



(51) International Patent Classification:

A22C 15/00 (2006.01)

(21) International Application Number:

PCT/EP2020/059541

(22) International Filing Date:

03 April 2020 (03.04.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

PA201900421 05 April 2019 (05.04.2019) DK

(71) Applicant: TEKNOLOGISK INSTITUT [DK/DK];
Gregersensvej 1, 2630 Taastrup (DK).

(72) Inventors: HANSEN, Niels Worsøe; c/o Gregersensvej
9, 2630 Taastrup (DK). ANDERSEN, Peter; c/o
Gregersensvej 9, 2630 Taastrup (DK). THAARUP, Klaus;
c/o Gregersensvej 9, 2630 Taastrup (DK). BOCK,
Mikkel; c/o Gregersensvej 9, 2630 Taastrup (DK). FAB-
RICIUS-OLSEN, Birger; c/o Gregersensvej 9, 2630 Taas-
trup (DK).

(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, CZ, DE, DJ, DK, DM, DO,

DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
MG, MK, MN, 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.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, 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, 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:

- without international search report and to be republished
upon receipt of that report (Rule 48.2(g))
- in black and white; the international application as filed
contained color or greyscale and is available for download
from PATENTSCOPE

(54) Title: AUTOMATIC REMOVAL OF MEAT ITEMS FROM A STORAGE RACK

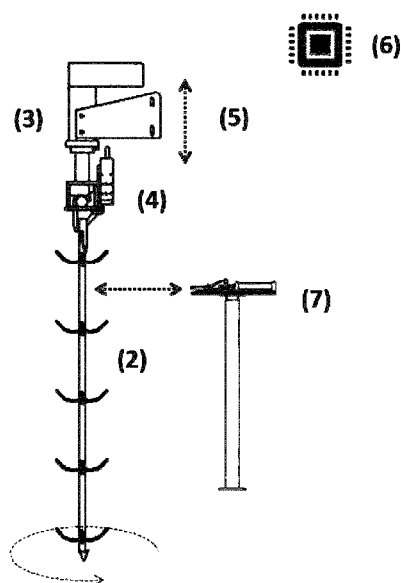


Fig. 1

(57) Abstract: This invention relates to systems and methods, for implementa-
tion in slaughterhouses, for automatic removal of meat items from a meat stor-
age/transport rack. The system and a related process of the invention helps avoid-
ing the manual hard work associated with removal of large and heavy meat pieces,
e.g. from racks for storage and/or transport of goods.



AUTOMATIC REMOVAL OF MEAT ITEMS FROM A STORAGE RACK

TECHNICAL FIELD

5 This invention relates to systems and methods, for implementation in slaughterhouses, for automatic removal of meat items from a meat storage/transport rack.

BACKGROUND ART

10 At abattoirs, and in particular at pig abattoirs, it is common to suspend pieces of meat on a specific transporting means, usually termed a "Christmas tree", for internal or external transport and/or storage. This Christmas tree essentially consists of a number of hooks, mounted on a vertical rod, which rod is configured to be suspended from an overhanging rail, and makes up a means for collecting and transporting the meat items
15 (storage/transport rack).

 The meat items usually hung onto such Christmas trees may e.g. be fore-ends, middles, hams, and bellies of pork, etc. Such meat items typically weigh of about 7 to 15 kg, and it takes very hard labour, and a lot of repetitive work, for manually processing these meat cuts. Therefore, steps to relieve this hard work has been taken.

20 Thus, US 4423808 described an apparatus for unhooking and transferring hung articles, such as cuts of meat, from haulage vehicles to sorting and warehousing installations.

 GB2281547 and EP1558510 describe a conveying arrangement that lifts the meat pieces onto a hook positioned on a transporting means (Christmas tree).

25 US 6082797 describes a gripping tool assembly disposed on a robot for gripping and moving objects between a pick-up zone and a drop-off zone.

 US 7654890 describes a method for de-rinding or trimming a piece of meat in which an industrial robot is employed.

 EP3072396 describes a handling system for handling sausage-shaped products.

30 EP3090971 describes a method for picking up sausage products from a storage structure for loading onto a conveyor, by use of a specific tool mounted on a robot.

 However, the method and devices described herein have never been disclosed.

SUMMARY OF THE INVENTION

35

 The present invention provides a system and a related process, that helps avoiding the manual hard work associated with removal of large and heavy meat pieces, e.g. from racks for storage and/or transport of goods.

In its first aspect, the invention provides a **meat handling system**, configured for removal of one or more meat items from a means for storage and/or transport of the meat items, which system is described in more details below.

In another aspect, the invention provides a **means for stabilising the storage/transporting means**.

In a third aspect, the invention provides a **gripping tool** for mounting on an industrial robot, which tool is described in more details below.

In a further aspect, the invention provides a **method for removal of one or more meat items**, located at a means for storage and/or transportation of the meat items, which method is described in more details below.

Other objects of the invention will be apparent to the person skilled in the art from reading the following detailed description and accompanying drawings.

Any combination of two or more of the embodiments described herein is considered within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is further illustrated by reference to the accompanying drawing, in which:

Fig. 1 shows the essential elements of the meat handling system (1) of the invention: **means for storage/transport (2)** of meat items; **means for turning the storage/transporting means (3)**; **means for fixation of the rotation of the storage/transporting means (4)**; **elevating means (5)**; **processing means (6)**; and, optionally, **means for stabilising the storage/transporting means (7)**;

Fig. 2 shows the essential elements of the **storage/transport means (2)** for use according to the invention: spikes/hooks (2.1) mounted in rows (here four spikes mounted in five rows, 2.1a-2.1e) on a vertical rod (2.2), which rod holds an upper hanger (2.3), and which spikes are for holding the meat items (12);

Fig. 3 shows the essential elements of the **means for turning the storage/transporting means (3)**: rotation servo-motor (3.1) for rotating the storage/transporting means (2), suspended from the turning means (3) by the upper hanger (2.3), putting its load on the sliding rod (11.2); and the **means for fixation of the rotation of the storage/transporting means (4)**: actuator (4.1), capable of raising/lowering a sliding blade (4.2) to fit in between two of the spikes (2.1) mounted in the upper row (2.1a) on the vertical rod (2.2);

Fig. 4 represent a more detailed example of the **means for fixation of the rotation of the storage/transporting means (4)**: actuator (4.1), capable of

raising/lowering a sliding blade (4.2) to fit in between two of the spikes (2.1) mounted in the upper row on the vertical rod;

Figs. 5A-5D show **the means for stabilising the storage/transporting means (7)** for use according to the invention, for preventing fluctuations and locking the storage/transporting means (2) in a fixed position allowing the gripping tool (9) to grab and removal of the meat item (12): gripper (7.1) mounted on a guiding rail/linear actuator (7.2) capable of ejecting the gripper (7.1) in order to reach the vertical rod (2.2) of the storage/transporting means (2), and grasping the vertical rod (2.2) to prevent the rod from swinging, and (3) shows the location of the means for rotating the storage/transporting means, and (4) shows the location of the rotation lock;

