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(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). WU, Haiyan; c/

o Gregersensvej, 2630 Taastrup (DK).

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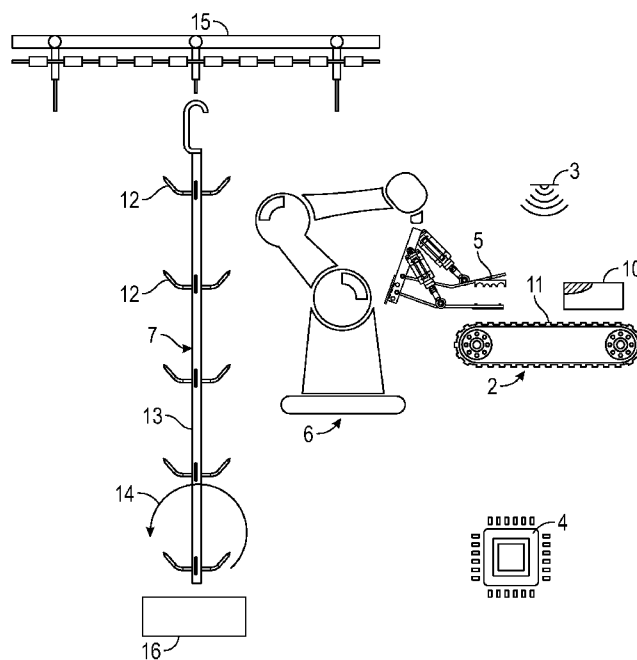


FIG. 1

(57) Abstract: This invention relates to systems and methods for automatic suspension of meat items, provided by a conveyor belt, on a meat storage/transport rack, for use at abattoirs, and in particular at pig abattoirs.

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AUTOMATIC SUSPENSION OF MEAT ITEMS**TECHNICAL FIELD**

5 This invention relates to systems and methods for automatic suspension of meat items, provided by a conveyor belt, on a meat storage/transport rack, for use at abattoirs, and in particular at pig abattoirs.

BACKGROUND ART

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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
15 overhanging rail or to be mounted on a stand, and makes up a means for collecting and transporting the meat items (storage/transport rack).

The meat items usually hung onto such Christmas trees may e.g. be fore-ends and bellies of pork. 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.
20 Therefore, steps to relieve this hard work has been taken.

Thus, DK153079 describes a system, involving a main conveyor/in-let conveyor and two auxiliary conveyors, for supplying a robot with mirrored meat items, in order to simplify the movement pattern of the robot involved in the system, thereby reducing the overall off-loading time.

25 GB 2281547 and EP 1558510 describe a conveying arrangement that lifts the meat pieces onto a hook positioned on the transporting means.

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.

EP3090971B1 describes a method for picking up sausage products from a storage
30 structure for loading onto a conveyor, by use of a specific tool mounted on a robot.

However, the method and devices described herein have not previously been disclosed.

SUMMARY OF THE INVENTION

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The present invention provides a system and a process, by which one can avoid the manual hard work associated with suspending large and heavy meat pieces, e.g. on racks for storage and/or transport of goods.

At abattoirs, and when dealing with the processing of e.g. fore-ends and bellies of pork, it is customary to sort these meat items into different weight classes, which necessitates division of the starting products into different product lines (waiting spaces) for storage and awaiting the further processing. When introduced at this sorting stage, the system and process of the present invention also optimises the production flow, as the use of robots eliminates the use of waiting spaces, storage and transportation lines.

The use of robots, rather than multiple, and long conveyors, also simplifies cleaning of the production lines.

While the process according to this invention allows for a varied and flexible suspension pattern, the process also ensures traceability of the processed meat items.

In its first aspect, the invention provides **a meat handling system (1)**, configured for moving and suspending one or more meat items (10) from an inlet conveyor belt (2) to a means for storage and/or transport (7) of the meat items, which system is described in more details below.

In another aspect, the invention provides **a gripping tool (5)** for mounting on an industrial robot (6), which tool is described in more details below.

In a third aspect, the invention provides **a method of moving and suspending one or more meat items (10)**, arriving at an inlet conveyor belt (2), onto a means for storage and/or transportation (7) 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: **An inlet conveyor belt (2)**, carrying and transporting the meat item (10) to be processed to the arrival area (11); **A sensor (3)**, which may in particular be a mechanical sensor or an optical sensor, or a vision device/camera (8), or a combination hereof, determining the position of the arriving work piece (10) on the inlet conveyor belt (2); **A processing means (4)**, in operation with the conveyor (2), the sensor (3), the industrial robot (6), the storage/transporting means (7), for determining the exact localisation of the arriving meat item (10); **A gripping tool (5)**, mounted on an industrial robot (6); **A robot (6)**; **A means for storage/transport of meat items (7)**, comprising

a number of hooks (12), mounted on a vertical rod (13), hanging from an overhanging rail (15), and/or mounted on a stand (16), and comprising a means for rotating the rod (14) so as to place the hooks (12) in proper position for receiving the meat item (10);

Fig. 2 shows an alternative embodiment of the meat handling system of the invention: **An inlet conveyor belt (2)**, carrying and transporting the meat item (10) to be processed to the arrival area (11); **A vision device/camera (8)**, installed at, or within operating distance of the arrival area, for obtaining images of the incoming meat item (10) and transmission of the digitalized data to a processing means (4); **A processing means (4)**, in operation with the inlet conveyor belt (2), the sensor (3), the industrial robot (6), the storage/transporting means (7), for determining the exact localisation of the arriving meat item (10); Optionally, **a light source (9)**, in case the vision device is for colour vision (colour camera), for illuminating the work piece (10) as an image is taken by the vision device;

Figs. 3A and 3B show an example of **a gripping tool (5)** for use according to the invention: Upper gripper plate (18); Lower gripper plate (19); Fork in gripping plate (20); Actuator for upper gripping plate (21); Actuator for lower gripping plate (22); Element for attachment to an industrial robot (23);

