to another possible embodiment, the cable drive unit (1) may comprise a base frame (3), a support frame (5) operatively mountable onto the base frame (3), and being laterally displaceable with respect to said base via a corresponding displacement assembly (7), and a drum (9) pivotably mountable about the support frame (5) for receiving a cable (11) to be wound about said drum (9).

Indeed, as can be easily understood, and according to optional embodiments of the present invention, it is the "drum" (9) about which the cable (11) is wound and/or unwound that is "displaced" during operation of the drive unit (1) so that the

cable (11) to be wound and/or unwound is kept in a substantially fixed and optimal configuration, contrary to conventional drive units where the drum is "fixed", and the cable is continuously moving from one side to another, via a wide range of significant angles, and forcefully with a "chain guide" pushing onto said cable, causing premature ware and other undesirable drawbacks.

As can be easily understood, and according to the present invention, the way in which the drum (9) is displaced in a reciprocating (ex. back-and-forth, etc.) motion with respect to the base frame (3) can be varied, and different components and features could be used to accomplish this displacement of the support frame (5) and corresponding drum (9) pivotally mountable thereabout, during operation of the cable drive unit (1).

According to one possible embodiment, the cable drive unit (1) may comprise a transmission assembly (13) operatively connectable between a shaft (15) of the drum (9) and the displacement assembly (7), the transmission assembly (13) being configured for displacing the support frame (5) and corresponding drum (9) with respect to the base frame (3) by a certain displacement for every rotational displacement of the drum (9).

Displacement (ex. lateral displacement, and/or other) of the support frame (5) with respect to the base frame (3) can be done in a gradual/progressive manner, or alternatively, lateral displacement of the support frame (5) with respect to the base frame (3) could be done incrementally (ex. in small increments, in a stepped manner, etc.).

Either way, and preferably, displacement of the support frame (5) with respect to the base frame (3) is done so as to be synchronized with a rotational displacement of the drum (9).

According to an optional embodiment, displacement of the support frame (5) with respect to the base frame (3) is done so as to be synchronized with a rotational displacement of the drum (9) via a corresponding transmission ratio or step of the transmission assembly (13).

As exemplified in the accompanying drawings, the transmission assembly (13) may comprise a worm gear (17) pivotally mountable about the support frame (5) within a given span, said worm gear (17) being threadedly engageable within a fixed component (19) (ex. vertical post, etc.) of the base frame (3) so that a rotation of the worm gear (17) in turn drives a lateral displacement of the support frame (5) with respect to the base frame (3).

According to one possible embodiment, the transmission assembly (13) may comprise a chain (21) operatively linking the drum (9) to the worm gear (17), as better shown in Figure 9, for example.

As also shown, a portion of the shaft (15) of the drum (9) can be provided with a first gear (23), and a portion of the worm gear (17) can be provided with a second gear (25), the chain (21) being mounted onto said first and second gears (25) of the transmission assembly (13), a given gear ratio being established between said first and second gears (25).

Optionally also, the transmission assembly (13) may comprise a chain tensioner (27) for ensuring a given tension within the chain (21).

According to one possible embodiment, the gear ratio is selected in relation to a diameter of the drum (9), and displacement of the support frame (5) and corresponding drum (9) is selected in relation to a diameter of the cable (11) to be wound about the drum (9).

Preferably, the drum (9) of the cable drive unit (1) is configured to rotate once for every incremental displacement of the support frame (5) and corresponding drum

(9), said incremental displacement corresponding substantially to a diameter of the cable (11) to be wound about the drum (9).

Even though the spacing between cable segments and the configuration of the drum (9) can be varied according to the present system, according to one possible embodiment, a spacing ranging between about 1/16 of an inch and about 1/8 of an inch is provided between cable segments (or rows, etc.) wound about the drum (9).

As can be easily understood when referring to the accompanying drawings, and more particularly, as better shown in Figures 9 and 10, for example, according to a possible embodiment of the present invention, the base frame (3) comprises at least one rail (29) on which the support frame (5) is configured to travel, and the support frame (5) comprises at least one wheel (31) for traveling over a corresponding rail (29) of the base frame (3).

According to one optional embodiment, the base frame (3) comprises a pair of rails (29) on which the support frame (5) is configured to travel, and the support frame (5) comprises a first pair of wheels (31) for traveling over a first corresponding rail (29) of the base frame (3), and a second pair of wheels (31) for traveling over a second corresponding rail (29) of the base frame (3), as exemplified in Figures 9-24.

Each wheel (31) of the support frame (5) may comprise a circumferential groove (33) positioned, shaped and sized to travel over a corresponding side edge (35) of a corresponding rail (29) of the base frame (3), as better shown in Figure 10.

The side edge (35) of the rail (29) can be a corner (ex. V-shaped, etc.) bar (37) rigidly affixable onto the rail (29), or any other suitable shape, in that the circumferential groove (33) of each wheel (31) is preferably configured to be complementary to the shape of the rail (29) on which the wheel (31) is intended to travel, or at the very least, the circumferential groove (33) of each wheel (31) is

complementary to the shape of the side edge (35) of the rail (29) on which the wheel (31) is intended to travel.

As also better exemplified in Figure 10, and according to a possible embodiment of the present invention, each axis of rotation (39) of each wheel (31) of the support frame (5) is inclined inwardly towards the drum (9), and optionally also, each rail (29) is substantially slanted with respect to the base frame (3). Furthermore, the displaceable support frame (5) may comprise bottom portions (41) complementary in shape to the slanted rails (29) of the cable drive unit (1), so as to allow the support frame (5) to move back-and-forth along the base frame (3) without any interference, as can be easily understood when referring to Figure 9, for example.

The drum (9) and corresponding accessories cooperating therewith can come in various shapes and forms, as can be easily understood. For example, a peripheral surface (43) of the drum (9) could ultimately be "smooth", but according to an optional embodiment of the present system, as exemplified in the accompanying drawings, the peripheral surface (43) of the drum (9) comprises recessed rows (61) for receiving corresponding wound segments (i.e. rows, portions, etc.) of the cable (11) onto the drum (9).

According to other possible embodiments, the drum (9) comprises at least one toothed peripheral edge (45), said toothed peripheral edge (45) being driven by a corresponding driving assembly (47), the driving assembly (47) being configured for driving the drum (9) along a first direction of rotation (ex. clockwise), and along a second opposite direction of rotation (ex. counter-clockwise), so as to wind (ex. roll, etc.) and unwind (ex. unroll, etc.) the cable (11) about the drum (9).

The driving assembly (47) may comprise a least one component selected from the group consisting of motors, gears, sprockets, reducers, chains, links,

connectors, and the like, as can be understood by a person skilled in the art, and according to other possible embodiments, as exemplified in the accompanying drawings, the cable drive unit (1) comprises a pair of opposite toothed peripheral edges (45), and thus a pair of driving assemblies (47), each one being used for driving the drum (9) along a given direction of rotation.

According to another possible embodiment of the present invention, the cable drive unit (1) comprises a range-limiting assembly (49) for limiting a distance of travel of the support frame (5) with respect to the base frame (3).

Such a range-limiting assembly (49) may come in various shapes and forms, but according to one possible embodiment illustrated in the accompanying drawings, the range-limiting assembly (49) comprises first and second plates (51a, 51b) operatively mounted onto the displaceable support frame (5) and each being configured for contacting a given switch (53) at the end of travel, so that at said end of said travel, the corresponding plate (51) contacting the switch (53) turns off a given rotational driving direction of the driving assembly (47) and turns on another opposite given rotational driving direction, thereby urging the displaceable support frame (5) into a reciprocating back-and-forth lateral movement during operation of the cable drive unit (1). The switch (53) can be mountable onto the fixed component (19) (ex. vertical post, etc.) of the base frame (3), for example.

The present cable drive unit (1) may also comprise at least one chain guide (55), and each chain guide (55) may be fixed with respect to the base frame (3), and/or positioned under the base frame (3). It is worth mentioning also that the presence of such a chain guide (55) is not essential for proper operation of the present cable drive unit (1) and is presented as an optional/additional feature only.

As can be understood from the different views illustrated in the accompanying drawings, the cable drive unit (1) may comprise different panels (57) for covering different sections of the cable drive unit (1), and according to optional embodiments,

these panels (57) are removably mountable onto said corresponding different sections of the cable drive unit (1), so as to enable a user thereof to properly inspect, maintain and/or service the cable drive unit (1), and the different components thereof, if need may be.

According to another aspect of the present invention, there is provided a free stall cleaning system (101) comprising at least one cable drive unit (1) such as the one described and illustrated herein. The free stall cleaner may comprise at least one accessory (59) selected from the group consisting of scrapers, wheels (ex. corner wheels), pulleys, cables and/or all of the various other accessories known in the prior art.

According to another aspect of the present invention, there is also provided a kit with corresponding components for assembling a cable drive unit (1) and/or a free stall cleaning system (101) such as the one described and illustrated herein.

According to another aspect of the present invention, there is also provided a method of winding a cable (11) of a free stall cleaning system (101) about a drum (9) of a corresponding cable drive unit (1), wherein the method comprises the step of displacing (ex. laterally, etc.) the drum (9) with respect to a base frame (3) while the cable (11) is being wound about the drum (9). The method may further comprise the step of oppositely displacing (ex. laterally reversing, etc.) the drum (9) with respect to the base frame (3) while the cable (11) is being unwound from the drum (9).

As may now better be appreciated, the present invention is a substantial improvement over the prior art in that, by virtue of its design and components, as explained herein, and the particular configuration of the cable drive unit (1) and/or components/accessories thereof, the cable drive unit (1) according to the present invention enables for a quicker, easier, simpler, more effective/reliable and more durable manner than what is possible with respect to other cable drive units available in the prior art.

For example, the present cable drive unit (1) is particularly advantageous in that, by virtue of its design, components and features, as better described and illustrated herein, it enables to eliminate (or at the very least, to substantially reduce) friction with the cable (11) while making sure to keep proper alignment of the cable (11) during operation (winding, pulling, etc.) of the cable drive unit (1). The cable (11) to be wound and/or unwound is preferably kept "straight" (i.e. positioned, centered, etc.) with respect to the drum (9), because the drum (9) is laterally moved as the cable is wound and/or unwound about the drum (9), thereby avoiding and/or minimizing premature cable wear, and as a result, substantially extending the useful life of the cable (11), along with corresponding advantages (cleaner barns, better barn layouts, increased use and productivity for the barn due to less cable replacement, less downtime, etc.).

Of course, and as can be easily by a person skilled in the art, the scope of the claims should not be limited by the possible embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.

CLAIMS:

1. A cable drive unit (1) for use with a free stall cleaning system (101), the cable drive unit (1) comprising:

a base frame (3);

a support frame (5) being displaceable with respect to the base frame (3) via a corresponding displacement assembly (7); and

a drum (9) pivotably mountable about the support frame (5) and displaceable therewith for receiving a cable (11) to be wound about said drum (9).

2. A cable drive unit (1) for use with a free stall cleaning system (101), the cable drive unit (1) comprising:

a base frame (3);

a support frame (5) operatively mountable onto the base frame (3), and being laterally displaceable with respect to said base via a corresponding displacement assembly (7); and

a drum (9) pivotably mountable about the support frame (5) for receiving a cable (11) to be wound about said drum (9).

3. A cable drive unit (1) according to claim 1 or 2, wherein the cable drive unit (1) comprises:

a transmission assembly (13) operatively connectable between a shaft (15) of the drum (9) and the displacement assembly (7), the transmission assembly (13) being configured for laterally displacing the support frame (5) and corresponding drum (9) with respect to the base frame (3) by a certain lateral displacement for every rotational displacement of the drum (9).

4. A cable drive unit (1) according to any one of claims 1-3, wherein displacement of the support frame (5) with respect to the base frame (3) is done in a progressive manner.