Figs. 6.1-6.3 show a gripping tool (9) of the invention: Gripping hook (9.1) with profile (9.5), support/backstop (9.2) with profile (9.5), actuator (9.3), and connection means (9.4);

Fig. 7 shows an overview of the meat handling system (1) of the invention, as part of an abattoir processing station, for removal of meat items from a storage/transport means (2): In-let conveyor/transport rail/overhead rail (11), providing the storage/transporting means (2) that may be loaded with meat items, to be directed to, and suspended from, the means for rotating the storage/transporting means (3) via a conventional loading/unloading station (11.1); and guided by the means for fixation of the rotation of the storage/transporting means (4), while the storage/transporting means (2) is being turned by the rotating means (3), and raised by the elevating means (5) to position a particular spike (2.1) in a pre-determined position for removal of the attached meat item using an industrial robot (8), mounted with the gripper of the invention (9); followed by unloading the meat item onto the out-let conveyor (10);

Fig. 8 illustrates an embodiment of the invention, wherein the automatic meat handling system (1) of the invention is part of the slaughter line, and two industrial robots (8) are serving three in-let conveyors (11), that brings incoming meat items (12) to three storage/transport means (2) installed in parallel, via (three) loading/unloading stations (11.1) feeding in to (three) meat handling stations (1) as illustrated in Fig. 9, which dual Christmas tree stations (2) help speeding up the overall process of unloading the Christmas trees in that a loaded Christmas tree is provided simultaneously with a second Christmas tree is being unloaded by the industrial robot (8), and the meat items (12) are being carried away on the out-let conveyor (10); and

Fig. 9 illustrates (three) meat handling stations (1) of the invention, each station arranged as dual storage station (2), operably attached to the rotating/elevating means (3+5) of the invention, capable of rotating and/or elevating the Christmas trees (2), which dual Christmas tree stations (2) help speeding up the overall process of unloading the Christmas trees in that a loaded Christmas tree is provided simultaneously

with a second Christmas tree is being unloaded by the industrial robot (8), and the meat items (12) are being carried away on the out-let conveyor (10).

DETAILED DISCLOSURE OF THE INVENTION

5

The meat handling system of the invention

In its first aspect, the invention relates to a meat handling system (1), configured for automatic removal of one or more meat items (12), from a means for storage and/or transport (2) of said meat items.

10 The meat handling system (1) of the invention may be characterised by comprising the following elements:

a means for storage/transport (2) of meat items (12);

a means for rotating the storage/transporting means (3);

15 **a means for fixation of the rotation of the storage/transporting means (4);**

an elevating means (5);

a processing means (6), in operation with the means for rotating the storage/transporting means (3), means for fixation of the rotation of the storage/transporting means (4), elevating means (5), and means for stabilising the storage/transporting means (7); and

20

an industrial robot (8), mounted with **a gripping tool (9)**, which robot is in operation with, and guided by, **the processing means (6)**.

In another embodiment, the meat handling system (1) also comprises:

25 **a means for stabilising the storage/transporting means (7)**, for preventing fluctuations when the storage/transporting means (2) is subjected to removal of the meat item (12) by the gripping tool (9), mounted on an industrial robot (8); and which stabilising means (7) is in operation with **the processing means (6)**.

30 In a further embodiment, the storage/transport means (2), The rotating means (3), the rotation lock (4), and the elevating means (5) are composed into one unit, that is further associated with a support, that may be floor mounted or mounted in the ceiling.

The meat handling system (1) of the invention may be further characterised by comprising:

35 **a means for storage/transport (2)** of meat items (12), which storage/transporting means (2) comprises a number of spikes (2.1), with the tip facing upwards, for holding the stored/transported meat items (12), and which spikes are aligned in rows (2.1a), both in the horizontal level, but also vertically, and mounted on a vertical rod (2.2), mounted with an upper hanger (2.3);

by which hanger (2.3) the storage/transporting means (2) is suspended from a **means for rotating the storage/transporting means (3)**, so as to turn the storage/transporting means (2) for bringing a spike (2.1), selected from a given row of spikes (e.g. 2.1a), into a certain pre-determined position, allowing for removal of the
5 loaded meat item (12) by **a gripping tool (9)**, mounted on **an industrial robot (8)**;
which rotation is further guided by **a means for fixation of the rotation of the storage/transporting means (4)**, holding an actuator (4.1) capable of raising/lowering a sliding blade (4.2) to fit into the space between two of the spikes (2.1) mounted in the upper row (2.1a) on the vertical rod (2.2), so as to lock the
10 rotation of the storage/transporting means (2) while the meat item (12) is being removed;

and which means for rotating the rod (3) is fixed to **a stand/support, which may be floor or ceiling mounted, comprising an elevating means (5)**, and which
15 (2.1) from a given row of spikes (e.g. 2.1a) into a certain, pre-determined position for removal of the meat item (12) by the gripping tool (9), mounted on the industrial robot (8);

and which meat handling system (1) also comprises:

a processing means (6), in operation with the means for rotating the
20 storage/transporting means (3), the means for fixation of the rotation of the storage/transporting means (4), the elevating means (5), and the industrial robot (8).

In yet another embodiment, the meat handling system (1) further comprises:

a means for stabilising the storage/transporting means (7), for preventing fluctuations, when the storage/transporting means (2) is subjected to
25 removal of the meat item (12) by the gripping tool (9), mounted on an industrial robot (8); and which stabilising means (7) is in operation with the processing means (6).

Means for storage/transport

The means for storage/transport (2) (in jargon often referred to as a Christmas
30 tree) for use according to the invention essentially represents a rack/stand, which storage/transporting means (2) comprises a number of spikes (2.1), with the tip facing upwards, for holding the stored/transported meat items (12), and which spikes are aligned in rows, both in the horizontal level, but also vertically, and mounted on a vertical rod (2.2), mounted with an upper hanger (2.3), by which hanger (2.3) the
35 storage/transporting means (2) is suspended.

The means for storage/transport (2) could hold essentially any number of hooks (2.1), but the industry norm currently is 4 x 5 hooks per Christmas tree, and the hooks

are aligned, both in the horizontal level, but also vertically, as illustrated e.g. on Figs. 1 and 2.

At abattoirs, the means for storage/transport (2) usually is transported hanging in a sliding rack, transport rail, or a conveyor/overhead rail (11), mounted in the ceiling.

5 This overhanging in-let conveyor can take any course, and usually runs past several workstations. At such workstations, the storage/transport means (2) may be diverted by use of a loading/unloading station (11.1), which is a mechanical shift track/carousel, capable of redirecting the storage/transport means (2).