Fig. 4 shows another example of **a gripping tool (5)** for use according to the invention: Upper gripper plate (18); Lower gripper plate (19); Fork in upper and lower gripping plate (20); Actuator for upper gripping plate (21); Actuator for lower gripping plate (22); Element for attachment to an industrial robot (23);

Fig. 5 shows an example of a work piece (10), meat-side (10A) out, to be processed according to the invention: 5A illustrates a right-side work piece, and 5B shows a left-side work piece, with an indication of the localisation of the gripping point (17);

Fig. 6 shows a flow of possible actions/determination undertaken by the **processing means (4)**: Start; Wait for meat edge; Take a picture; Find the angle of the meat; determine if it is left or right; Find the gripping point on the meat; Send data to the robot (6);

Fig. 7 shows the initial phase for suspension on the meat item on a means for storage/transport (7): The meat item, meat-side up (10A) arrives at the inlet conveyor belt (2), and is being grabbed by the gripper (5), mounted on the industrial robot (6); and

Fig. 8 shows the final phase for suspension on the meat item on a means for storage/transport (7): The meat item (10) has been picked up and is held by the gripper (5) mounted on an industrial robot (6), and is being hung, rind-side outwards (10B), on a hook (12) sitting on the means for storage/transport (7).

DETAILED DISCLOSURE OF THE INVENTION

The meat handling system of the invention

In its first aspect, the invention relates to a meat handling system (1),
5 configured for moving one or more meat items (10), arriving at an inlet conveyor belt (2), on a means for storage and/or transport (7) of said meat items.

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

an inlet conveyor belt (2), optionally in operation with the processing means
10 (4), for transporting and providing the meat items (10) to an arrival area (11);

a sensor (3), which may be an optical sensor, e.g. a vision device/camera (8), installed at, or within operating distance of the arrival area, in operation with the processing means (4), for detecting the arrival of the meat items at the arrival area (10);

15 **one or more, optionally interrelated, processing means (4)**, in operation with the inlet conveyor belt (2), the sensor (3), the one or more industrial robots (6), the storage/transporting means (7), the means for turning the rod (14), for determining the exact localisation of the arriving meat item (10), for determining the localisation of a suitable gripping point (17) on the meat item (10), and for accurate delivery of the meat
20 item (10) on the means for storage/transport (7);

a gripping tool (5), for mounting on an industrial robot (6), capable of picking, grabbing, clamping or holding the arriving meat item (10), while in motion, and lifting it up from the conveyor (2), so it can finally be hung on a means for storage/transport (7);

one or more industrial robots (6), in operation with the processing means
25 (4), each robot mounted with a gripping tool (5); and

a means for storage/transport (7) of meat items, in operation with the processing means (4), which storage/transporting means comprises a number of hooks (12), with the tip facing upwards, for receiving the meat items (10) to be stored/transported, and which hooks are mounted on a vertical rod (13), which rod is
30 operatively connected to a means for turning the rod (14), in operation with the processing means (4), so as to bring a hook into a certain position for receiving the meat item (10), delivered by the gripping tool (5), mounted on the robot (6), and which rod is suspended from an overhanging rail (15), and/or mounted on a stand (16).

35 Starting materials

Meat items (10) to be processed according to the present invention may be any piece of meat, and of any animal origin, e.g. beef, pork, lamb and goat, but may in particular be pork fore-end, ham, pork belly, pork loin, pork backs, and/or pork middles.

The workpieces may appear in mirror forms, e.g. represent right- or left-side meat items of the slaughtered animal, that may need to be turned or handled/manipulated accordingly.

Also, the meat piece hung on the Christmas tree should face the rind-side
5 outwards and, consequently, the meat-side should point inwards, towards the rod of the Christmas tree.

Upon arrival, each meat item may, or may not, have an accompanying product ID attached, which ID may provide descriptive information about e.g. the origin of the meat product, weight, etc.

10

The inlet conveyor

The inlet conveyor belt (2) for use according to the invention, for transporting and providing a meat item (10) to an arrival area (11), may be any conveyor belt conventionally used in abattoirs.

15 Normally the meat item (10) for processing according to the invention arrives on the conveyor (2) with its meat-side (10A) pointing upwards, and its rind-side (10B) pointing down. Also, in some abattoirs or in some processes, the meat pieces (10) arrive in a fixed, orderly, pattern, right- and left-sides (10_R, 10_L) alternating, allowing pace-controlled (clocking) management of the further process. However, in other processes,
20 the meat items (10_R, 10_L) may arrive in an unpredictable order, and need to be turned or handled/manipulated accordingly, e.g. by help of the vision device (8).

Optionally, the inlet conveyor is equipped with an encoder, allowing it to be in operation with the processing means (4), so the speed of the conveyor may be adapted to suit the need of the remaining processes.

25 There are four widely used methods of applying encoders to conveyors: motor mount, roller shaft mount, belt/chain driven and surface mount. Any type of encoder may be employed according to the invention.

The sensor

30 The sensor (3) for use according to the invention, installed at, or within operating distance of the arrival area, may be any sensor that is able to determine the position of the arriving meat item (10) on the inlet conveyor belt (2).

If the meat items (10) to be processed arrive in a predictable manner, as described above, e.g. with a certain/fixed distance to the edge of the conveyor belt, the
35 sensor may be a simple mechanical or optical sensor, capable of detecting e.g. the front edge of the arriving meat item (10), thus allowing the robot (6) to position the gripper (5) in the exact position, calculated by the processor (4).

If, on the other hand, the meat items (10) to be processed do not arrive in a predictable manner, and right- and left-side work pieces (10_R, 10_L) arrive in a random order, the sensor must be able to determine its exact position, not only the position of the front edge, but also the lateral placement of the arriving meat item (10) on the conveyor belt (2), and to determine the nature of the arriving work piece, e.g. whether it represents a right-side (10_R) or left-side (10_L) meat item. In such cases, the sensor preferably is an optical sensor, and preferably a vision device/camera (8), installed at, or within operating distance of the arrival area, for obtaining at least one image of the meat item (10) while it is being transported along the conveyor (2), for digitalization of the obtained image, and transmission of the digitalized data to a processing means (4). Such equipment will allow for determination of the essential features relating to the position of such arriving work pieces (10), incl. e.g. determination of left- or a right-side meat cuts (10_R, 10_L), determination of the angle arriving work piece (10), and finally determine the localisation of a suitable gripping point (17) on the arriving meat item (10).