5. A cable drive unit (1) according to any one of claims 1-3, wherein displacement of the support frame (5) with respect to the base frame (3) is done incrementally.

6. A cable drive unit (1) according to any one of claims 1-5, wherein displacement of the support frame (5) with respect to the base frame (3) is synchronized with a rotational displacement of the drum (9).

7. A cable drive unit (1) according to any one of claims 1-6, wherein displacement of the support frame (5) with respect to the base frame (3) is synchronized with a rotational displacement of the drum (9) via a corresponding transmission ratio or step of the transmission assembly (13).

8. A cable drive unit (1) according to any one of claims 3-7, wherein the transmission assembly (13) comprises a worm gear (17) pivotally mountable about the support frame (5) within a given span, said worm gear (17) being threadedly engageable within a fixed component (19) of the base frame (3) so that a rotation of the worm gear in turn drives a lateral displacement of the support frame (5) with respect to the base frame (3).

9. A cable drive unit (1) according to claim 8, wherein the transmission assembly (13) comprises a chain (21) operatively linking the drum (9) to the worm gear (17).

10. A cable drive unit (1) according to claim 8 or 9, wherein a portion of the shaft (15) of the drum (9) is provided with a first gear (23), and wherein a portion of the worm gear (17) is provided with a second gear (25), the chain (21) being mounted onto said first and second gears (25) of the transmission assembly (13), a given gear ratio being established between said first and second gears (25).

11. A cable drive unit (1) according to claim 9 or 10, wherein the transmission assembly (13) comprises a chain tensioner (27) for ensuring a given tension within the chain (21).

12. A cable drive unit (1) according to claim 9, wherein the gear ratio is selected in relation to a diameter of the drum (9).

13. A cable drive unit (1) according to any one of claims 1-12, wherein displacement of the support frame (5) and corresponding drum (9) is selected in relation to a diameter of the cable (11) to be wound about the drum (9).

14. A cable drive unit (1) according to any one of claims 1-13, wherein the drum (9) of the cable drive unit (1) is configured to rotate once for every incremental lateral displacement of the support frame (5) and corresponding drum (9), said incremental lateral displacement corresponding substantially to a diameter of the cable (11) to be wound about the drum (9).

15. A cable drive unit (1) according to any one of claims 1-14, wherein a spacing ranging between about 1/16 of an inch and about 1/8 of an inch is provided between cable segments wound about the drum (9).

16. A cable drive unit (1) according to any one of claims 1-15, wherein the base frame (3) comprises at least one rail (29) on which the support frame (5) is configured to travel.

17. A cable drive unit (1) according to any one of claims 1-16, wherein the support frame (5) comprises at least one wheel (31) for traveling over a corresponding rail (29) of the base frame (3).

18. A cable drive unit (1) according to any one of claims 1-17, wherein the base frame (3) comprises a pair of rails (29) on which the support frame (5) is configured to travel.

19. A cable drive unit (1) according to any one of claims 1-18, wherein the support frame (5) comprises a first pair of wheels (31) for traveling over a first corresponding rail (29) of the base frame (3), and a second pair of wheels (31) for traveling over a second corresponding rail (29) of the base frame (3).

20. A cable drive unit (1) according to claim 17 or 19, wherein each wheel (31) of the support frame (5) comprises a circumferential groove (33) positioned, shaped and sized to travel over a corresponding side edge (35) of a corresponding rail (29) of the base frame (3).

21. A cable drive unit (1) according to claim 20, wherein the side edge (35) of the rail (29) is a corner bar (37) rigidly affixable onto the rail (29).

22. A cable drive unit (1) according to claim 20 or 21, wherein the circumferential groove (33) of each wheel (31) is complementary to the shape of the rail (29) on which the wheel (31) is intended to travel.

23. A cable drive unit (1) according to any one of claims 20-23, wherein the circumferential groove (33) of each wheel (31) is complementary to the shape of the side edge (35) of the rail (29) on which the wheel (31) is intended to travel.

24. A cable drive unit (1) according to any one of claims 17 and 19-23, wherein each axis of rotation (39) of each wheel (31) of the support frame (5) is inclined inwardly towards the drum (9).

25. A cable drive unit (1) according to any one of claims 17-24, wherein each rail (29) is substantially slanted with respect to the base frame (3).

26. A cable drive unit (1) according to any one of claims 17-25, wherein the displaceable support frame (5) comprises bottom portions (41) complementary in shape to slanted rails (29) of the cable drive unit (1).

27. A cable drive unit (1) according to any one of claims 1-26, wherein a peripheral surface (43) of the drum (9) is smooth.

28. A cable drive unit (1) according to any one of claims 1-26, wherein a peripheral surface (43) of the drum (9) comprises recessed rows (61) for receiving corresponding wound segments of the cable (11) onto the drum (9).

29. A cable drive unit (1) according to any one of claims 1-28, wherein the drum (9) comprises at least one toothed peripheral edge (45), said toothed peripheral edge (45) being driven by a corresponding driving assembly (47).

30. A cable drive unit (1) according to claim 29, wherein the driving assembly (47) is configured for driving the drum (9) along a first direction of rotation, and along a second opposite direction of rotation, so as to wind and unwind the cable (11) about the drum (9).

31. A cable drive unit (1) according to claim 29 or 30, wherein the driving assembly (47) comprises a least one component selected from the group consisting of motors, gears, sprockets, reducers, chains, links and connectors.

32. A cable drive unit (1) according to any one of claims 1-31, wherein the cable drive unit (1) comprises a pair of opposite toothed peripheral edges (45), and thus a pair of driving assemblies (47), each one being used for driving the drum (9) along a given direction of rotation.

33. A cable drive unit (1) according to any one of claims 1-32, wherein the cable drive unit (1) comprises a range-limiting assembly (49) for limiting a distance of travel of the support frame (5) with respect to the base frame (3).

34. A cable drive unit (1) according to claim 33, wherein the range-limiting assembly (49) comprises first and second plates (51a, 51b) operatively mounted onto the displaceable support frame (5) and each being configured for contacting a given switch (53) at the end of travel, so that at said end of said travel, the corresponding plate (51) contacting the switch (53) turns off a given rotational driving direction of the driving assembly (47) and turns on another opposite given rotational driving direction, thereby urging the displaceable support frame (5) into a reciprocating back-and-forth lateral movement during operation of the cable drive unit (1).

35. A cable drive unit (1) according to claim 34, wherein the switch (53) is mountable onto the fixed component (19) of the base frame (3).

36. A cable drive unit (1) according to any one of claims 1-35, wherein the cable drive unit (1) comprises at least one chain guide (55).

37. A cable drive unit (1) according to claim 36, wherein each chain guide (55) is fixed with respect to the base frame (3).

38. A cable drive unit (1) according to claim 36 or 37, wherein each chain guide (55) is positioned under the base frame (3).

39. A cable drive unit (1) according to any one of claims 1-38, wherein the cable drive unit (1) comprises panels (57) for covering different sections of the cable drive unit (1).

40. A free stall cleaning system (101) comprising at least one cable drive unit (1) according to any one of claims 1-39.

41. A free stall cleaner according to claim 40, wherein the free stall cleaner comprises at least one accessory (59) selected from the group consisting of scrapers, wheels, pulleys and cables.

42. A kit with corresponding components for assembling a cable drive unit (1) according to any one of claims 1-39.

43. A method of winding a cable (11) of a free stall cleaning system (101) about a drum (9) of a corresponding cable drive unit (1), wherein the method comprises the step of displacing the drum (9) with respect to a base frame (3) while the cable (11) is being wound about the drum (9).

44. A method according to claim 43, wherein the method further comprises the step of oppositely displacing the drum (9) with respect to the base frame (3) while the cable (11) is being unwound from the drum (9).

FIG. 1 (PRIOR ART)

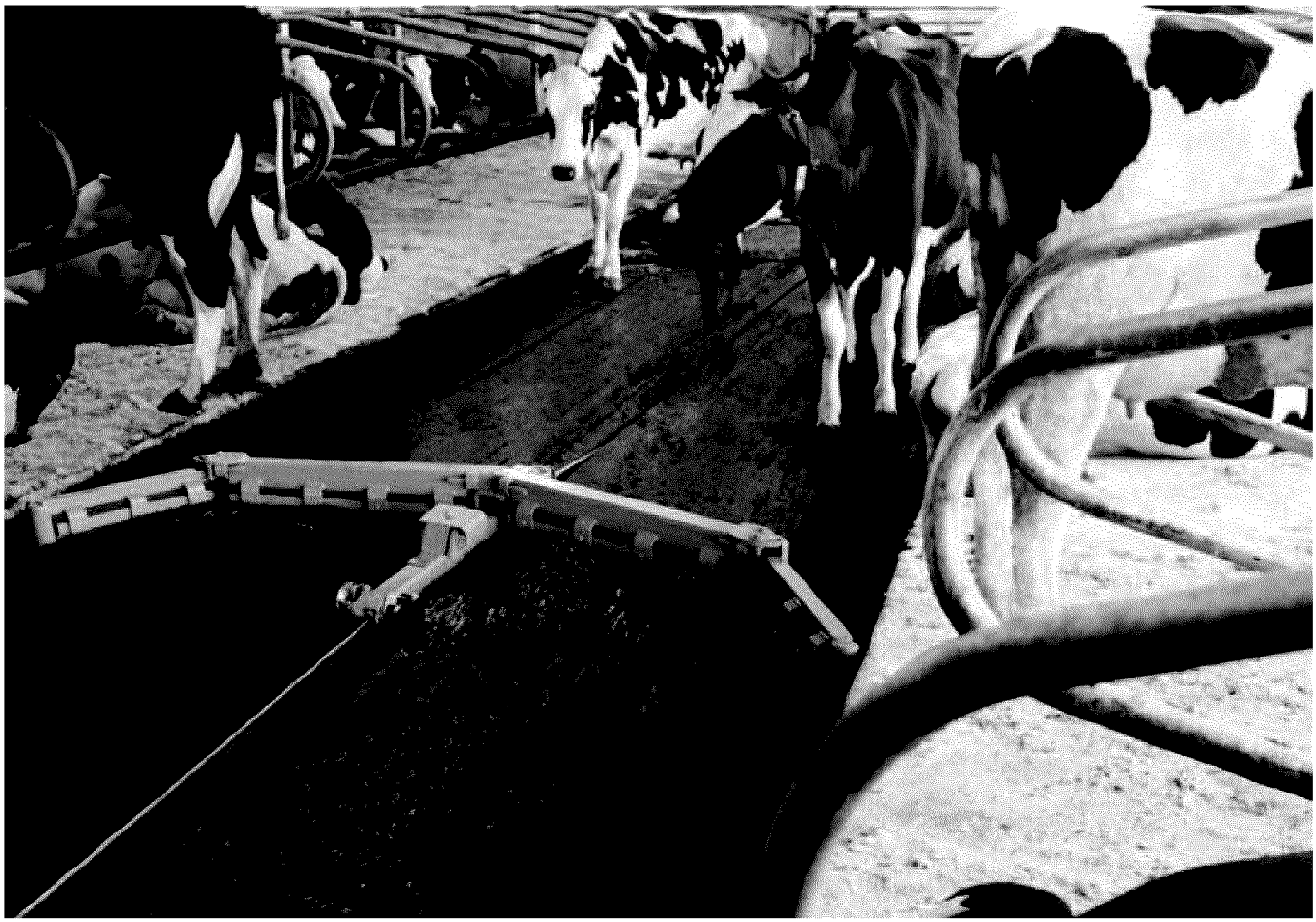


FIG. 2 (PRIOR ART)

FIG. 3 (PRIOR ART)