Such conventional loading/unloading station (11.1) may be employed in order to
10 transfer the storage/transport means (2) from the in-let conveyor (11) to the means for rotating/elevating the storage/transporting means (3).

The means for rotating/elevating the storage/transporting means

The **means for rotating** (3) the vertical rod of the means for storage/transport
15 (Christmas tree) is a mechanical device, e.g. a servomotor, controlled by the processing means (6). This turning device (3) may engage and turn the vertical rod (2.2) of the means for storage/transport (2) via an exchange in a housing (3.2) for suspending and turning the storage/transport means.

The housing (3.2) for suspending and turning the storage/transport means is
20 designed so that the rod (2.2) and hanger (2.3), suspended from the sliding rod (11.2) that carries the load, can rotate freely underneath the rotating means (3).

While the storage/transporting means (2) is being turned by the rotating means (3), it shall be liftable by the elevating means (5).

The **means for elevating** (5) the storage/transport (Christmas tree) for use
25 according to the invention shall be able to raise/lower the storage/transporting means (2), so as to bring a spike (2.1) from a given row of spikes (e.g. 2.1a) into a certain, pre-determined position for removal of the meat item (12) by the gripping tool (9), mounted on the industrial robot (8).

Moreover, the combined means for rotating/elevating the storage/transporting
30 means (3+5) for use according to the invention shall be fixed to a stand, which may be mounted on the floor or mounted in the ceiling.

Means for fixation of the rotation of the storage/transporting means

It is important that the storage/transporting means (2) remains stable during
35 unloading, so that the robotic arm (8.1), holding the gripping tool (9), can address the exact location of the particular spike holding the meat (12) that shall be unloaded. Therefore, the means for rotating the storage/transporting means (3) for use according

to the invention also comprises a means for stopping the rotation of the storage/transporting means/rotation lock (4).

The rotation lock (4) of the invention comprises a sliding blade (4.2), designed to fit in between two of the spikes (2.1) mounted in the upper row (2.1a) on the vertical rod (2.2). To facilitate positioning, the sliding blade (4.2) ends in a downward tip.

The rotation lock (4) of the invention also comprises an actuator (4.1), controlled by the processing means (6), and capable of raising/lowering the sliding blade (4.2) so as to bring the tip of the sliding blade down between two adjacent spikes.

The rotation lock (4) of the invention is designed to act in two steps. In the first step the tip of the sliding blade (4.2), by the combined action of the rotating means and the elevating means, and controlled by the processing means (6), pushes to one of the hooks on the Christmas tree (2), so that the hooks rotational orientation becomes limited, and in step two, the sliding blade (4.2) can engage with, and slide in between two of the hooks (2.1).

Hereby, the rotation of the hooks is considerably limited, and the spikes on the storage/transport means (2) are oriented and placed in the correct angle for the industrial robot (8) and the gripper (9) to perform its action.

Processing means

In operation with the rotating means (3), the fixation of rotation means (4), and the elevating means (5), the processing means (6) for use according to the invention shall guide the robot (8) used according to the invention to direct the gripping tool (9) of the invention to a particular, pre-determined spike (2.1), mounted on the means for storage/transport (2), and cause the gripping tool to grab the meat piece (12) and unhook it from the spike (2.1), for finally placing the meat item (12) onto the out-let conveyor belt (10).

Therefore, the processor (6) communicates with, and provides instruction to the industrial robot (8), for the robot to perform the desired task, e.g. direct the gripping tool (9) to a meat item (12) hanging on a spike (2.1) on the storage/transport means (2), grabbing and lifting the meat piece (12) with the gripping tool (9), removing the meat item (12) from the storage/transport means (2) and placing it on the out-let conveyor (10).

Having removed one piece of meat, the storage/transport means (2) is turned a quarter of a round (i.e. 90°) to place the next spike (2.1) in position for removal of the meat item (12). This rotation is repeated until all meat items have been removed from the actual row.

Having removed all meat items (12) from a row of spikes, the storage/transport means (2) is elevated by the elevation means (5), in order to place a spike from the

lower row in position for the robot to continue its task, i.e. direct the gripping tool (9) to the next meat-bearing spike.

The processing means (6) for use according to the invention may be any commercially available processor/PC capable of receiving and processing of data
 5 obtained from any of the above-mentioned devices (i.e. the rotating/elevating means (3+5), the fixation means (4), and the elevating means (5)).

Means for stabilising the storage/transporting means

In a further embodiment, and in order to optimise its stability during un-loading,
 10 the meat handling system of the invention may also comprise **a means for stabilising the storage/transporting means (7)**. Instability may in particular arise from fluctuations when the storage/transporting means (2) is subjected to removal of the meat item (12) by the gripping tool (9). The stabilising means (7) of the invention may be characterised by comprising the following elements:

- 15 (a) a rod stabiliser/gripper (7.1); and
 - (b) a guiding rail/linear actuator (7.2);
- which elements are fixed by being mounted on a floor stand or by being mounted in the ceiling.

The stabilising means (7) of the invention shall be placed within an operational
 20 distance from the storage/transport means (2) to be stabilised.

The stabilising means (7) of the invention shall be controlled by a processing means (6).

According to this embodiment, the rod stabiliser/gripper (7.1) is holding a gripper claw capable of gripping the vertical rod (2.2) of the storage/transporting means
 25 (2), which is designed as a horizontal guide, mounted on a guiding rail/linear actuator (7.2) that is fixed to the floor or mounted in the ceiling, and which stabilising means (7) is under the control of the processing means (6).

In order to reduce friction, the gripping claw (7.1) preferably is lined with a plastic material, e.g. a nylon material.

30 In one embodiment, the rod stabiliser/gripper (7.1) is mounted in a position that is about 20 cm above the level of the spike that is in position for action.

The stabilising means (7) of the invention may be used in the system of the invention and/or in the method of the invention.

35 Stabilised means for storage/transport of meat items

Together with the storage/transport means (2), the means for stabilising the storage/transporting means (7) make up **a stabilised means for storage/transport of meat items**.

The stabilised means for storage/transport of meat items (7) of the invention may be used in the system of the invention and/or in the method of the invention.

Gripping tool

5 In another aspect, the invention provides a gripping tool (9), for mounting on an industrial robot (8), which tool is intended for gripping and holding a piece of meat (12), which meat is suspended from a hook (2.1) belonging to a storage/transport means ("Christmas tree") (2).

The gripping tool (9) of the invention may be characterised by comprising one
10 or more gripping hooks (9.1), in interaction with one or more supports/backstops (9.2), which gripping hook (9.1) and/or support/backstop (9.2) is operated by an actuator (9.3).