In a further embodiment, the sensor (3) for use according to the invention comprises a mechanical or an optical sensor, and/or a vision device/camera (8), or any combination hereof.

The vision device/camera (8) for use according to the invention may be any commercially available vision system. Vision systems essentially comes in three main categories:

1D vision analyses a digital signal one line at a time instead of looking at a whole picture at once, and is accomplished by use of a line-scanner;

2D vision is looking at the whole picture, and may be accomplished by use of an industrial camera; and

3D vision systems typically comprise multiple cameras and/or one or more laser displacement sensors.

The vision device/camera (8) for use according to the invention may be any commercially available 1D, 2D or 3D camera, e.g. an RGB (colour) camera, an infra-red (IR) camera, or an RGB-IR camera, a 3D (range) camera, or an RGB-3D camera.

Lighting devices

In case the vision device is a colour vision device (colour camera), and for illuminating the work piece (10) as an image is taken by the vision device (8), the meat handling system (1) of the invention preferably comprises one or more lights sources (9), set up to illuminate the meat item (10) while it is being transported along the inlet conveyor belt (2), and for illuminating the meat item while an image is taken by the vision device (3).

The processing means

Based on inputs from the sensor (3) and/or the vision device/camera (8), the processing means (4) for use according to the invention shall be able to recognise and
5 optionally identify the incoming meat item, and to guide the robot (6) used according to the invention to deliver the meat item (10) accurately on the storage/transport means (7).

The processing means (4) for use according to the invention may be any commercially available processor/PC capable of receiving and processing of data
10 obtained from one or more of the following: the inlet conveyor belt (2) used according to the invention; the sensor (2) used according to the invention; the images obtained by the vision device (8) used according to the invention; the robot(s) used according to the invention; the storage/transporting means (7) used according to the invention; and the processing means (4) may in addition be in communication with one or more other,
15 optionally interrelated or inter-connected, processors (4), used according to the invention.

Processing is the mechanism for extracting information from a digital image and may take place externally in a PC-based system, or internally in a standalone vision system. Processing is performed by software and consists of several steps. First, an
20 image is acquired from the sensor. Next, the software locates the specific features, runs measurements, and compares these to the specification. Finally, a decision is made, and the results are communicated.

Since vision systems often use a variety of off-the-shelf components, these items must coordinate and connect to other machine elements quickly and easily.
25 Typically, this is done by either discrete I/O signal or by data sent over a serial connection to a device that is logging information or using it.

The processor (4) for use according to the invention shall analyse the transmitted data and take the necessary action in respect of any measurement results. The processor may also receive data from outside the system of the invention, e.g. in
30 the form of a product ID with concomitant information about e.g. the origin of the meat product and/or weight.

Often, information about the weight of a given piece of meat is available from the supplied product ID. Alternatively, a weighing station may be introduced prior to the system of the invention, allowing determination of weight, and capable of transmitting
35 data regarding the weight found to the processor (4).

In one embodiment, the processor (4) determines and adjusts (in communication with the encoder) the speed by which the inlet conveyor belt (2) transports the incoming meat item (10).

In another embodiment, the processor (4) receives a signal from the sensor (3), determines the position/localisation of the arriving meat item (10) to be processed, and calculates the localisation of a suitable gripping point (17) on the meat item (10).

In a third embodiment, the processor (4) communicates with, and provides
5 instruction to the industrial robot (6), for the robot to perform a desired task, e.g. grab a meat piece (10) with the gripping tool (5), lift the meat piece (10) with the gripping tool (5), direct the gripping point (17) to a hook (12) mounted on the means for storage/transport (7), and fit the piece of meat onto the hook by perforating the meat.

In a fourth embodiment, the processor (4) communicates with the means for
10 storage/transport (7), for and provides instructions for the storage rack (7) for bringing it into a fixed position for receiving the meat item (10), or for the turning means (14) to rotate the rod (13), or for bringing it into a position for receiving the next meat item (10), delivered by the gripping tool (5), mounted on the industrial robot (6).

The processor (4) for use according to the invention is able to communicate with
15 devices outside the system, and to receive data from here, e.g. information derived from a concomitant product ID, or a weight as determined on a separate weighing station. By taking such information into account, the processor (4) may be able to sort the incoming meat items (10) according to e.g. weight.

In a fifth embodiment, the processor (4) performs a sorting of the incoming
20 meat items (10) according to their weight and distributes meat items (10) of different weight, or belonging to different weight classes, to different storage/transport means (7).

The gripping tool

25 The gripping tool (5) for use according to the invention may be any suitable tool capable of picking, grabbing, clamping or holding a piece of meat of a given size. Examples of useful tools include a pricker, a tip, a wrench, tongs or clamping tool, a grab, a vacuum gripper, etc.

In one embodiment, the gripping tool (5) for use according to the invention is a
30 specially adapted tool comprising an upper gripper plate (18) and a lower gripper plate (19), which plates are inverted (mirror-faces of each other), and both hold a fork (20), allowing the work piece (10) to be hung on a hook (12), of the storage/transport rack (7), and which gripping tool is capable of sliding underneath the arriving meat item (10), grabbing the meat item (10) and lifting it up from the conveyor (2), turning the meat
35 item (10) around so it can finally be hung on a means for storage/transport (7) with its rind-side outwards, during which process the hook (12) perforates the meat item (10).

To exercise this process, the gripping tool preferably comprises two actuators, one actuator (21) for activating the upper gripper plate, and another actuator (22) for activating the lower gripper plate.