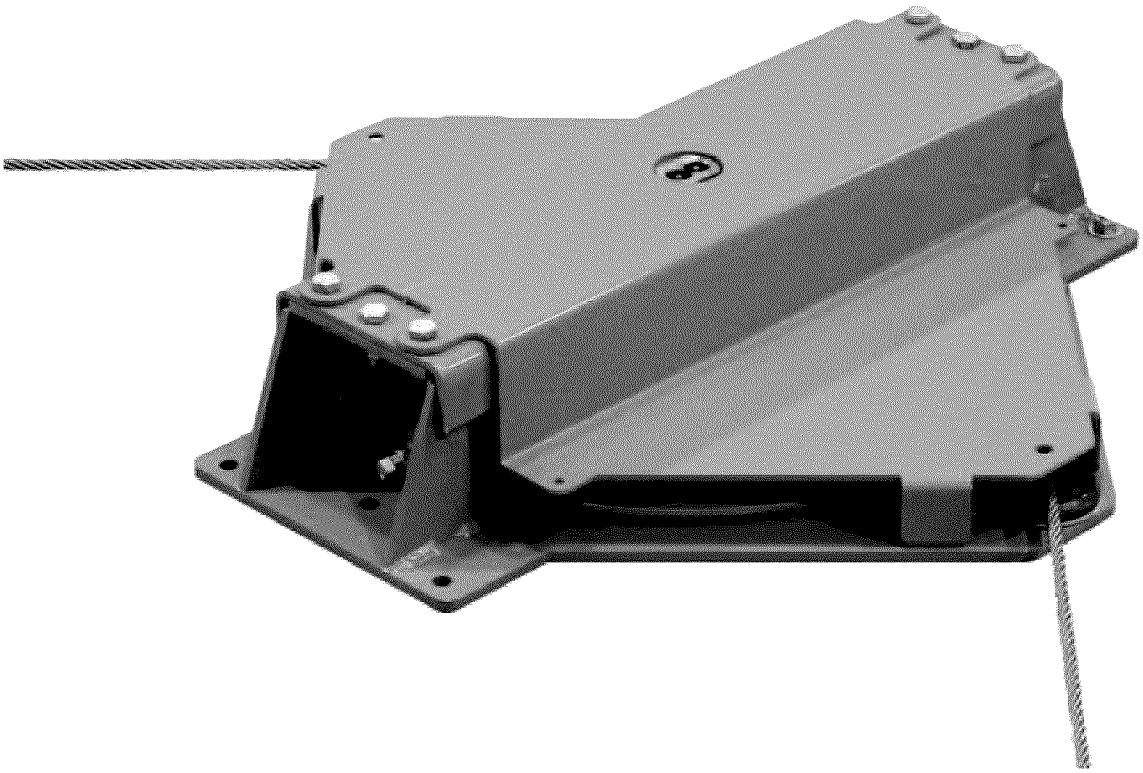


FIG. 4 (PRIOR ART)

FIG. 5 (PRIOR ART)

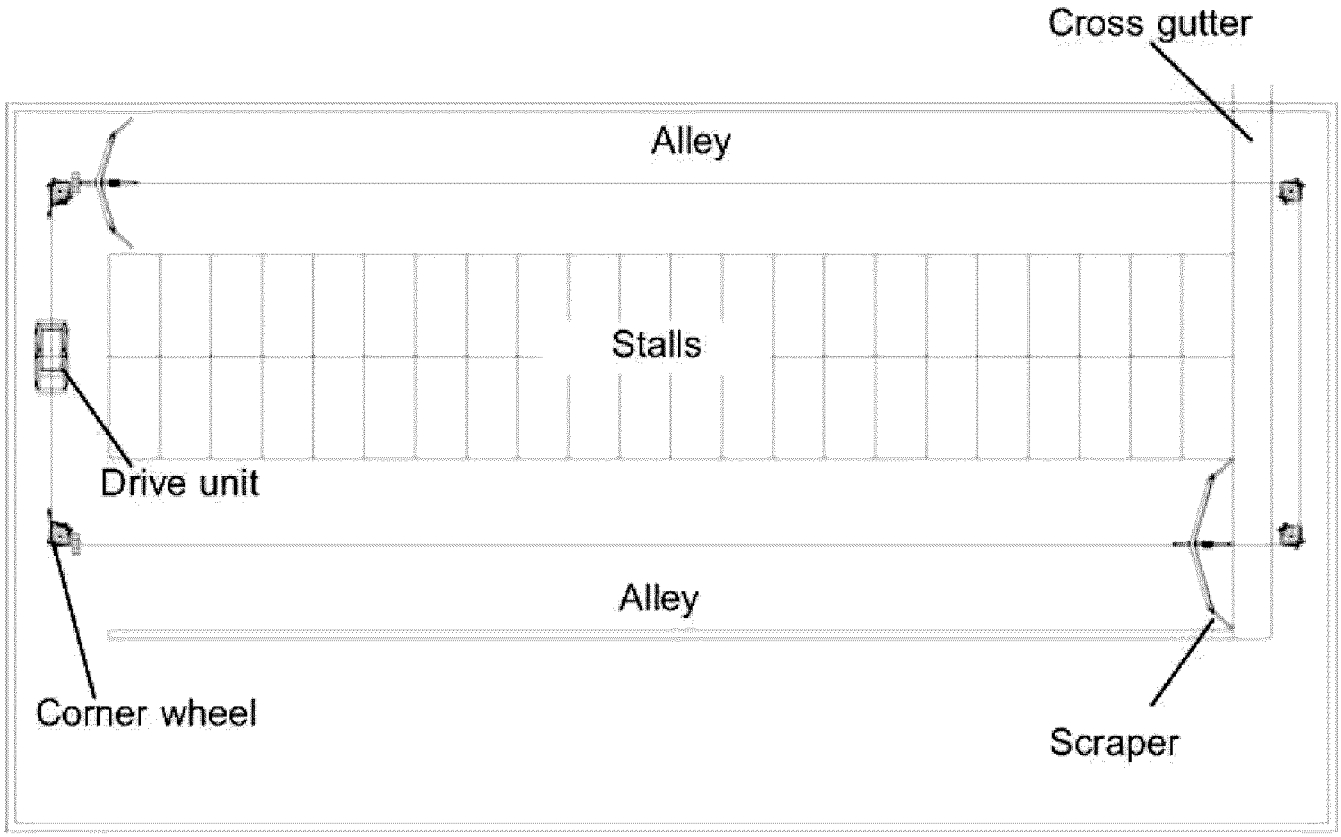


FIG. 6 (PRIOR ART)

FIG. 7 (PRIOR ART)

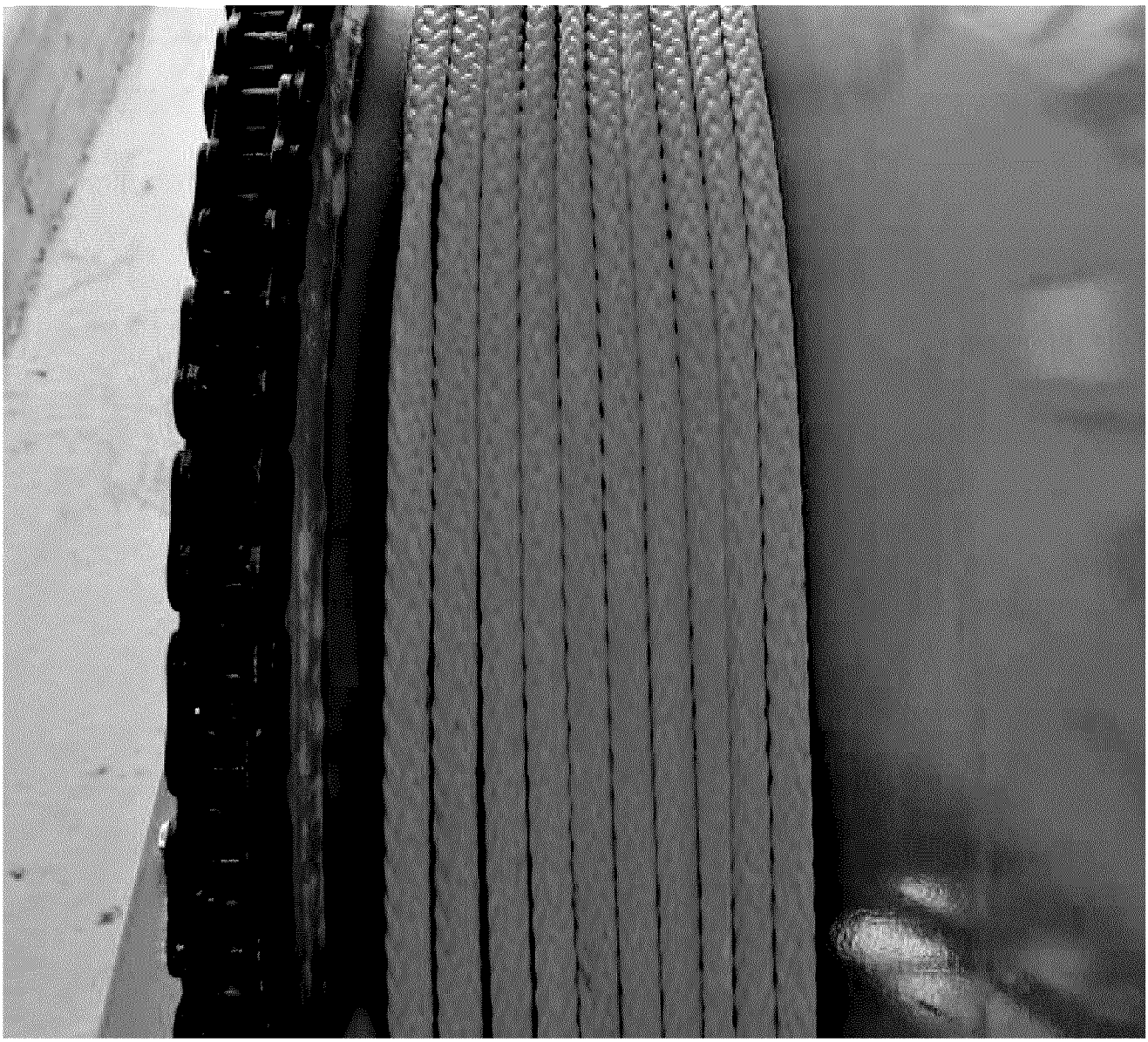


FIG. 8 (PRIOR ART)