As the actuator (9.3) is comprised within a tool for mounting on an industrial robot (8), which robot (8) is guided and controlled by a processing means (6), the
15 actuator (9.3) should also be controlled by the processing means (6).

The gripping hooks (9.1) shall be designed so that they can grip the meat piece (12) from behind (i.e. the backside, which is the side opposite of the approaching robotic arm (8.1)) and pull the meat piece (12) off the hook (2.1). This may be accomplished by having one gripping bracket (9.1) that holds an opening or a slot that allows for
20 penetration of the meat hook (2.1), or by having two hooks (9.1) intended to attack on either side of the meat hook (2.1).

The support/backstop (9.2) shall constitute a solid opposition to the gripping hooks (9.1), so that the meat piece (12) is securely held during operation. This may be accomplished by use of e.g. one hook (9.2a), or a bracket (9.2b), which fittings may
25 have a simple shape (9.2a, 9.2b) or may be bent in various ways (9.2c).

The gripping tool (9) of the invention may be attached to a robotic arm (8.1) of the industrial robot (8) via a connection means (9.4). In one embodiment, the gripping tool (9) is clamped onto the connection means (9.4) manually by means of screws or other fasteners. In another embodiment, the gripping tool (9) is automatically secured
30 to the connection means (9.4) by use of a standard robot tool quick change system.

To help securing a tight hold of the meat item (12), the gripping hooks (9.1) and/or the support/backstop (9.2) of the invention may further comprise a suitable pattern or profile (9.5) on its surface facing the meat.

Gripping of the meat item shall be engaged by use of one or more actuators
35 (9.3). Gripping may be accomplished by use of an actuator operating the gripping hook (9.1), or operating the support/backstop (9.2), or by use of two actuators operating both.

In one embodiment, gripping of the meat item (12) shall be engaged by use of an actuator (9.3) actuator operating the support/backstop (9.2).

The method of the invention

5 In a third aspect, the invention provides a method for automatic removal of meat items (12) from a meat storage/transport rack (2).

The method of the invention may be characterised by comprising the subsequent steps of:

- a. provision of a fully loaded means for storage/transport (2) of meat items, and
10 suspension hereof from a means for rotating the storage/transporting means (3);
- b. positioning of a pre-selected spike (2.1) selected from the upper row of spikes (2.1a), making it available for engagement by a robotic arm (8.1) mounted with a gripping tool (9);
- c. removal of all meat items, one by one, from this top-row (2.1a), by the action
15 of the gripping tool (9) mounted on the industrial robot (8), and by rotating the storage/transport means (2);
- d. withdrawal of the gripping tool (9) from the means for storage/transport (2), making it available for elevation by an elevating means (5), followed by positioning of a pre-selected spike (2.1) selected from the second row of spikes (2.1b), making it
20 available for engagement by the robotic arm (8.1) mounted with the gripping tool (9);
- e. removal of all meat items, one by one, from the second (2.1b), by the action of the gripping tool (9) mounted on the robot (8), and by rotating the storage/transport means (2);
- f. repetition of steps d-e until all meat items (12) from the means for
25 storage/transport (2) have been removed;
- g. replacement of the now unloaded means for storage/transport (2) for a new fully loaded storage/transport means (2); and
- h. repetition of steps a-g.

In another embodiment, the method of the invention may be characterised by
30 further comprising the use of **a means for stabilising the storage/transporting means (7)**, for preventing fluctuations when the storage/transporting means (2) is subjected to removal of the meat item (12).

The method of the invention may also be characterised in that the industrial robot (8), the means for rotating the storage/transporting means (3), the means for elevating
35 the storage/transporting means (3), the actuator comprised within the gripping tool (9), and the means for stabilising the storage/transporting means (7), are all in operation with, and shall be guided and controlled by a processing means (6).

According to the method of the invention, a means for storage/transport (2), loaded with meat items (12), is conveyed to, and caused to be suspended from, a means for rotating the storage/transporting means (3). This may take place via a conventional loading/unloading station (11.1).

5 Following suspension, the storage/transport means (2) is subjected to rotation and/or elevation by the means for rotating the storage/transporting means (3) and the elevating means (5); and guided by the means for stopping the rotation of the storage/transporting means (4).

10 In one embodiment, when the loaded Christmas tree (2) has arrived, and has been placed in the desired height by help of the elevation means (5), the rotational positioning of the Christmas tree is initiated by having the rotation servo motor (3.1) make an oscillating movement (i.e. by programming the processing means (6)), in order to make space for the sliding blade (4.2) to slip down between two of the hooks (2.1) located in the upper row (2.1a) of the Christmas tree (2). When the sliding blade (4.2) is
15 in place (accomplished by the action of the actuator (4.1), and guided by the processor (6)), the Christmas tree is brought into a rotational position that allows the robot (8) to perform its action, where the Christmas tree (2) is locked by the action of the rotation lock (4).

20 Having arranged the storage/transport means (2) such that a spike (2.1) (loaded with a piece of meat (12)) is placed in a position for the gripper (9) to approach the spike, the gripper (9) grabs the piece of meat (12) hanging on the spike (2.1), and lifts and removes the meat item (12) from the spike, and delivers and places it onto an out-let conveyor (10).

25 Having removed this first piece of meat, the storage/transport means (2) is rotated (activated by the rotation servo motor (3.1)) to place the next spike in position for the gripper (9) to remove the next meat item (12) and placing it onto the out-let conveyor. When operating on a standard storage/transport means (Christmas trees) (2), holding four spikes in a row (and having five rows), the storage/transport means (2) is rotated a quarter of a round (i.e. 90°) to place the next spike in position for the gripper
30 (9) to remove the next meat item (12).

35 Having removed all meat items (12) from the upper row of spikes (2.1a), the storage/transport means (2) is subjected to elevation, activated by the elevating means (5), so that the next row of spikes (2.1b) is lifted, and in a combination with the rotating means (3), is brought into position for the gripper (9) to repeat the process described above (i.e. to place the next spike in position for the gripper (9) to remove the next meat item (12) and placing it onto the out-let conveyor), and start removing the meat items (12) from the second row of spikes (2.1b).

Having removed all meat items (12) from the second row of spikes (2.1b), the storage/transport means (2) is again subjected to elevation by the elevating means (5), thereby bringing the third row of spikes (2.1c) into position for removal of the meat items, following the procedure described above.

5 When operating on a standard storage/transport means (Christmas trees) (2), holding four spikes in a row, and having five rows, the storage/transport means (2) is rotated a quarter of a round (i.e. 90°) to place the next spike in position for the gripper (9) to remove the next meat item (12), and the storage/transport means (2) is levelled for up to five times.