Upon picking up the meat item (10) from the inlet conveyor belt (2), and if the
5 meat item (10) arrives facing its meat-side (10A) up, the actuator (21) activates the upper gripper plate, thus opening the gripping tool and bringing it into position for receiving the arriving meat item (10). When in the determined position, the upper gripper plate actuator (21) activates the plate to close the gripping tool (5), thereby allowing it to lift the meat item (10) from the conveyor (2).

10 Upon delivery of the meat item (10) on the storage/transport rack (7), where it is desired that the rind-side (10B) faces outwards, the meat item (whether 10_R or 10_L) may need to be turned around. When the robot (6) has completed the necessary actions and placed the meat piece (10) on the appropriate hook (12), the lower gripper plate actuator (22) opens the gripping tool and removed the gripping tool (5) from the
15 storage/transport rack (7).

The robot (6) may then turn to repeat this process.

When used according to the invention, the gripping tool (5) is mounted on a robot (6), and the gripping tool (5) therefore also comprises an element (23) for attachment to a robot.

20

The industrial robot

The industrial robot (6) for use according to the invention shall be controlled by a processor (4) used according to the invention, and the robot (6) shall be equipped with a gripping tool (5) of the invention.

25 The robot (6) used according to the invention should deliver the meat item (10) accurately on the storage/transport means (7).

The robot (6) for use according to the invention may be any commercially available industrial robot. Industrial robots may be classified based on their coordinate systems, i.e. based on reachable coordinates of a point on the end-effector, and include
30 Cartesian robots (when arms of a robot move in the XYZ rectangular coordinate system), Cylindrical robots (when arms of a robot move in one angular and two linear directions), Spherical robots (the arms move in two angular and one linear direction), SCARA robots (Selective Compliance Arm for Robotic Assembly; have two parallel revolute joints providing compliance in a selected plane), and Articulated robots (also known as the
35 anthropomorphic robot, the robot arm has 3 revolute joints).

Industrial robots suited for use according to the present invention would in particular be a 4-6 axis robot.

The means for storage/transport

The means for storage/transport (7) (in jargon often referred to as a Christmas tree) for use according to the invention essentially represents a rack/stand, holding a number of hooks (12), each with the tip facing upwards, for receiving the meat items (10) to be stored/transported, and which hooks are mounted on a vertical rod (13), which rod is operatively connected to a means for turning the rod (14), in operation with the processing means (4), so as to place a hook in a certain position for receiving the meat item, and which rod is suspended from an overhanging rail (15), and/or mounted on a stand (16).

10 The robot (6) used according to the invention should deliver the meat item (10) accurately on the storage/transport means (7).

The means for storage/transport (7) could hold essentially any number of hooks (12), but the industry norm currently is 4 x 5 hooks per Christmas tree, and the hooks preferably are aligned, both in the horizontal level, but also vertically, as illustrated on 15 Figs. 1 and 7.

The means for turning the vertical rod (14) of the means for storage/transport (Christmas tree) may e.g. be a mechanical device, positioned underneath the rod (13). The device (14) may be driven by a servomotor, in operation with, and controlled by the processing means (4). The turning device (14) may be attached to the vertical rod (13) 20 of the means for storage/transport (7) by a hollow pipe holding a number of open slot holes that fit the number of – vertically mounted – hooks on the Christmas tree (the number illustrated in the figures being four).

While the robot (6) used according to the invention may be able to place the meat item (10) in any place and in any position on the storage/transport means (7), it 25 may be desired to have the storage/transport means (7) move and/or rotate itself so as to speed up the overall suspension process.

In one embodiment, the means for turning the vertical rod (14), in communication with, and guided by, the processing means (4), performs a rotation of 90° each time a new meat item (10) is being presented by the robot (6), allowing the 30 robot to aim for the same point each time the meat item shall be hung onto the Christmas tree.

For the same reason (to speed up the overall process), it is also desired that the means for turning the vertical rod (14), or the stand (16) for holding the means for storage/transport (7), is capable of lifting the storage/transport means (7) up or down, 35 allowing the robot to aim for the same point each time the meat item shall be hung onto the Christmas tree.

The gripping tool (5) of the invention

In another aspect, the invention relates to an especially designed gripping tool (5) for use according to the invention (cf. Figs. 3A, 3B and 4).

The gripping tool (5) of the invention, designed for being mounted on an industrial robot (6), may be characterised by comprising:

an upper gripper plate (18) and a lower gripper plate (19), which plates are inverted (mirror-faced), and both hold a fork (20);

an actuator for upper gripping plate (21), and an actuator for lower gripping plate (22); and

an element for attachment (23) to an industrial robot.

The gripping tool of the invention is capable of sliding underneath the arriving meat item (10), grabbing the meat item while in motion, and lifting it up from the conveyor (2), turning the meat item around so it can finally be hung on a means for storage/transport (7), e.g. with its rind-side outwards.

In one embodiment, the gripping tool (5) for use according to the invention constitutes a one-sided tool, wherein the upper gripper plate (18) and the lower gripper plate (19), which plates are inverted (mirror-faces of each other), and both plates hold a fork (20), and both plates face in one and the same direction (cf. Fig. 3A and 3B).

In another embodiment, the gripping tool (5) for use according to the invention constitutes a two-sided tool, wherein the upper gripper plate (18) and the lower gripper plate (19), which plates are inverted (mirror-faces of each other), and both plates hold two forks (20), and both plates face in two directions (cf. Fig. 4).

The method of the invention

In another aspect, the invention relates to a method for automatically moving and suspending one or more meat items (10), arriving on an inlet conveyor belt (2), on a means for storage and/or transportation (7) of said meat items.