FIG. 9

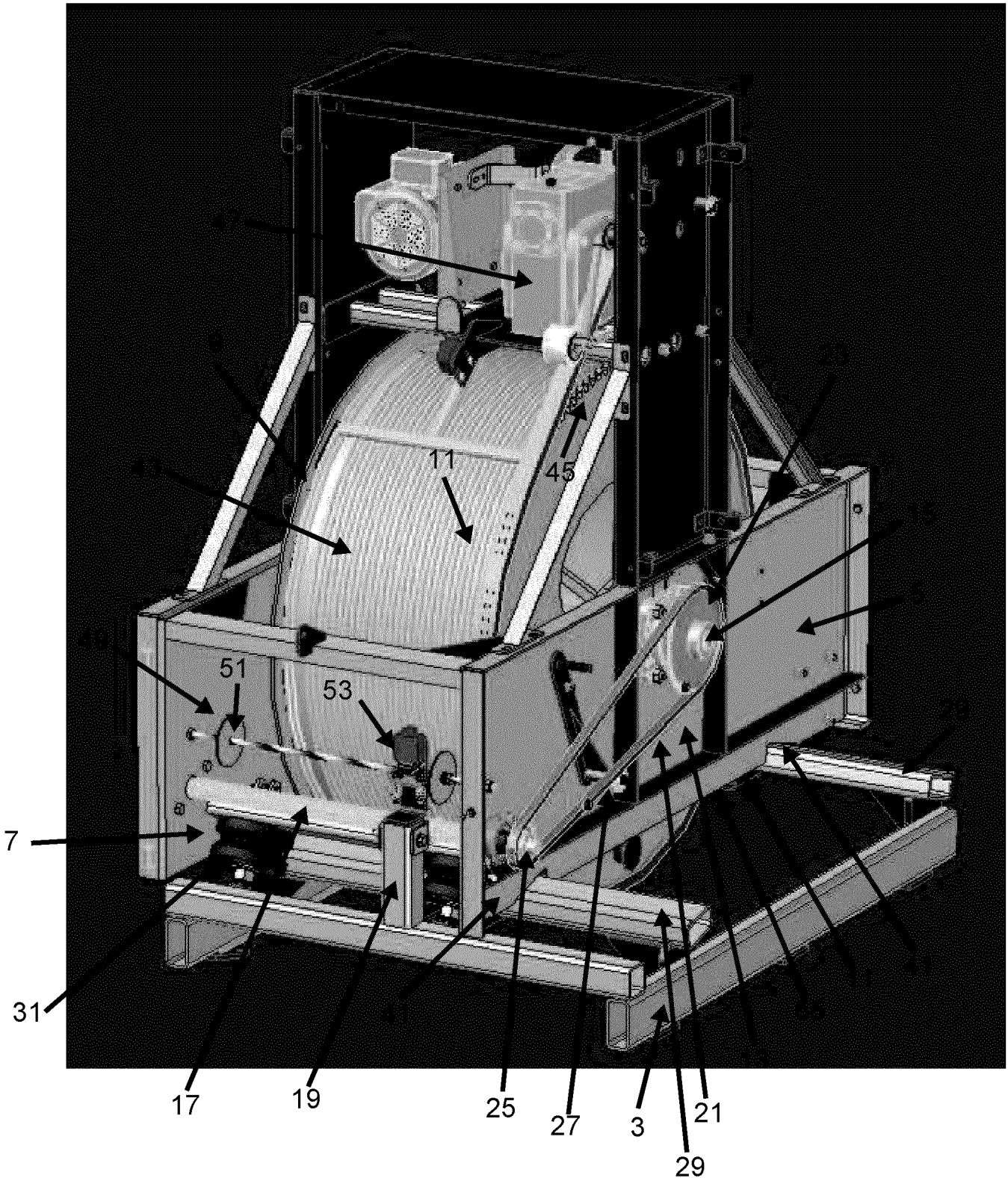


FIG. 10

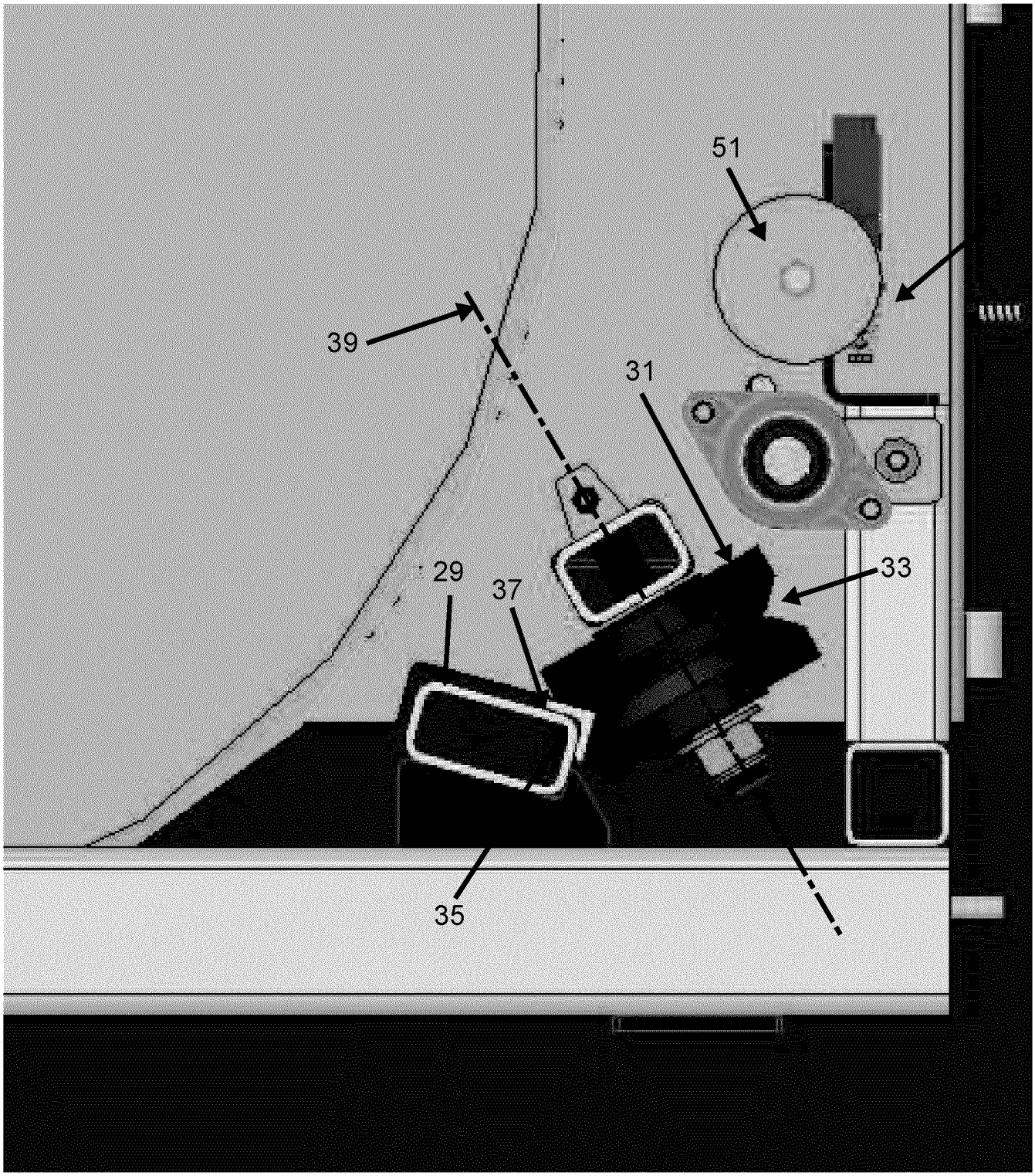


FIG. 11

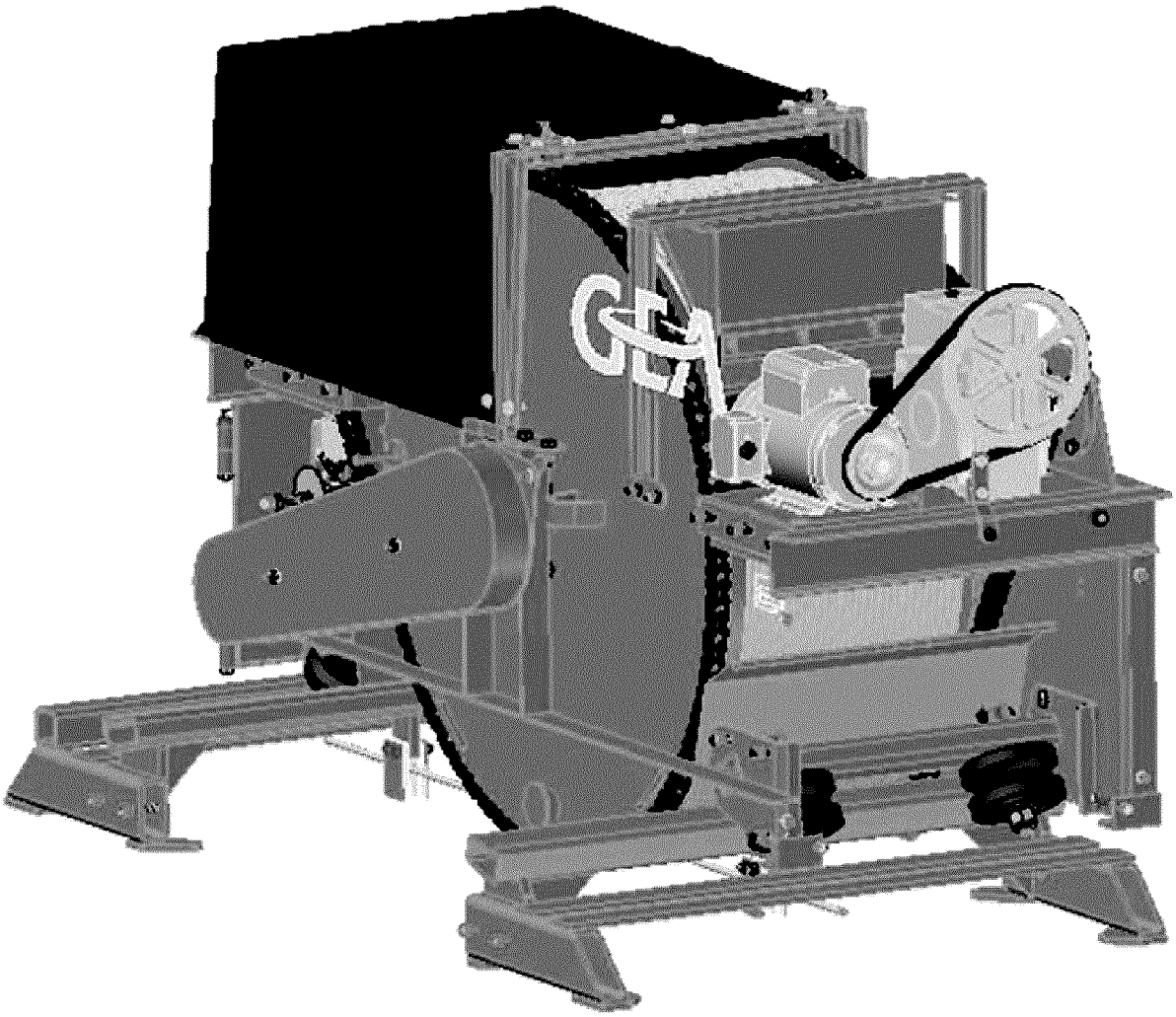


FIG. 12

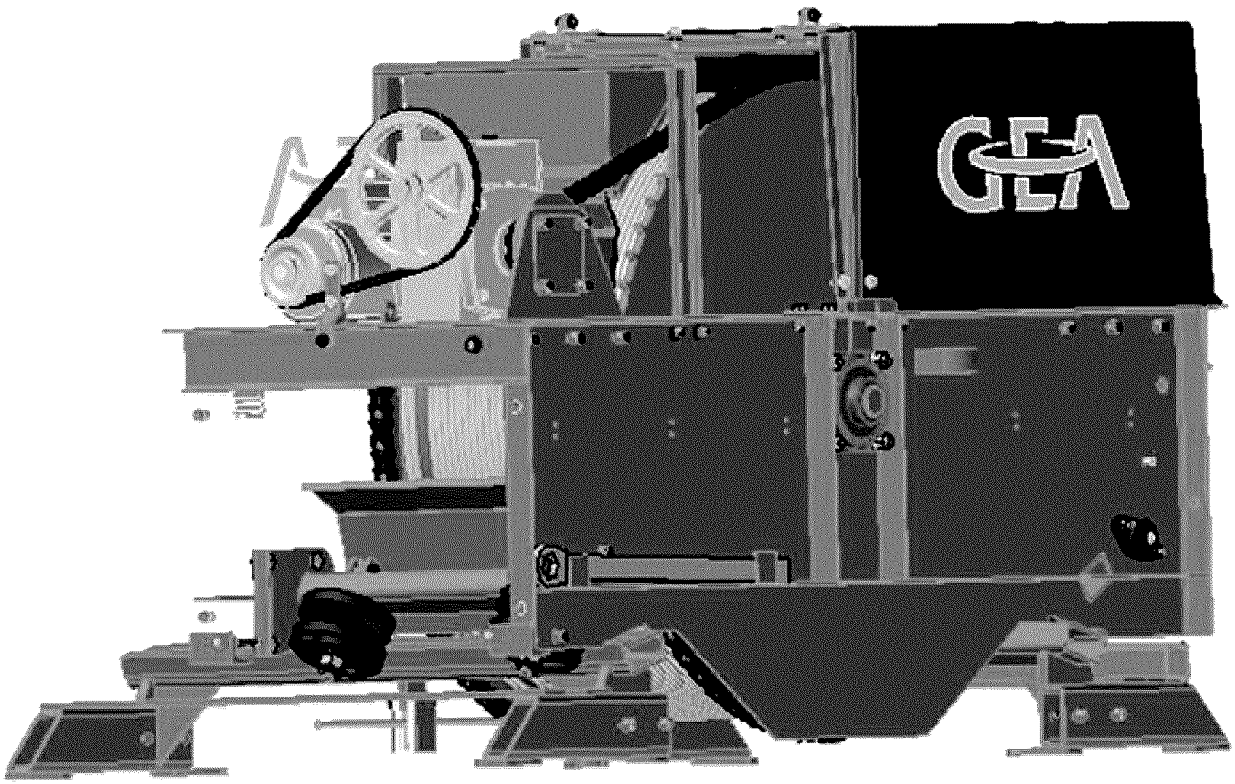


FIG. 13

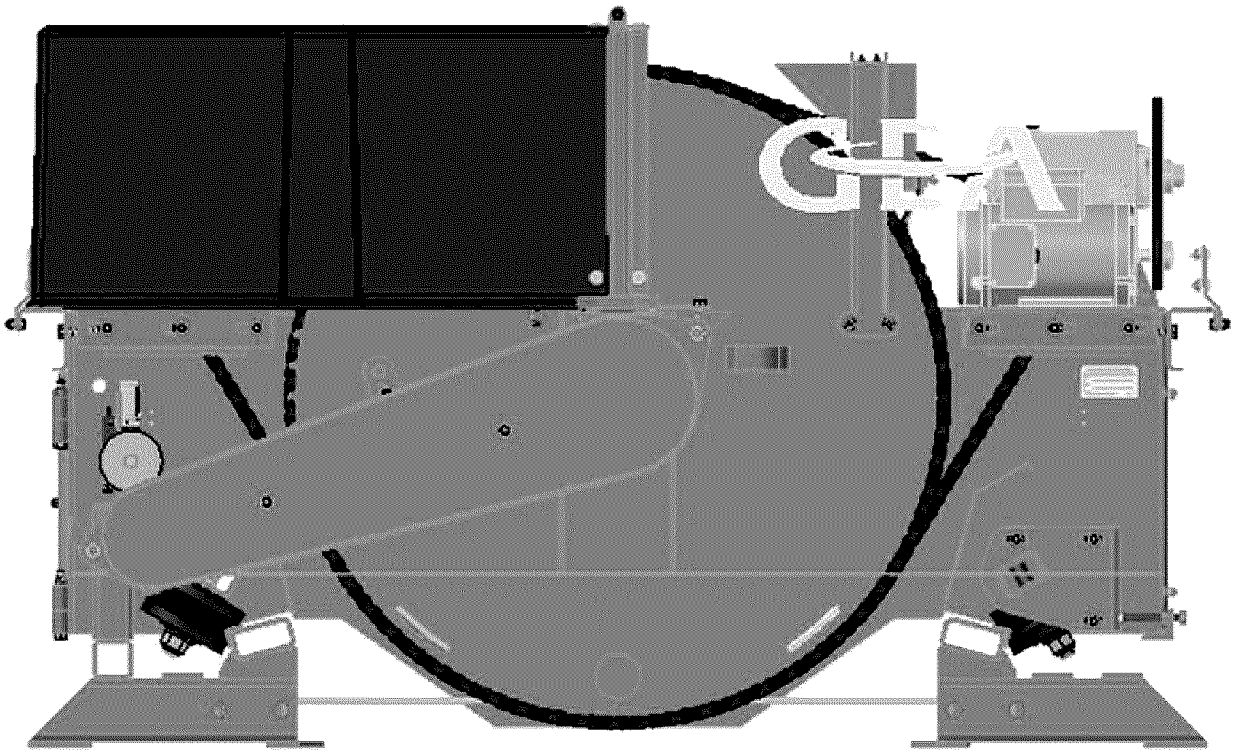


FIG. 14

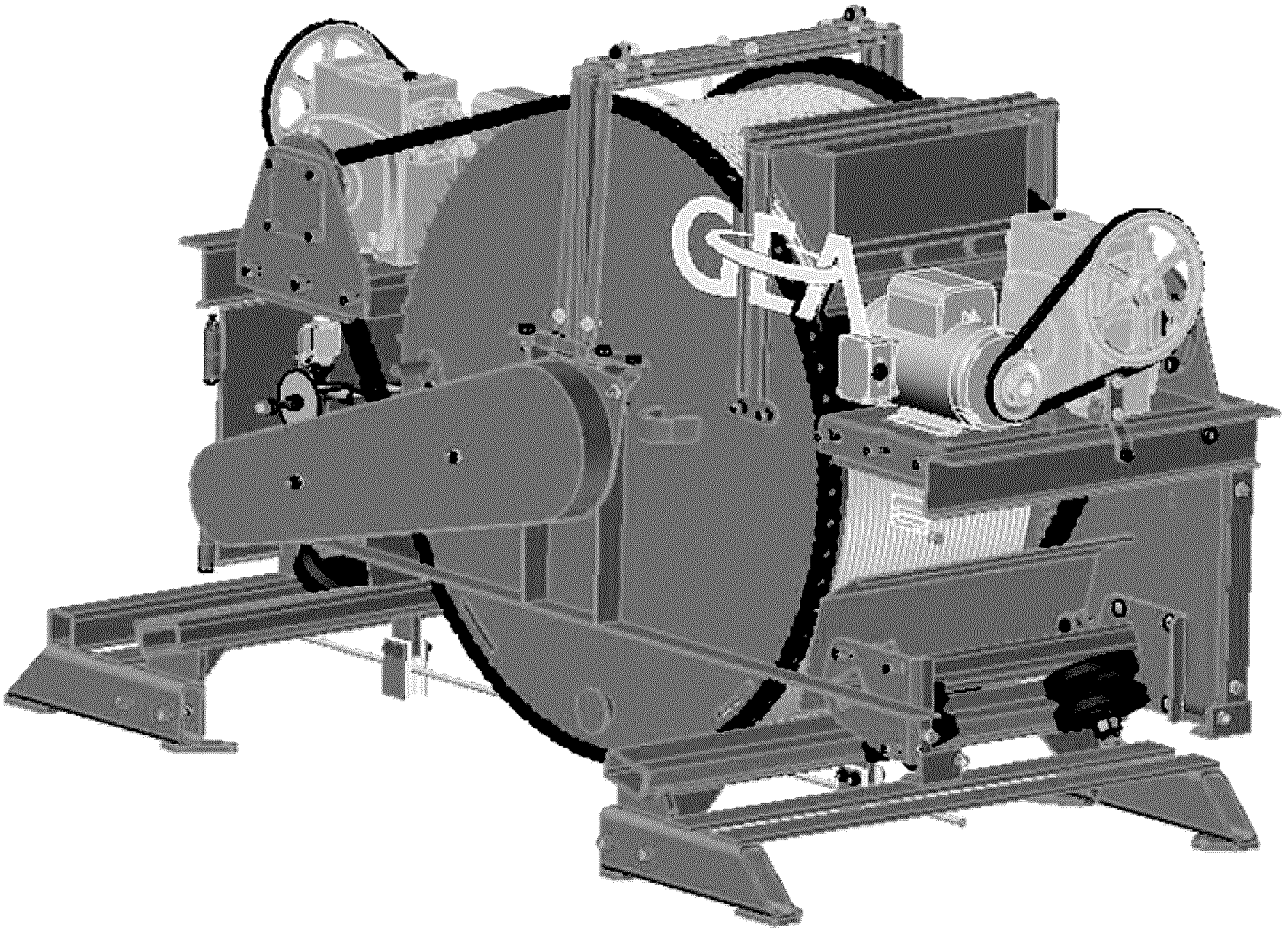


FIG. 15

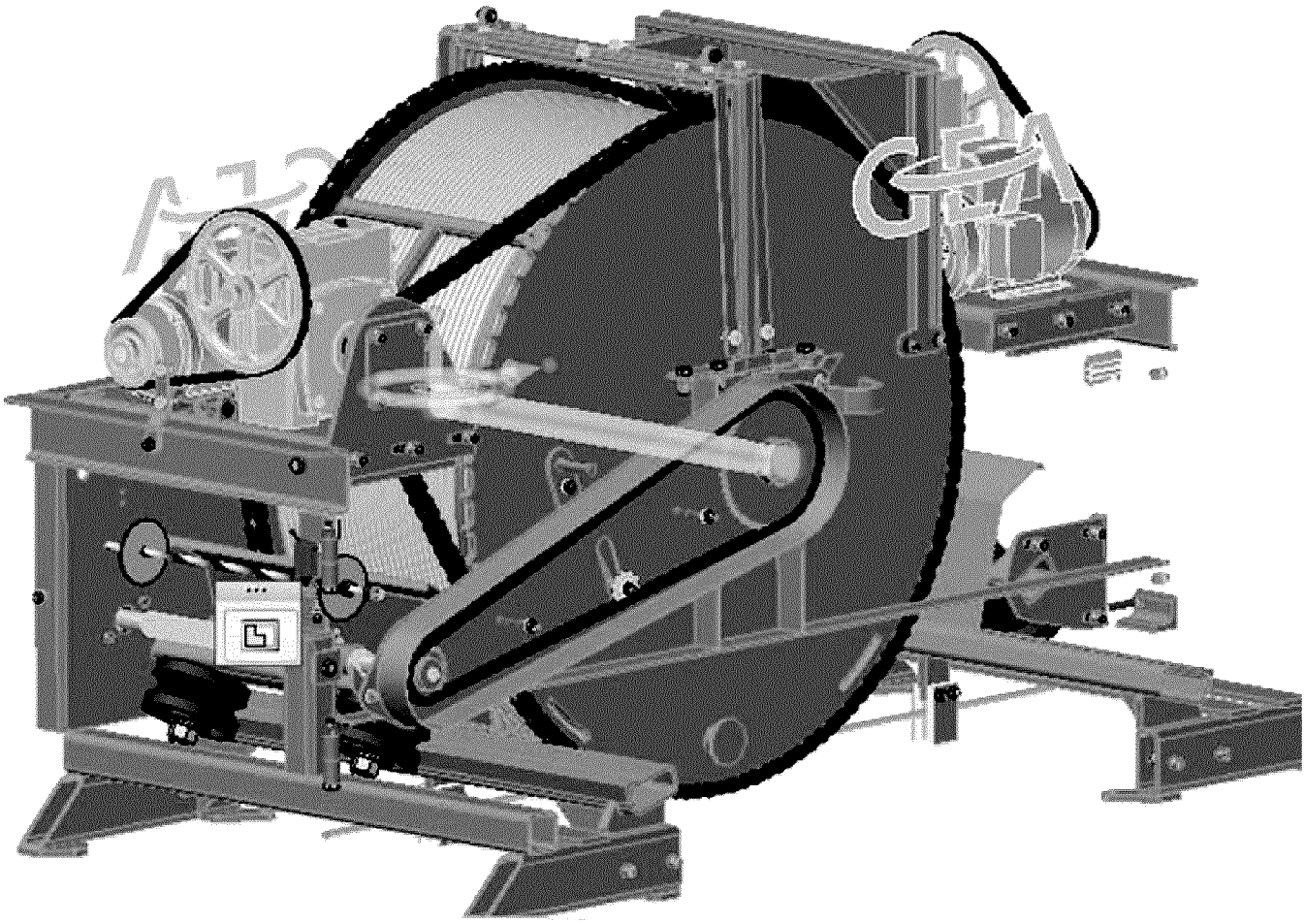


FIG. 16

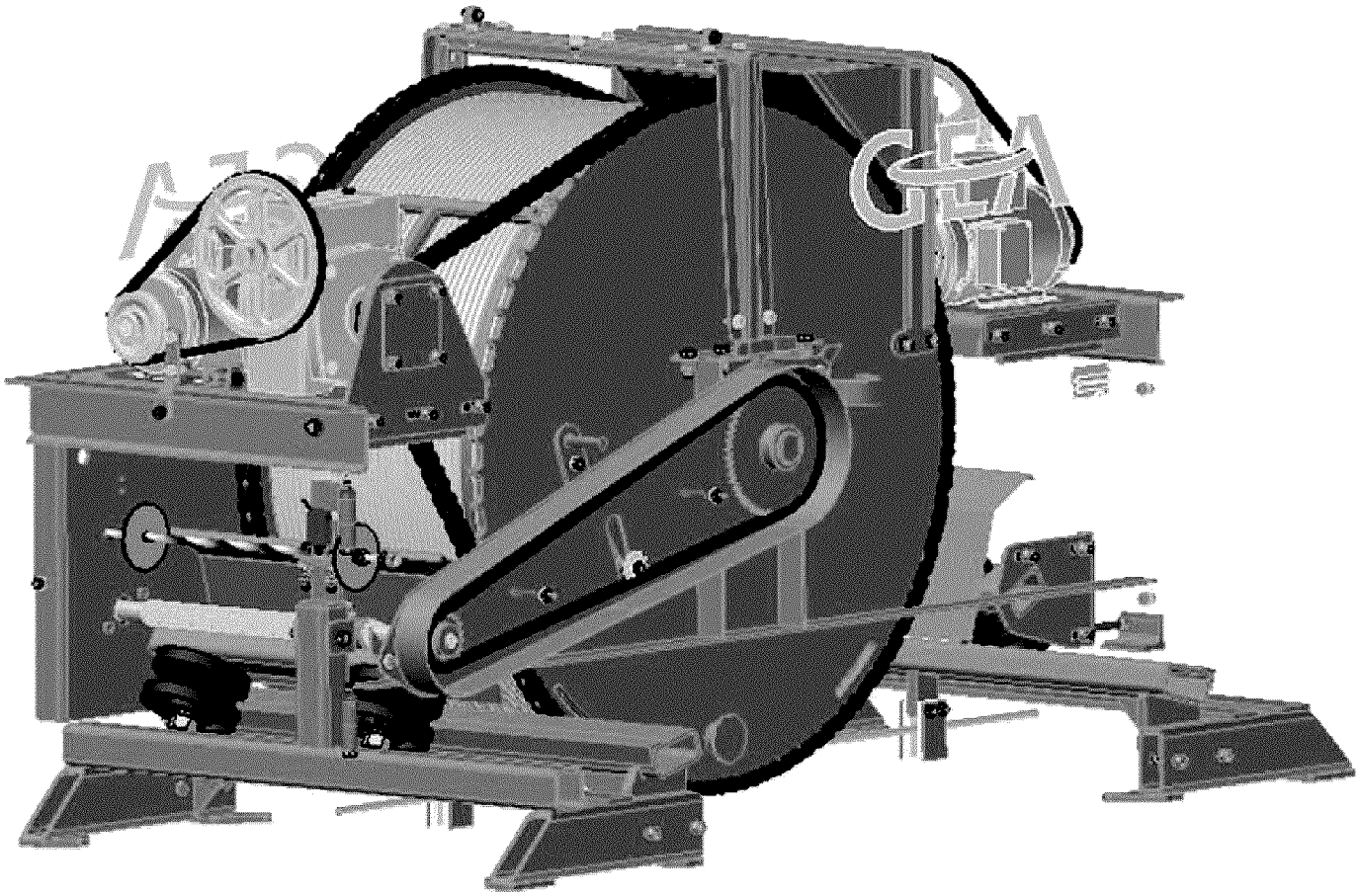


FIG. 17

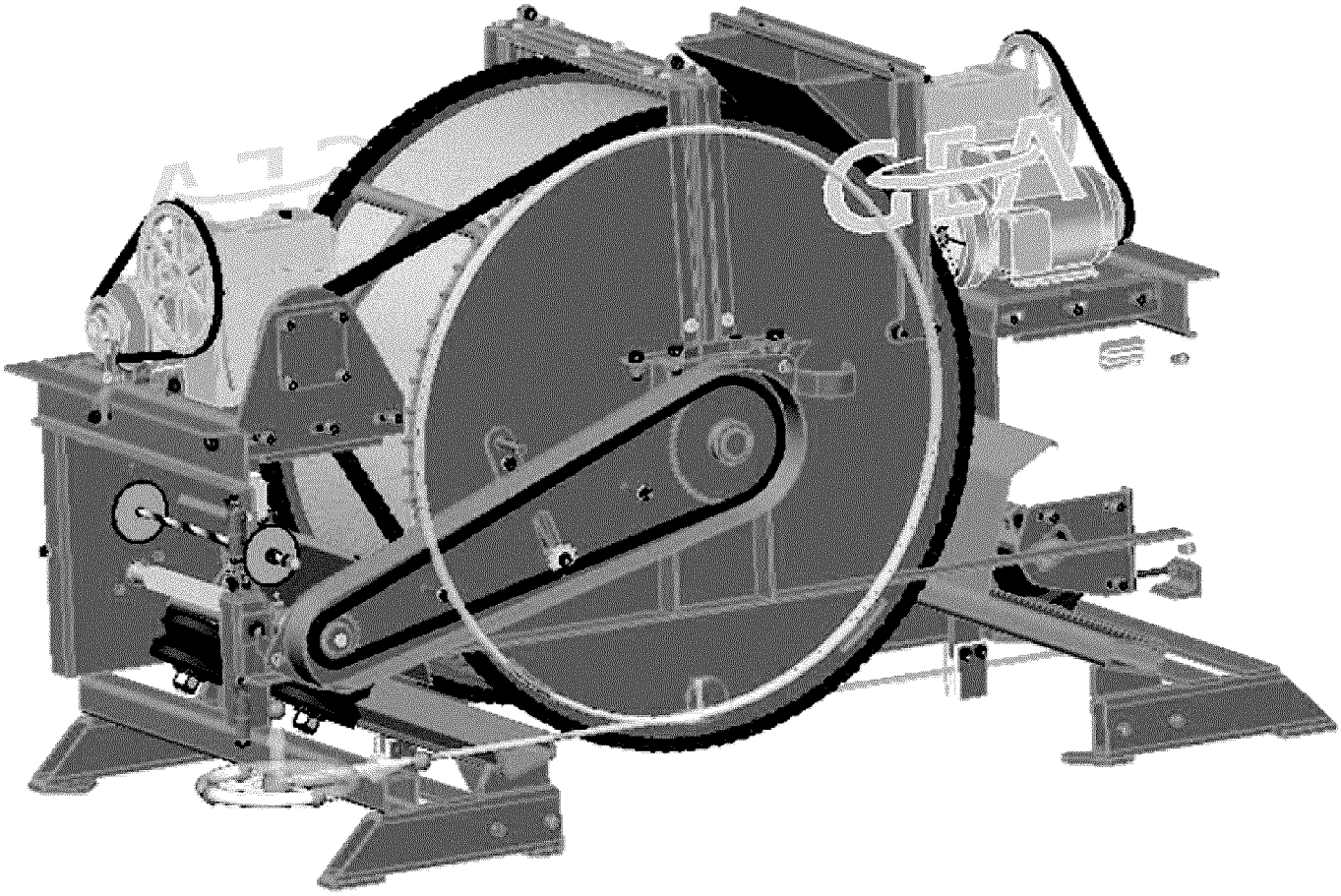


FIG. 18

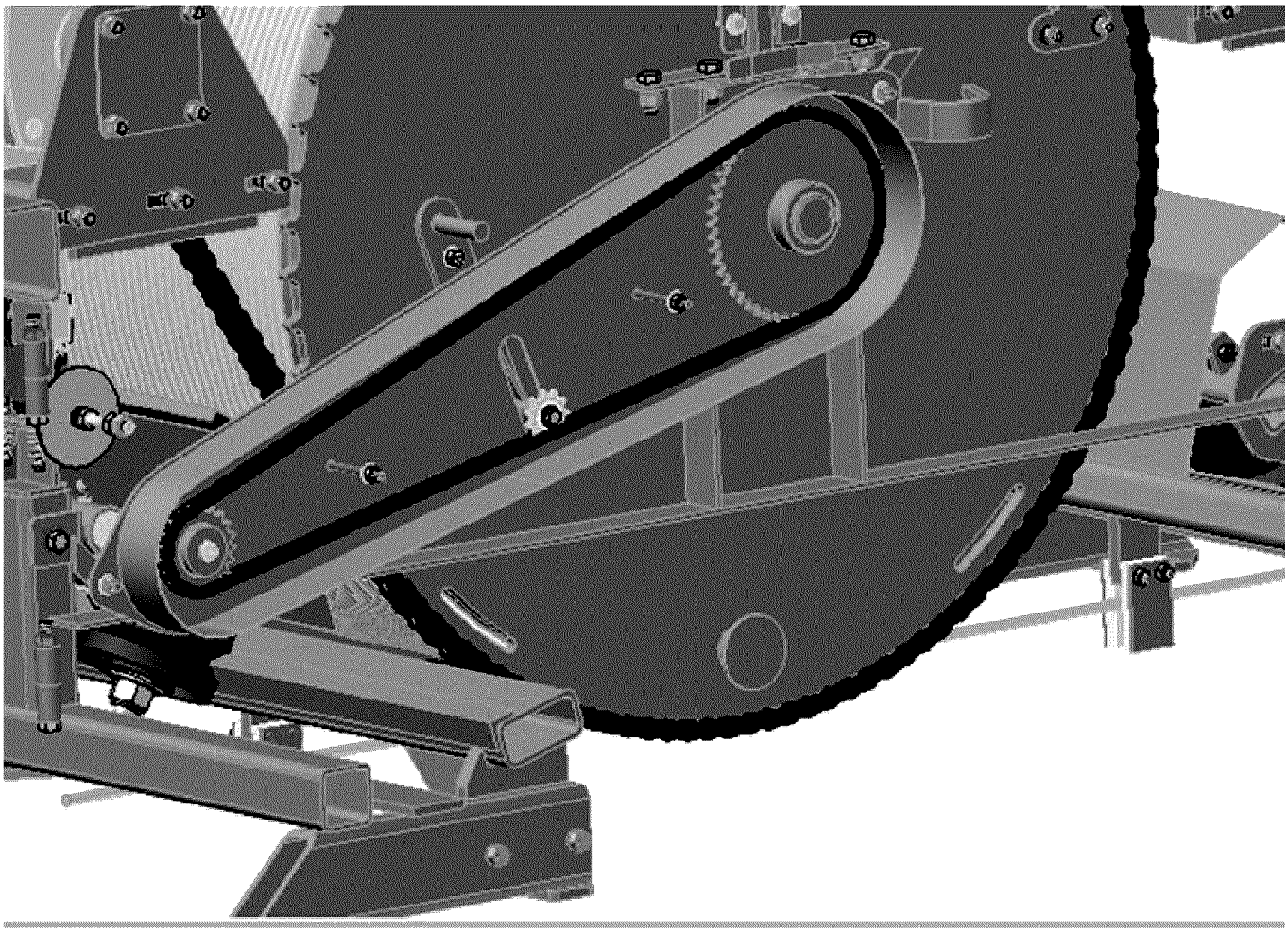