10 Even the storage/transport means (2) is hung from a hook, i.e. the upper hanger (2.3), but due to the weight of the fully loaded storage/transport means (2), it remains stable and does not swing, and allows the robot arm, mounted with the gripping tool (9) to approach and hit the pre-determined spike (2.1) of the upper row (2.1a). However, as the storage/transport means (2) is becoming unloaded, and its weight
15 diminishes, the storage/transport means (2) becomes prone to start swinging, whereby it becomes more uncertain whether the gripping tool (9) can hit the right point (i.e. the pre-determined spike).

To secure the storage/transport means (2) from starting swinging, and to assist the gripping tool (9) in hitting the right spike (2.1), the means for stabilising the
20 storage/transporting means (7) may be activated. As the stabilising means (7) is in communication with the processing means (6), activation is accomplished by the processor (6).

Activation of the stabilising means (7) is preferably initiated when the first row (2.1a) has been un-loaded, thereby exposing the upper part of the vertical rod (2.2).
25 However, activation of the stabilising means (7) may also be deferred until the second row of spikes (2.1b) has been un-loaded, thereby exposing a larger part of the vertical rod (2.2).

Upon activation of the stabilising means (7), the rod stabiliser/gripper (7.1) is brought into an open position, and the rod stabiliser/gripper (7.1) is ejected via the
30 guiding rail/linear actuator (7.2). After having reached its destination (i.e. the vertical rod 2.2), rod stabiliser/gripper (7.1) is brought to a closed position, thus closing its jaws around an exposed part of the rod (2.2) (cf. Figs. 5A-5C).

In one embodiment, when the rod stabiliser/gripper (7.1) is brought to a "closed position", this "closed position" means that the stabiliser/gripper (7.1) closes itself
35 around the vertical rod (2.2), so that fluctuations are prevented, but the rod (2.2) is free to rotate, as described above.

In another embodiment, when the rod stabiliser/gripper (7.1) is brought to a closed position, this closed position means that the stabiliser/gripper (7.1) closes itself

tight around the vertical rod (2.2), so that fluctuations are prevented, but also so tight that the rod (2.2) is not free to rotate, as it shall, as described above. According to this embodiment, the processing means (6) may be programmed to effect successive opening and closing of the stabiliser/gripper (7.1), but without intermediate withdrawal
5 and reversal of the rod stabiliser/gripper.

After activation of the activation of the stabilising means (7) as described above, the robot (8) starts removing the meat items (12) hanging from the lower row of spikes (e.g. row 2.1b), and continues its work as described above, removing all (four) pieces of meat items from this row. Upon conclusion of this work, the robot (8) withdraws the
10 gripping tool (9) from the storage/transport means (2), and the stabilising means (7) is being de-activated, i.e. rod stabiliser/gripper (7.1) is brought to an open position, thus releasing the vertical rod (2.2), and rod stabiliser/gripper (7.1) is being reversed via the guiding rail/linear actuator (7.2).

These actions leave the storage/transport means (2) free to rotation and
15 elevation, and the meat removal cycle is repeated as described above: positioning of the spike in question, activation of the stabilising means (7) so as to prevent the storage/transport means (2) from swinging (but not preventing it to turn), gripping and removing the meat piece (12) from the spike, and placing it on the out-let conveyor (10), turning the storage/transport means (2) a quarter of a round (90°) to place the
20 next spike in the right position, unloading this and the following pieces of meat remaining on this row of spikes, withdrawal of the gripping tool (9) and de-activating the stabilising means (7), followed by elevation/rotation of the stabilising means (7) to get ready for the next round of meat removal.

In a further embodiment, the system (1) of the invention makes part of the
25 slaughter line in a layout as outlined in Fig. 8. According to this embodiment, the automatic meat handling system (1) of the invention is part of the slaughter line, and two industrial robots (8) are serving three in-let conveyors (11), that brings incoming meat items (12) to three storage/transport means (2) installed in parallel, via (three) loading/unloading stations (11.1) feeding in to (three) meat handling stations (1) as
30 illustrated in Fig. 9, which dual Christmas tree stations (2) help speeding up the overall process of unloading the Christmas trees in that a loaded Christmas tree is provided simultaneously with a second Christmas tree is being unloaded by the industrial robot (8), and the meat items (12) are being carried away on the out-let conveyor (10).

Having been un-loaded from the storage/transport means (2), the meat items
35 (12) may be placed on an out-let conveyor (10) for further processing.

List of reference signs

In the figures, identical structures, elements or parts that appear in more than one figure are generally labelled with the same numeral in all the figures in which they appear.

- | | |
|----|---|
| 5 | 1. Meat handling system
2. Means for storage/transport of meat items/"Christmas tree"
2.1. Spikes/hooks for holding the meat
2.2. Vertical rod
2.3. Hanger |
| 10 | 3. Means for rotating the storage/transporting means
3.1. Rotation servo motor
3.2. Housing for suspending and turning the storage/transport means
4. Means for fixation of the rotation of the storage/transporting means (rotation lock) |
| 15 | 4.1. Actuator
4.2. Sliding blade
5. Elevating means
6. Processing means
7. Means for stabilising the storage/transporting means |
| 20 | 7.1. Rod stabiliser/gripper
7.2. Guiding rail/linear actuator
8. Industrial robot
8.1. Robotic arm
9. Gripping tool |
| 25 | 9.1. Gripping hook
9.2. Support/backstop
9.3. Actuator
9.4. Connection means
10. Out-let conveyor |
| 30 | 11. In-let conveyor/transport rail/overhead rail
11.1. Loading/unloading station
11.2. Sliding rod
12. Meat item/workpiece |

CLAIMS

1. An automatic meat handling system (1), characterised by comprising the following elements:

- 5 **a means for storage/transport (2)** of meat items (12);
 a means for rotating the storage/transporting means (3);
 a means for fixation of the rotation of the storage/transporting means (4);
 an elevating means (5);
 10 **a processing means (6)**, in operation with the means for rotating the storage/transporting means (3), means for fixation of the rotation of the storage/transporting means (4), elevating means (5), means for stabilising the storage/transporting means (7); and
 an industrial robot (8), mounted with **a gripping tool (9)**, which robot is in
 15 operation with, and guided by, **the processing means (6)**.

2. The meat handling system of claim 1, which system further comprises:
 a means for stabilising the storage/transporting means (7), which stabilising means (7) is in operation with **the processing means (6)**.