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

(a) providing one or more meat items (10), via a carrier/conveyor (2), to an arrival area (11);

(b1) detecting the arrival of a meat items (10) on the inlet conveyor belt (2), using a sensor (3), installed at, or within operating distance of the arrival area (11), which sensor (3) is in operation with the processing means (4); and/or

(b2) detecting the arrival of the meat items (10) on the inlet conveyor belt (2), using a vision device/camera (8), installed at, or within operating distance of the arrival area (11), which vision device/camera (8) is in operation with the processing means (4),

and obtaining one or more images of the arriving meat item (10), while the meat item is in motion, and transmission of the digitalized data to the processing means (4); and

(c) determining the localisation of a suitable gripping point (17) on the meat item (10) using a processing means (4);

5 (d) grabbing the meat item (10), while in motion, by the gripping point (17), lifting it and hanging it on a hook (12) mounted on a storage/transporting means (7), by use of a gripping tool (5) mounted on an industrial robot (6);

(e) bringing the storage/transporting means (7) into position for receiving the next meat item (10);

10 (f) collecting the one or more meat items (10) on the means for storage/transport of meat items (7), and, when filled, removing it for further transport, storage, and/or processing; and

(g) providing another storage/transporting means (7) and bringing it into position for receiving the next meat item (10).

15 In one embodiment, in step (b1), the arrival of a meat items (10) on the inlet conveyor belt (2) is detected using a mechanical or an optical sensor (3), installed at, or within operating distance of the arrival area (11), which sensor (3) is in operation with the processing means (4).

In another embodiment, in step (b2), the arrival of the meat items (10) on the
20 inlet conveyor belt (2) is detected using a vision device/camera (8), installed at, or within operating distance of the arrival area (11), which vision device/camera (8) is in operation with the processing means (4), and obtaining one or more images of the arriving meat item (10), while the meat item is in motion, and transmission of the digitalized data to the processing means (4).

25 The means for storage/transport of meat items (7), i.e. the "Christmas tree", usually is transported hanging in a sliding rack, transport rail, or a conveyor/overhead rail, mounted in the ceiling (as depicted in Fig. 1). However, the storage/transport means (7) may also be moved around using a carousel.

In one embodiment, the means for storage/transport of meat items (7) is
30 provided using a rail conveyor, suspended in the ceiling.

In another embodiment, the means for storage/transport of meat items (7) is provided using a carousel.

When the storage/transport means (7) has arrived, it may, advantageously, whether by turning, lifting or lowering, or by a combination of these actions, be
35 positioned so that the subject can be accessed by the gripping tool (5), mounted on the robotic arm (6).

After having delivered the first meat item (10) onto the storage/transport means (7), the storage/transporting means may be brought into position for receiving

the next meat item. This may be accomplished by rotation, or by lifting or lowering, or by a combination of these actions, and may involve the action of the means for turning the rod (14), allowing the robot to aim for the same point each time the meat item shall be hung onto the Christmas tree.

- 5 In one embodiment, the means for turning the vertical rod (14), in communication with the processing means (4), performs a rotation of 90° each time a new meat item (10) is being presented by the robot (6).

After having filled one storage/transport means (7), this loaded storage/transporting means shall be removed, allowing for the arrival of the next
10 storage/transport means (7). The storage/transporting means may be removed by lifting it off the conveyor rail or carousel, optionally using a specially adapted lift or robot.

The loaded storage/transport means (7) may then be removed from the processing area for further transport, storage, and/or processing by conventional means.

15 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.

1. Meat handling system
- 20 2. Inlet conveyor belt
3. Sensor
4. Processing means/PC
5. Gripping tool
6. Industrial robot/manipulator
- 25 7. Means for storage/transport of meat items
8. Vision device/camera
9. Light source
10. Meat item/work piece
- 10A. Meat-side of meat item
- 30 10B. Rind-side of meat item
11. Arrival/reception area
12. Hook mounted on a means for storage/transport
13. Vertical rod of the means for storage/transport
14. Means for turning the rod
- 35 15. Overhanging rail for suspension of the means for storage/transport
16. Stand for holding the means for storage/transport
17. Gripping point
18. Upper gripper plate

- 19. Lower gripper plate
- 20. Fork in gripping plate
- 21. Actuator for upper gripping plate
- 22. Actuator for lower gripping plate
- 5 23. Element for attachment to an industrial robot
- 26. Meat edge

CLAIMS

1. **A meat handling system (1)**, configured for moving and suspending one or more meat items (10) from an inlet conveyor (2) to a means for storage and/or
5 transport (7) of said meat items, which system comprises:

an inlet conveyor belt (2), optionally in operation with the processing means (4), for transporting and providing the meat items (10) to an arrival area (11);

a sensor (3), installed at, or within operating distance of the arrival area (11), in operation with the processing means (4), for detecting the arrival of the meat items
10 (10) at the arrival area (11);

one or more, optionally interrelated, processing means (4), in operation with the inlet conveyor belt (2), the sensor (3), the one or more industrial robots (6), and/or the storage/transporting means (7), the means for turning the rod (14), for determining the exact localisation of the arriving meat item (10), for determining the
15 localisation of a suitable gripping point (17) on the meat item;

a gripping tool (5), for mounting on the industrial robot (6), capable of picking, grabbing, clamping or holding the arriving meat item (10) while in motion, and lifting it up from the conveyor (2), so it can finally be hung on the means for storage/transport (7);

20 **one or more industrial robots (6)**, in operation with the processing means (4), each robot mounted with the gripping tool (5); and

a means for storage/transport (7) of meat items, in operation with the processing means (4), which storage/transporting means comprises a number of hooks (12), with the tip facing upwards, for receiving the meat items (10) to be
25 stored/transported, and which hooks are mounted on a vertical rod (13), which rod is operatively connected to a means for turning the rod (14), in operation with the processing means (4), so as to bring a hook into a certain position for receiving the meat item (10), delivered by the gripping tool (5), mounted on the industrial robot (6), and which rod is suspended from an overhanging rail (15), and/or mounted on a stand (16).

30

2. The meat handling system (1) of claim 1, wherein the sensor (3) is a mechanical or an optical sensor, or a vision device/camera (8), or any combination hereof.

3. The meat handling system (1) of either one of claims 1-2, wherein the gripping
35 tool (5) is a tool according to any one of claims 3-5.

4. A gripping tool (5), for mounting on an industrial robot (6), which gripping tool comprises:

an upper gripper plate (18) and a lower gripper plate (19), which plates are inverted (mirror-faced), and both hold a fork (20);

5 an actuator for upper gripping plate (21), and an actuator for lower gripping plate (22); and

an element for attachment (23) to an industrial robot.