FIG. 19

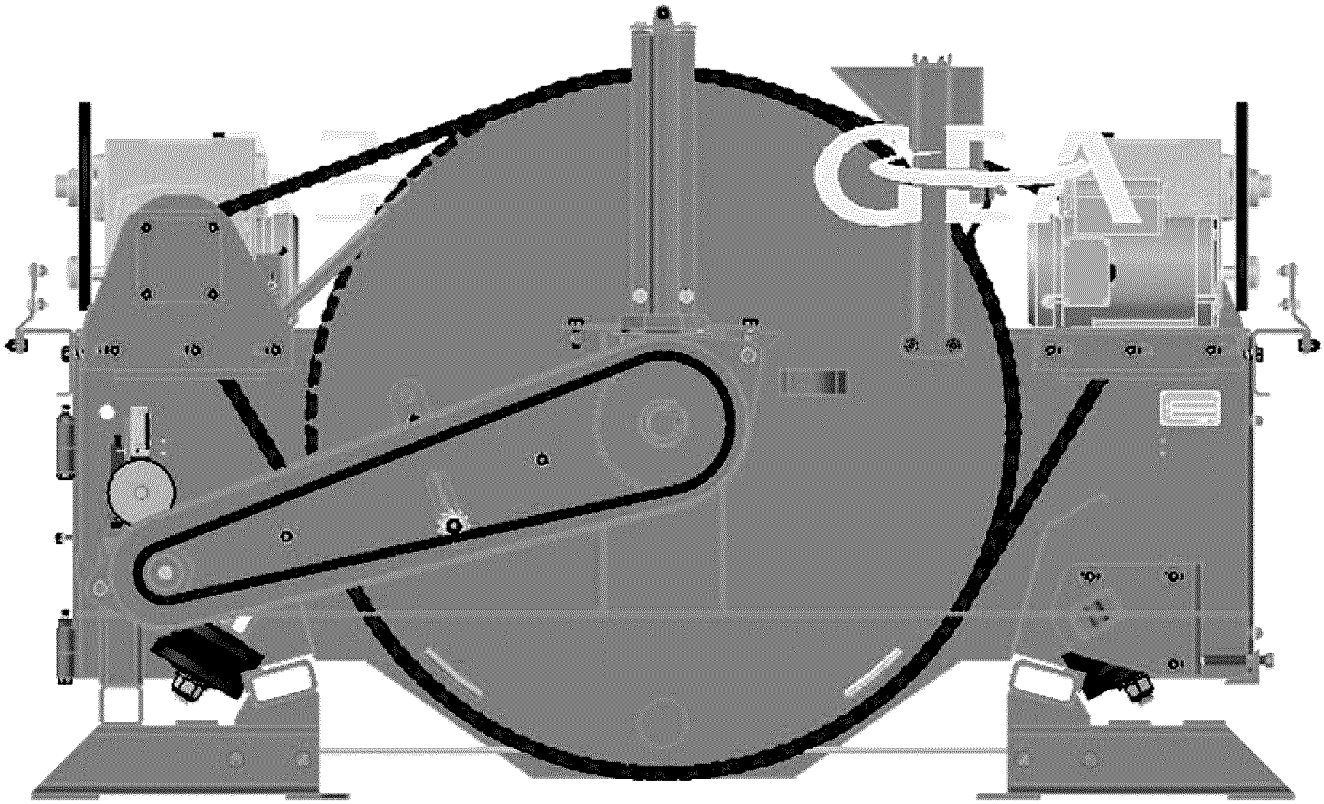


FIG. 20

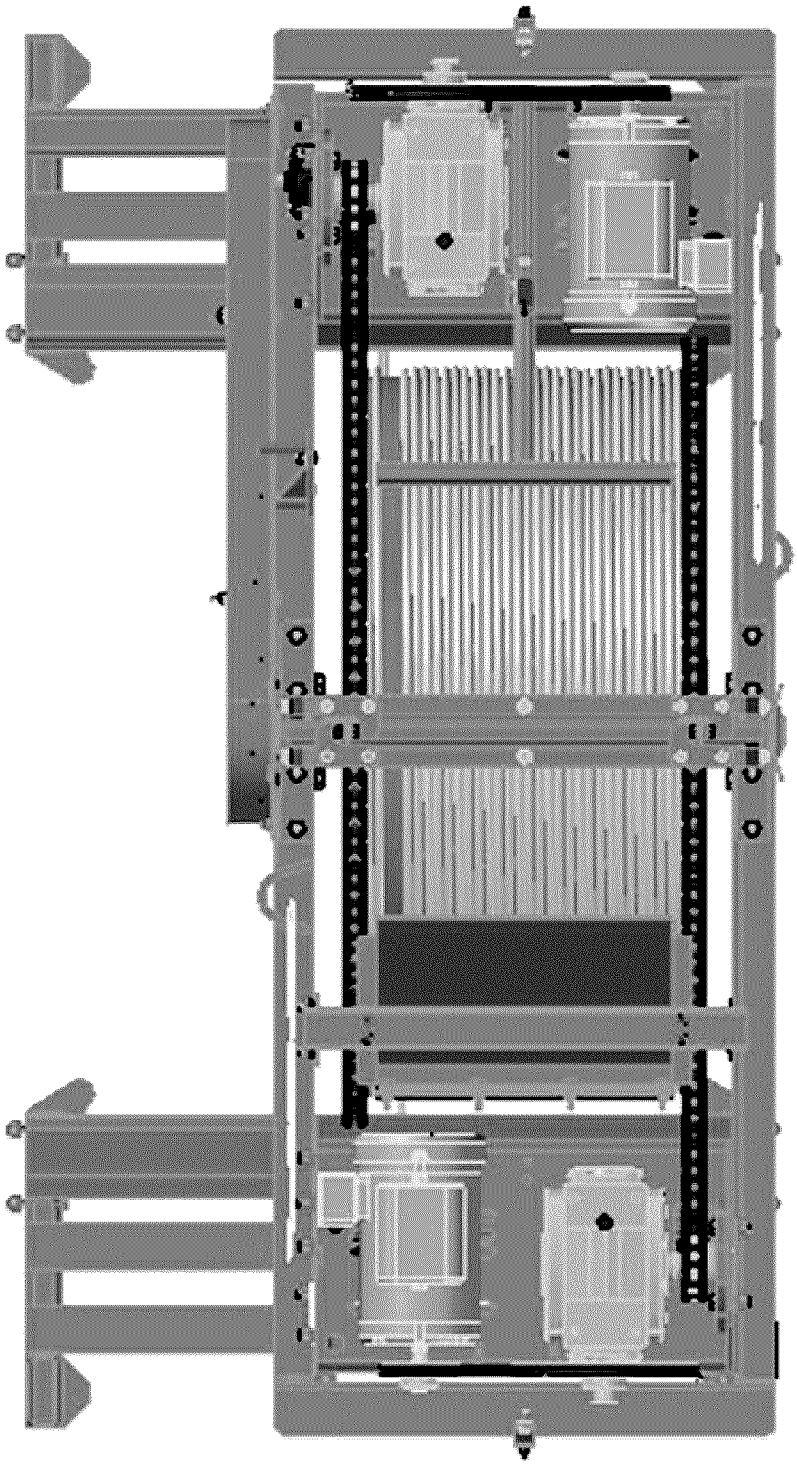


FIG. 21

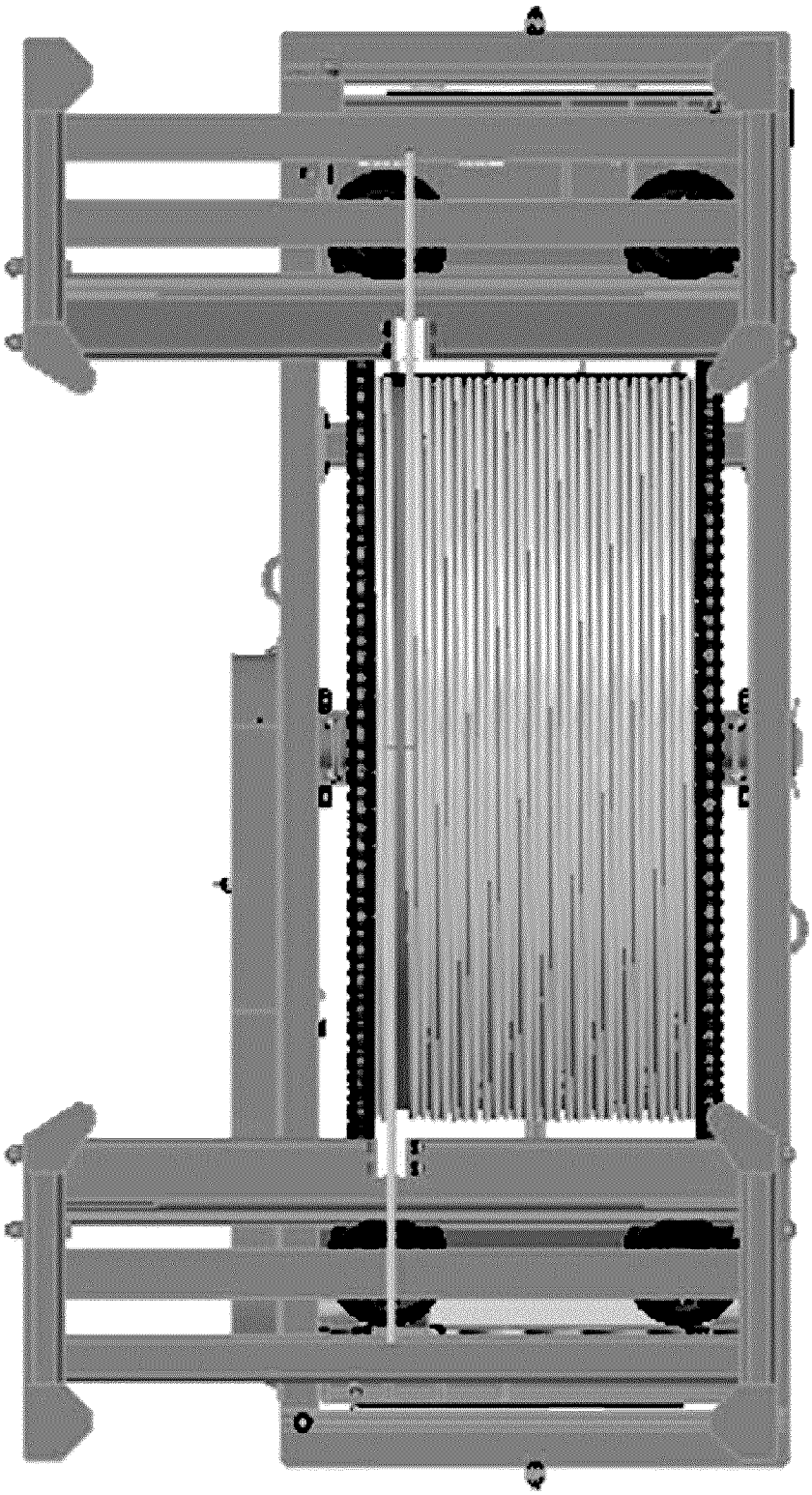


FIG. 22

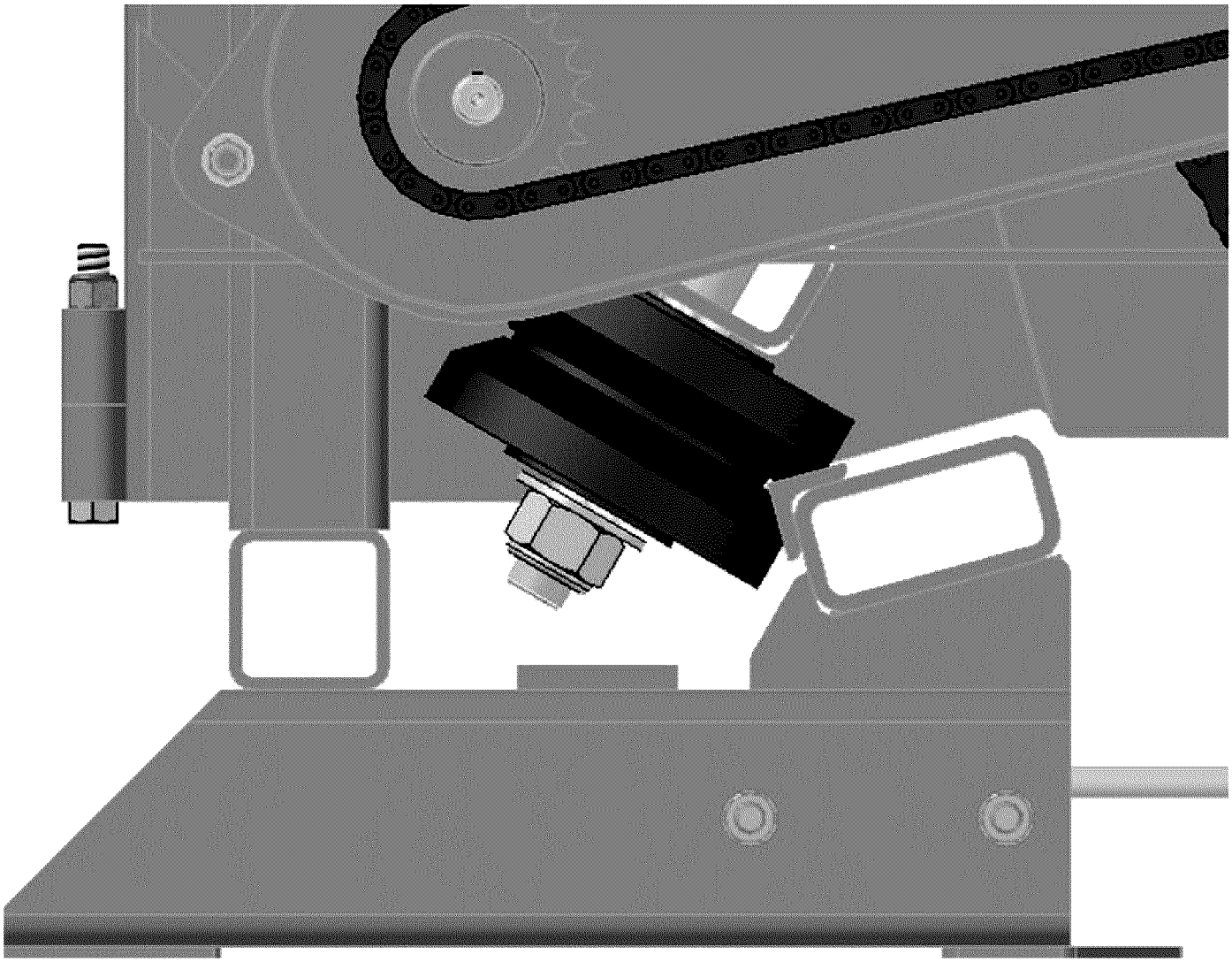


FIG. 23

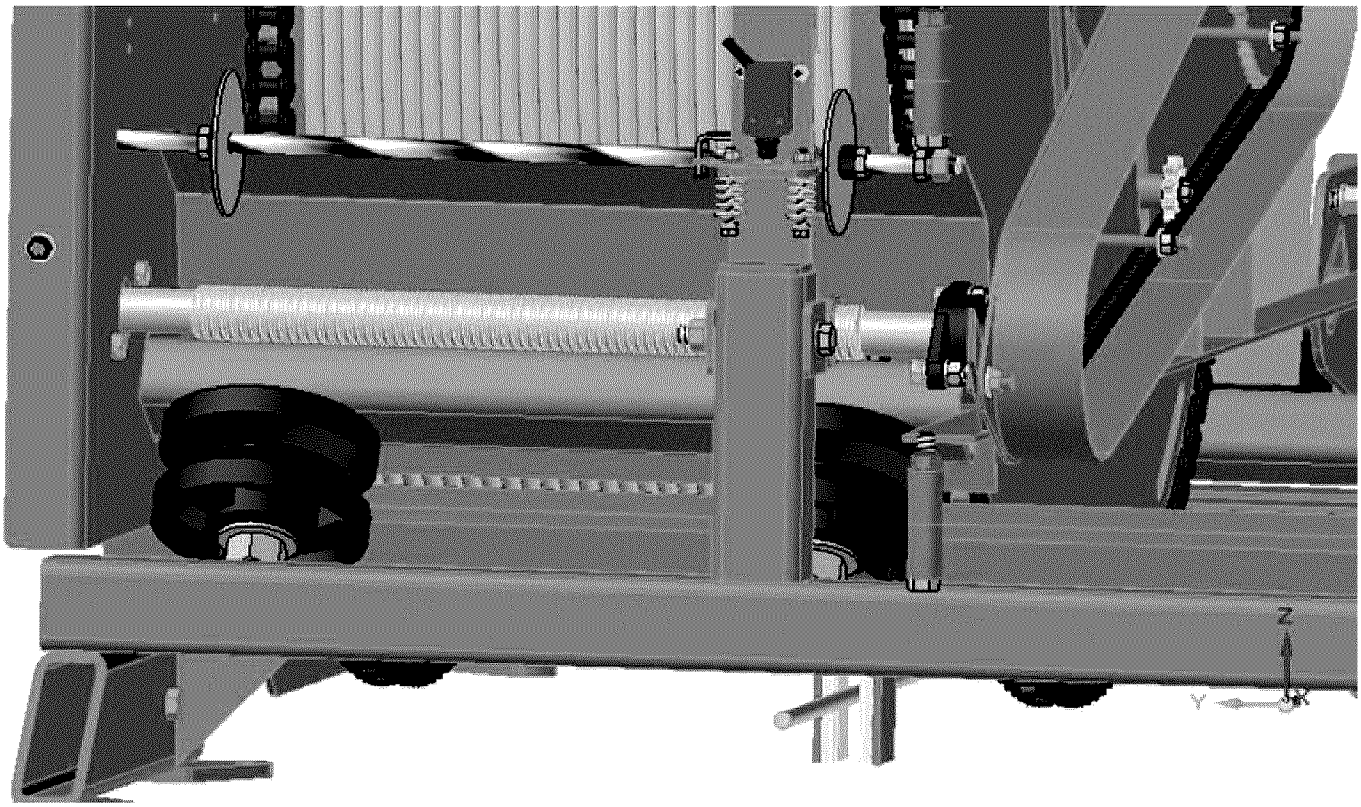
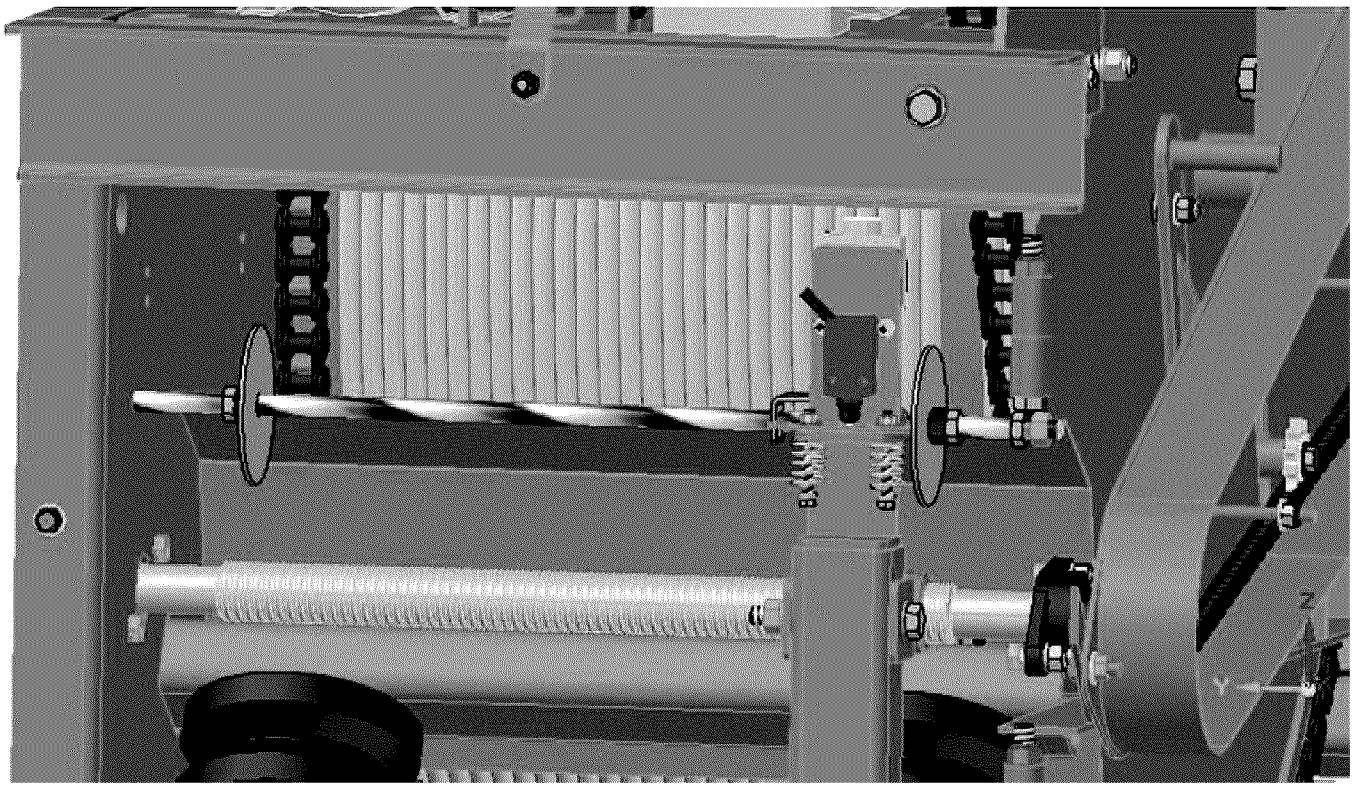


FIG. 24



INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2015/050039

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***B66D 1/60*** (2006.01) , ***A01K 1/01*** (2006.01) , ***B65H 57/28*** (2006.01) , ***B66D 1/38*** (2006.01)