20

3. The meat handling system of either one of claims 1-2, which system is further characterised by comprising:

- a means for storage/transport (2)** of meat items (12), which storage/transporting means (2) comprises a number of spikes (2.1), with the tip facing
 25 upwards, for holding the stored/transported meat items (12), and which spikes are aligned in rows (2.1a), both in the horizontal level, but also vertically, and mounted on a vertical rod (2.2), mounted with an upper hanger (2.3);
 by which hanger (2.3) the storage/transporting means (2) is suspended from **a means for rotating the storage/transporting means (3)**, so as to turn the
 30 storage/transporting means (2) for bringing a spike (2.1), selected from a given row of spikes (e.g. 2.1a), into a certain pre-determined position, allowing for removal of the loaded meat item (12) by **a gripping tool (9)**, mounted on **an industrial robot (8)**;
 which rotation is further guided by **a means for fixation of the rotation of the storage/transporting means (4)**, holding an actuator (4.1) capable of
 35 raising/lowering a sliding blade (4.2) to fit into the space between two of the spikes (2.1) mounted in the upper row (2.1a) on the vertical rod (2.2), so as to lock the rotation of the storage/transporting means (2) while the meat item (12) is being removed;

and which means for rotating the rod (3) is fixed to **a stand, which may be floor or ceiling mounted, comprising an elevating means (5)**, and which is capable of raising/lowering the storage/transporting means (2), so as to bring a spike (2.1) from a given row of spikes (e.g. 2.1a) into a certain, pre-determined position for removal of
5 the meat item (12) by the gripping tool (9), mounted on the industrial robot (8);

and which meat handling system (1) also comprises:

a processing means (6), in operation with the means for rotating the storage/transporting means (3), the means for fixation of the rotation of the storage/transporting means (4), the elevating means (5), and the industrial robot (8).

10

4. **A means for stabilising the storage/transporting means (7)**, which stabilising means (7) comprises:

(a) a rod stabiliser/gripper (7.1); and

(b) a guiding rail/linear actuator (7.2);

15 which elements are fixed by being mounted on a floor stand or by being mounted in the ceiling.

5. The stabilising means (7) of claim 4, for use in the system of any one of claims 1-3, or for use in the method of any one of claims 6-8.

20

6. **A gripping tool (9)** for mounting on an industrial robot (8), which tool is *characterised by* comprising one or more gripping hooks (9.1), in interaction with one or more supports/backstops (9.2), which gripping hook and/or support/backstop is operated by an actuator (9.3).

25

7. The gripping tool (9) of claim 6, for use in the system of any one of claims 1-3, or for use in the method of any one of claims 8-10.

8. A method for automatic removal of one or more meat items from **a means for storage/transport (2)** of meat items (12), which method comprises the subsequent steps of:

a. provision of a fully loaded means for storage/transport (2) of meat items, and suspension hereof from a means for rotating the storage/transporting means (3);

b. positioning of a pre-selected spike (2.1) selected from the upper row of
35 spikes (2.1a), making it available for engagement by a robotic arm (8.1) mounted with a gripping tool (9);

c. removal of all meat items, one by one, from this top-row (2.1a), by the action of the gripping tool (9) mounted on the industrial robot (8), and by rotating the storage/transport means (2);

d. withdrawal of the gripping tool (9) from the means for storage/transport (2),
5 making it available for elevation by an elevating means (5), followed by positioning of a pre-selected spike (2.1) selected from the second row of spikes (2.1b), making it available for engagement by the robotic arm (8.1) mounted with the gripping tool (9);

e. removal of all meat items, one by one, from the second (2.1b), by the action of the gripping tool (9) mounted on the robot (8), and by rotating the storage/transport
10 means (2);

f. repetition of steps d-e until all meat items (12) from the means for storage/transport (2) have been removed;

g. replacement of the now unloaded means for storage/transport (2) for a new fully loaded storage/transport means (2); and

15 h. repetition of steps a-g.

9. The method of claim 8, which method further comprises the use of **a means for stabilising the storage/transporting means (7)**.

20 10. The method of either one of claims 6-7, wherein the industrial robot (8), the means for rotating the storage/transporting means (3), the means for elevating the storage/transporting means (3), the actuator comprised within the gripping tool (9), and the means for stabilising the storage/transporting means (7), are all in operation with, and shall be guided and controlled by a processing means (6).