5. The gripping tool of claim 4, wherein the upper gripper plate (18) and the
10 lower gripper plate (19), which plates are inverted (mirror-faces of each other), and both plates hold a fork (20), and both plates face in one and the same direction (cf. Fig. 3A and 3B).

6. The gripping tool of claim 4, wherein the upper gripper plate (18) and the
15 lower gripper plate (19), which plates are inverted (mirror-faces of each other), and both plates hold two forks (20), and both plates face in two directions (cf. Fig. 4).

7. A method of automatically moving and suspending one or more meat items (10), arriving at an inlet conveyor belt (2), onto a means for storage and/or
20 transportation (7) of said meat items, which method comprises the subsequent steps of:

(a) providing one or more meat items (10), via a carrier/conveyor (2), to an arrival area (11);

(b1) detecting the arrival of the meat item (10) on the inlet conveyor belt (2), using a sensor (3), installed at, or within operating distance of the arrival area (11),
25 which sensor (3) is in operation with the processing means (4); and/or

(b2) detecting the arrival of the meat items (10) on the inlet conveyor belt (2), using a vision device (8), installed at, or within operating distance of the arrival area (11), which vision device (8) is in operation with the processing means (4), and obtaining one or more images of the arriving meat item (10), while the meat item is in
30 motion, and transmission of the digitalized data to the processing means (4); and

(c) determining the localisation of a suitable gripping point (17) on the meat item (10) using a processing means (4);

(d) grabbing the meat item (10), while in motion, by a gripping point (17), lifting it and hanging it on a hook (12) mounted on a storage/transporting means (7), by
35 use of the gripping tool (5) mounted on an industrial robot (6);

(e) bringing the storage/transporting means (7) into position for receiving the next meat item (10);

(f) collecting the one or more meat items (10) on the means for storage/transport of meat items (7), and, when filled, removing it for further transport, storage, and/or processing; and

(g) providing another storage/transporting means (7) and bringing it into
5 position for receiving the next meat item (10).

8. The method of claim 6, wherein, in step (b1), the arrival of the meat item (10) on the inlet conveyor belt (2) is detected using a mechanical or an optical sensor (3), installed at, or within operating distance of the arrival area (11), which sensor (3) is
10 in operation with the processing means (4).

9. The method of claim 6, wherein, in step (b2) the arrival of the meat items (10) on the inlet conveyor belt (2) is detected using a vision device (8), installed at, or within operating distance of the arrival area (11), which vision device (8) is in operation
15 with the processing means (4), and obtaining one or more images of the arriving meat item (10), while the meat item is in motion, and transmission of the digitalized data to the processing means (4).

10. The method of claim 7, wherein, in step (e), the means for
20 storage/transport of meat items (7) is provided using a rail, suspended in the ceiling.

11. The method of claim 7, wherein, in step (e), the means for storage/transport of meat items (7) is provided using a carousel.

25 12. Use of the system according to either one of claims 1-2, in the method according to claim 7.