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)
IPC (2006.01): A01K 1/01, A01K, B66D 1/39, B66D

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel Orbit (Keywords: drum, scrap*, cable, chain, rope, wear*, drive, winch, hoist, frame, mov*, slid*, displac*, recip*, free*, dung, manure, excrement, farm, agri*, worm,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	GB2183212A, (Williams, G. H.) 03 June 1987 (03-06-1987) *whole document*	1-19, 27, 28, 33 36,37,39, 42 40, 41, 43, 44
Y	US2004261205A1, (Berg, V. R.) 30 December 2004 (30-12-2004) *whole document*	40, 41, 43, 44
A	US4243137A, (Laurenz, F. R.) 06 January 1981 (06-01-1981) *whole document*	1, 40, 42, 43
A	US2028532A, (Treloggen, W. C.) 21 January 1936 (21-01-1936) *whole document*	1, 40, 42, 43

☐ Further documents are listed in the continuation of Box C.

☑ 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 26 March 2015 (26-03-2015)	Date of mailing of the international search report 17 April 2015 (17-04-2015)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Shawn De Salvo (819) 934-4270

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2015/050039

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
GB2183212A 03	June 1987 (03-06-1987)	GB8528893D0	02 January 1986 (02-01-1986)
		GB2183212B	08 November 1989 (08-11-1989)
US2004261205A1 30	December 2004 (30-12-2004)	US2004261205A1	30 December 2004 (30-12-2004)
		US6948450B2	27 September 2005 (27-09-2005)
US4243137A 06	January 1981 (06-01-1981)	None	
US2028532A 21	January 1936 (21-01-1936)	None	