25

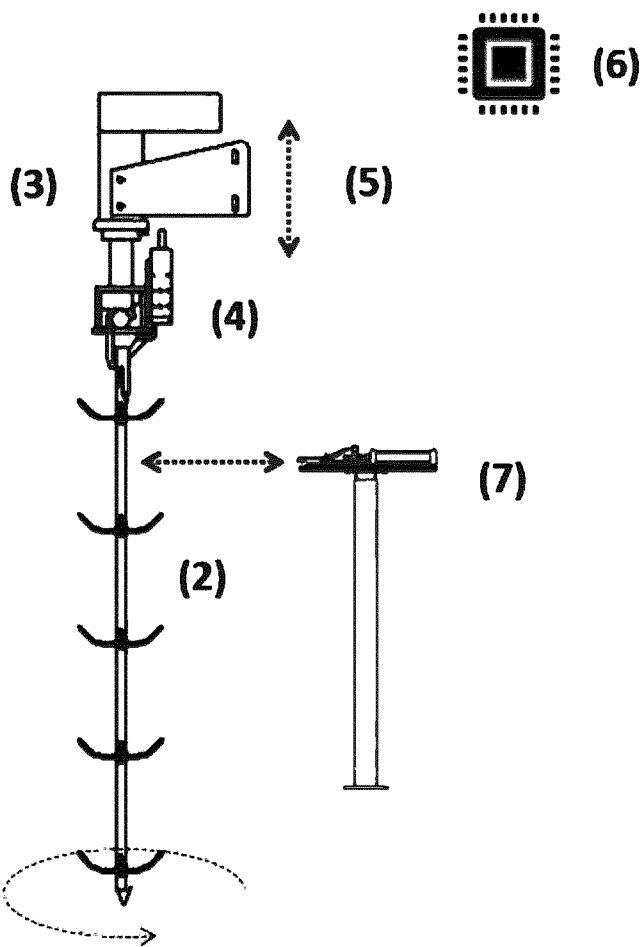


Fig. 1

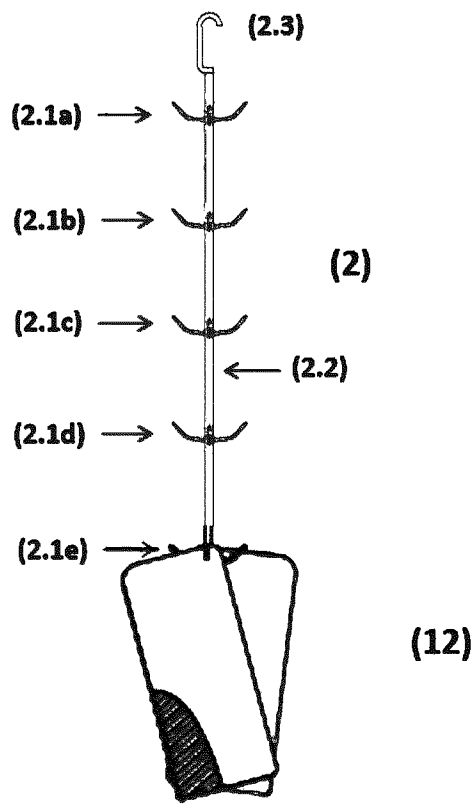


Fig. 2

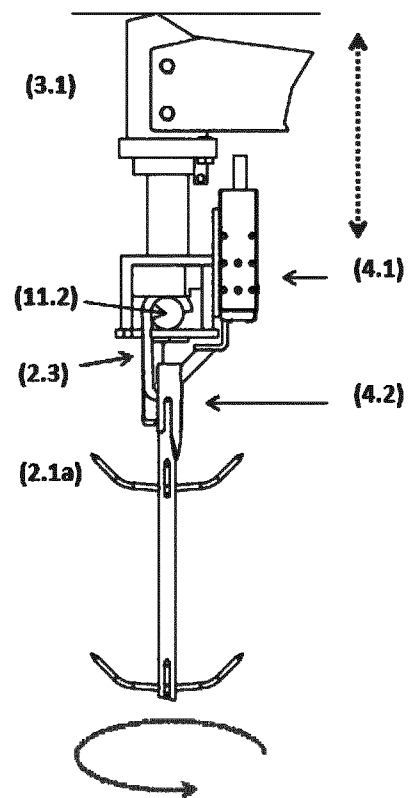


Fig. 3

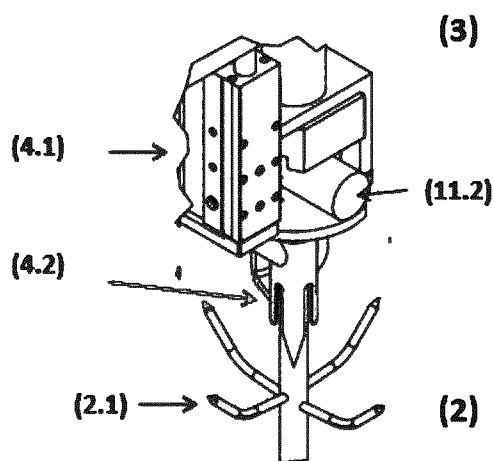


Fig. 4

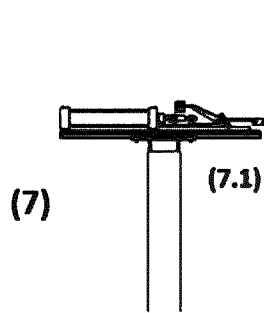


Fig. 5A

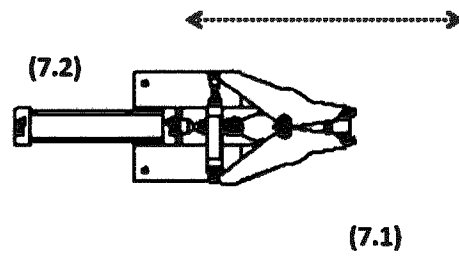


Fig. 5B

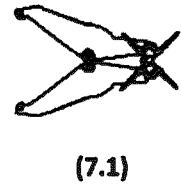


Fig. 5C