13. Use of the gripper according to any one of claims 3-5, in the method according to claim 7.

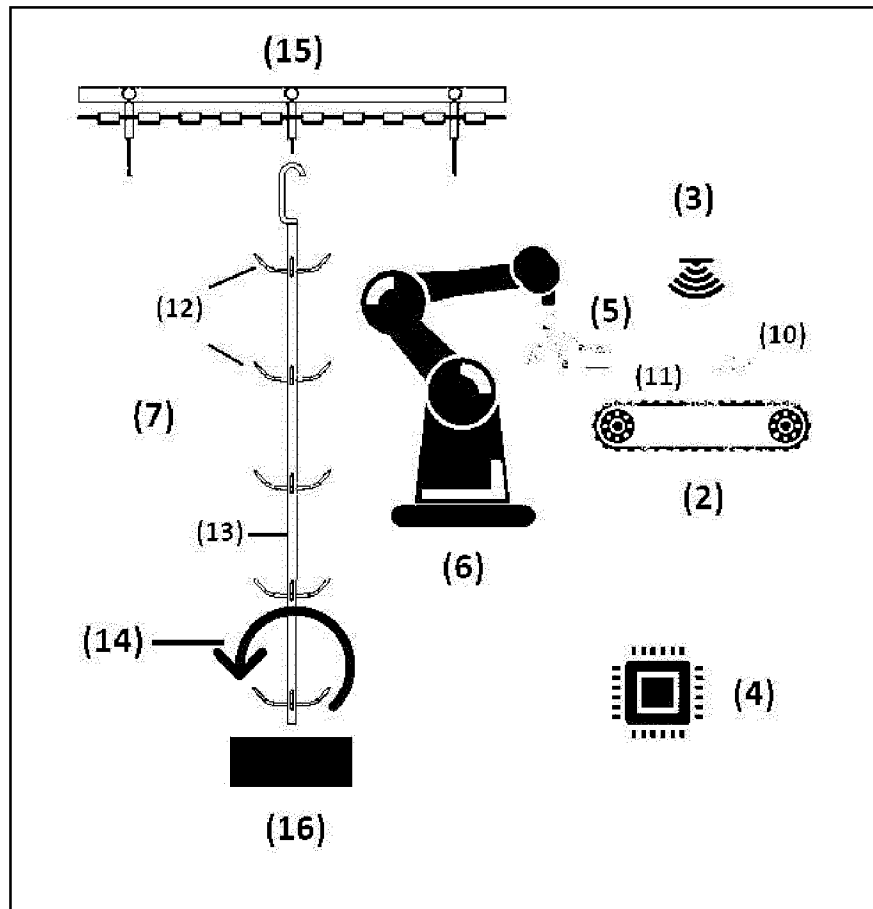


Fig. 1

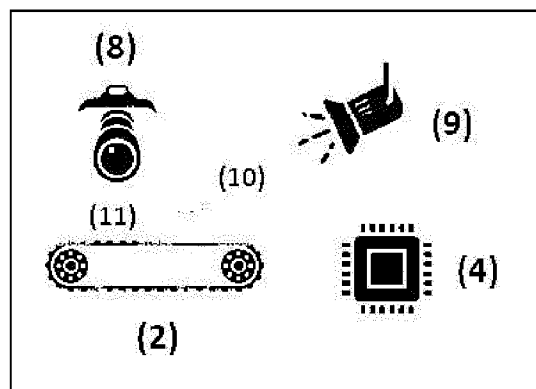


Fig. 2

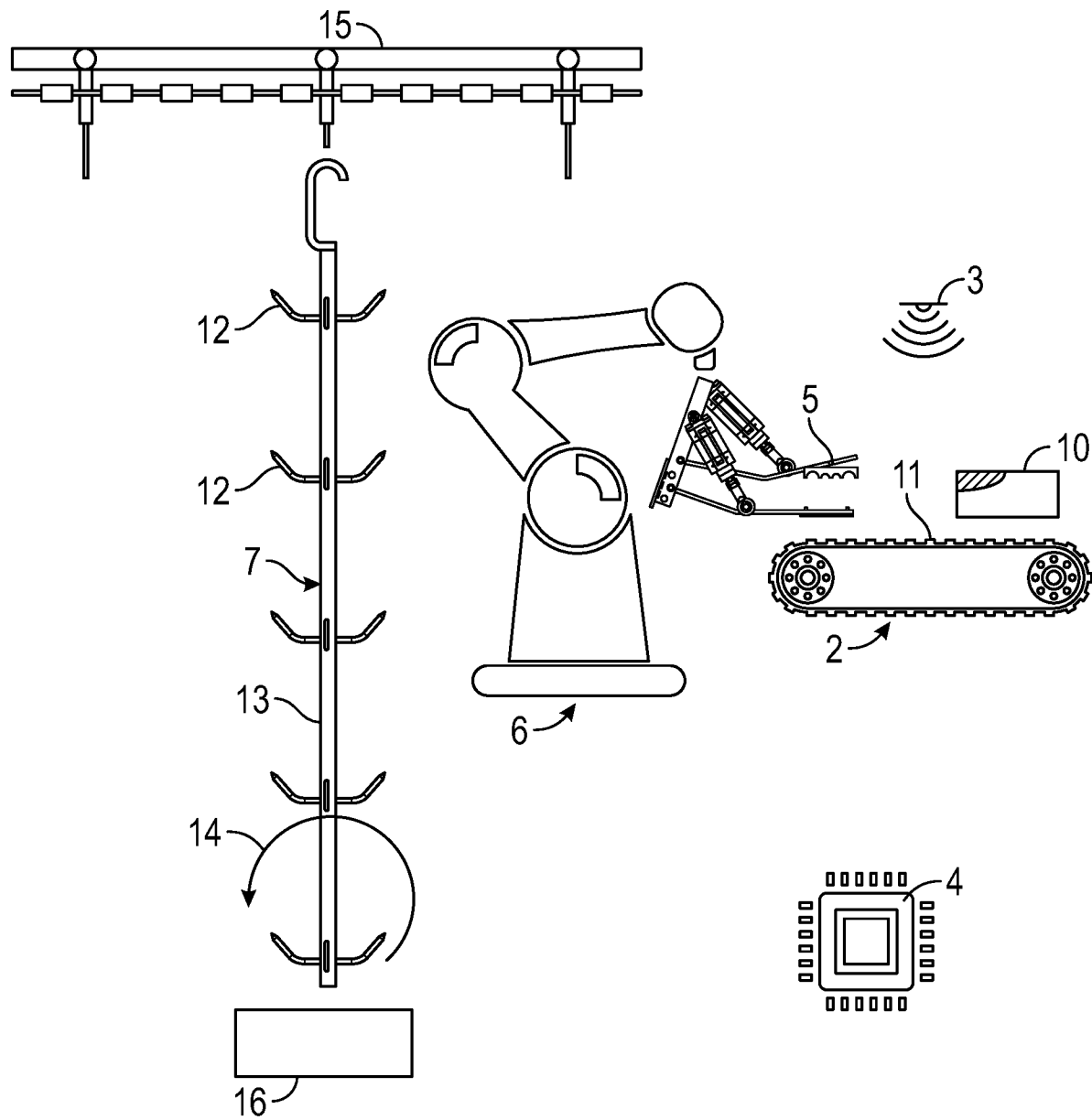


FIG. 1

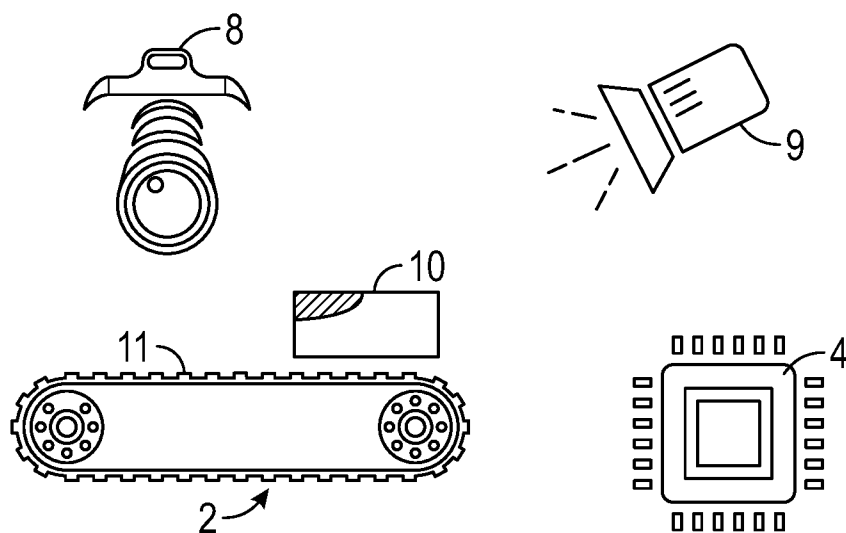