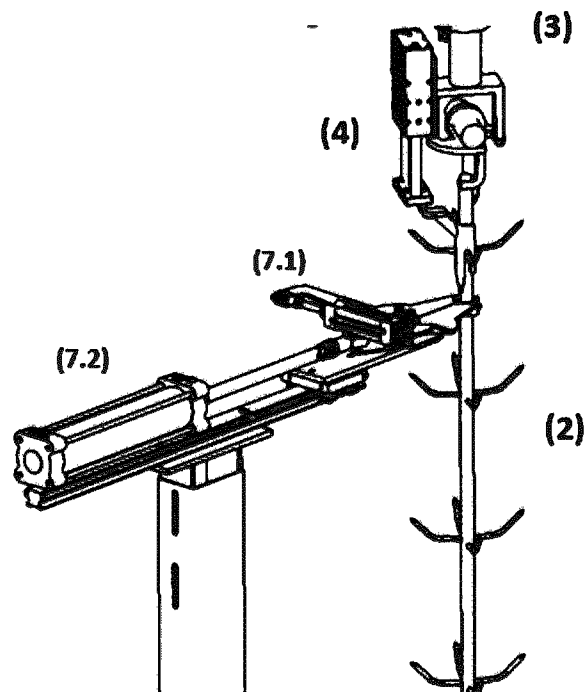


Fig. 5D

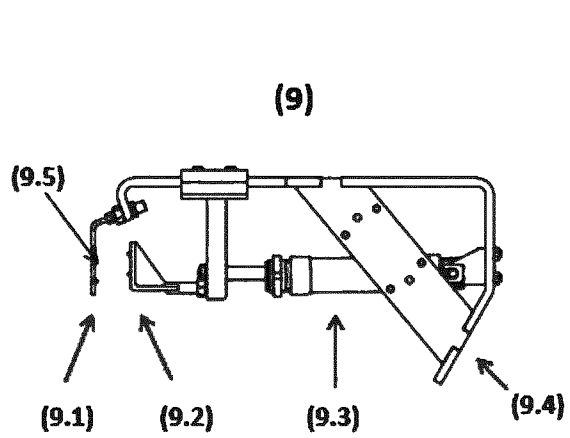


Fig. 6.1

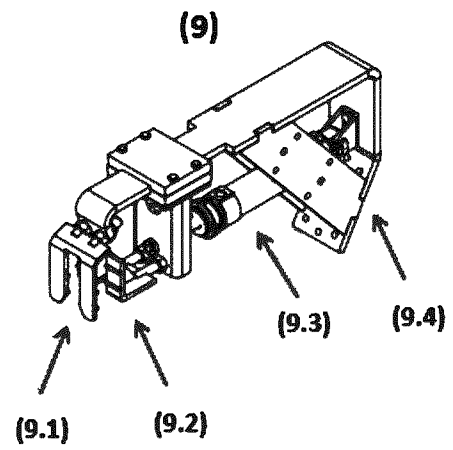


Fig. 6.2

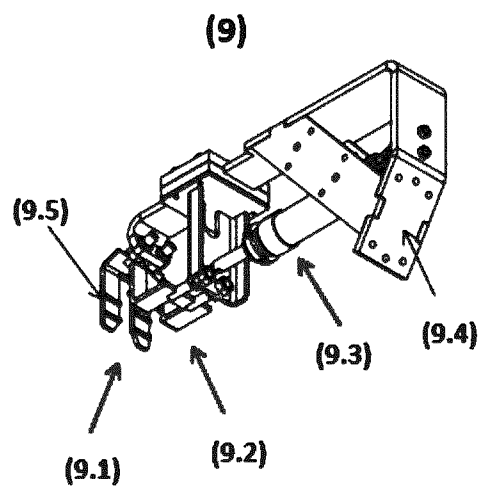


Fig. 6.3

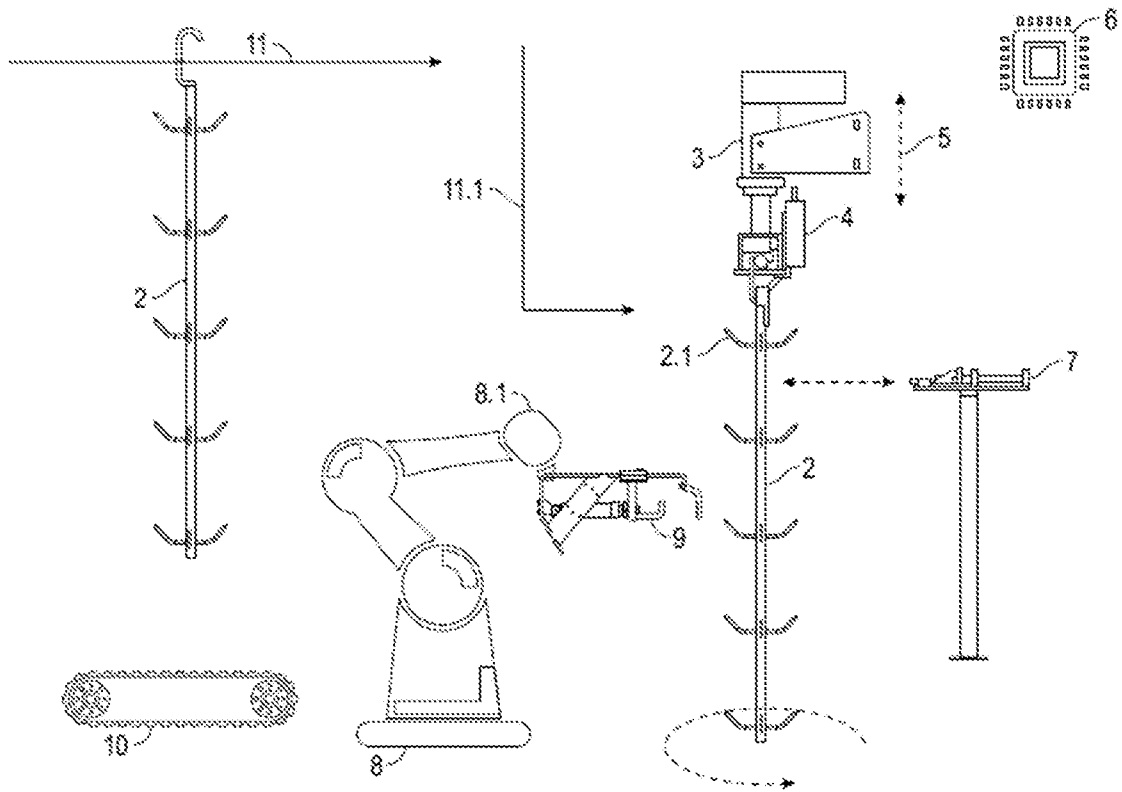


Fig. 7

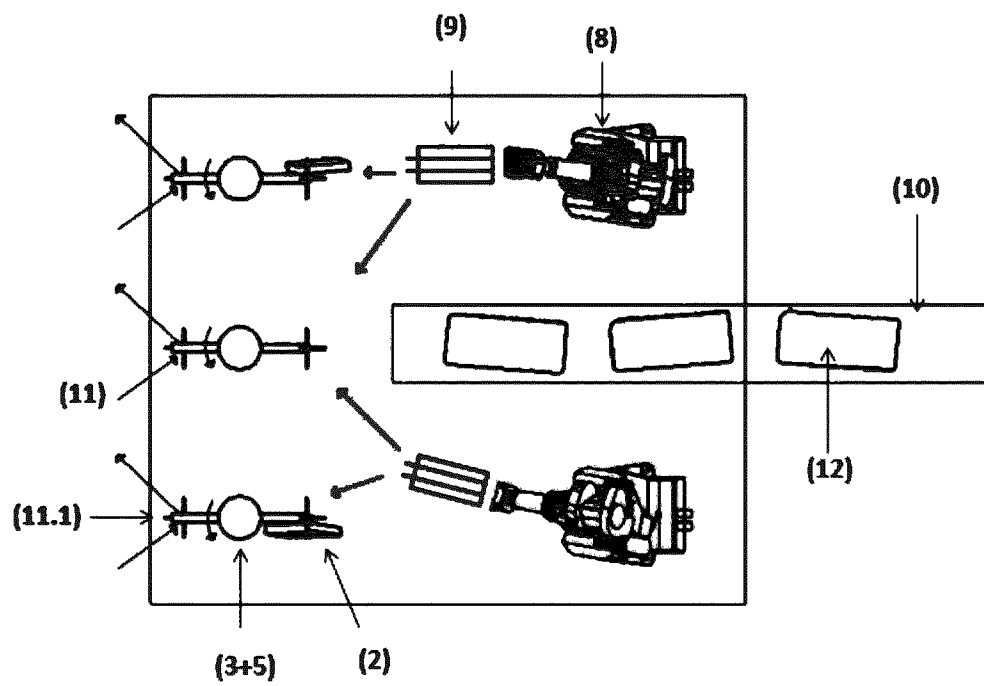


Fig. 8

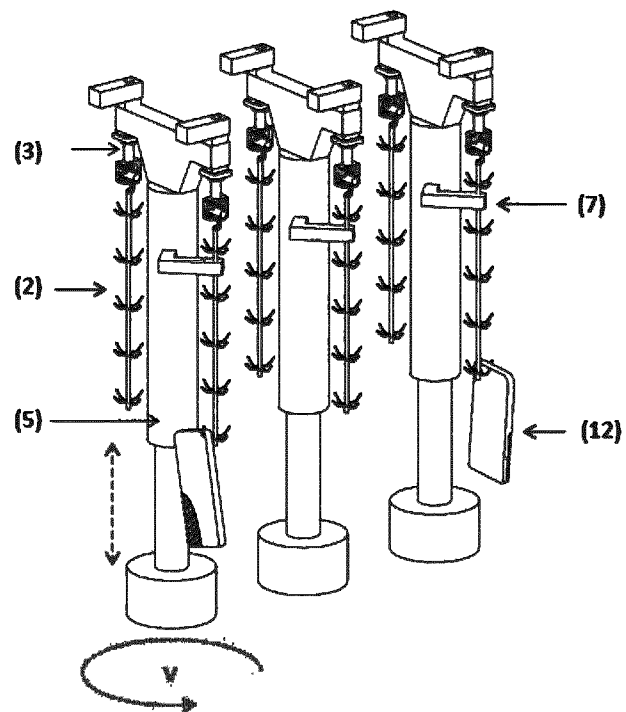


Fig. 9