FIG. 2

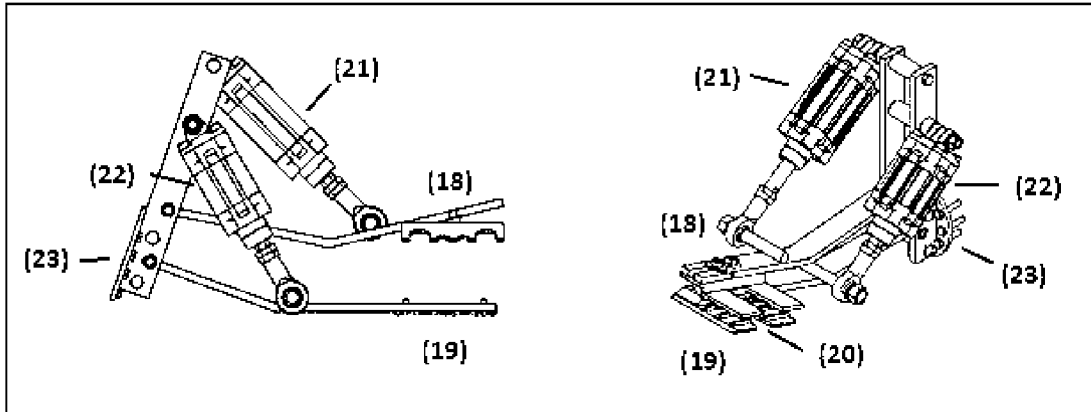


Fig. 3A

Fig. 3B

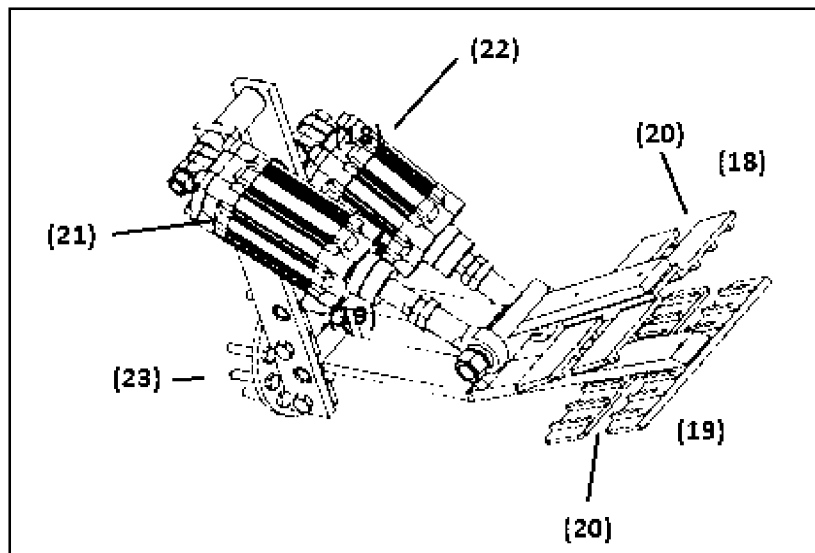
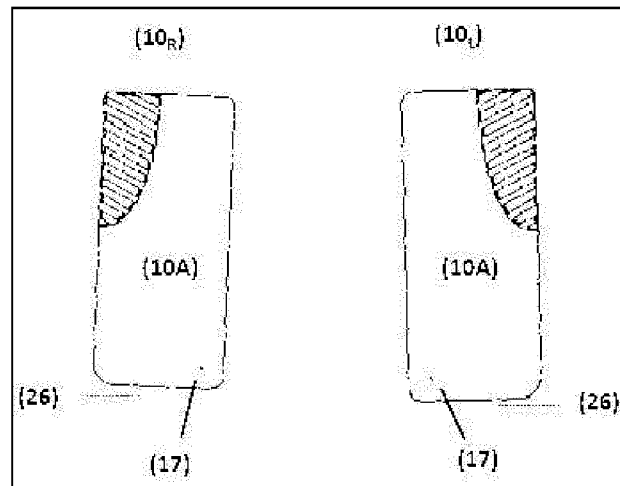
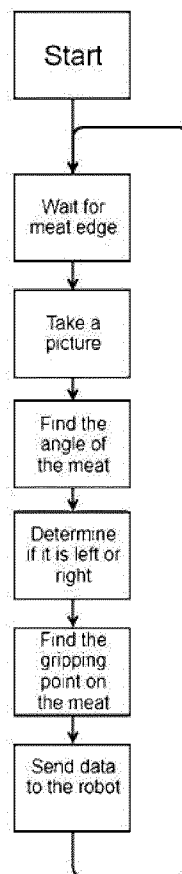


Fig. 4

**Fig. 5A****Fig. 5B****Fig. 6**

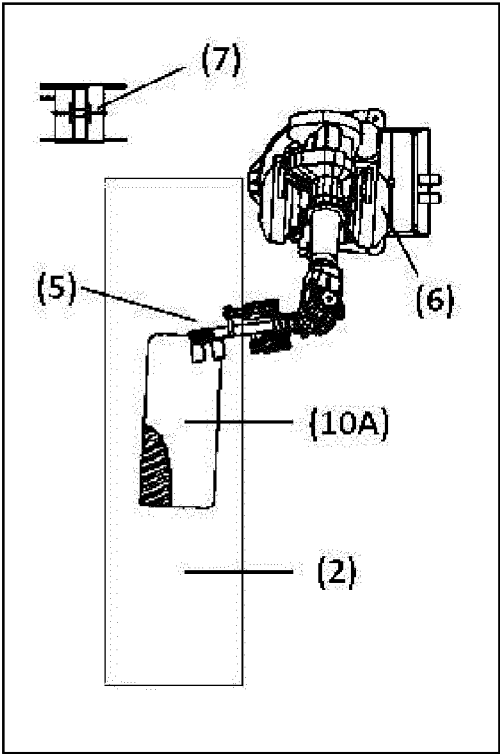


Fig. 7

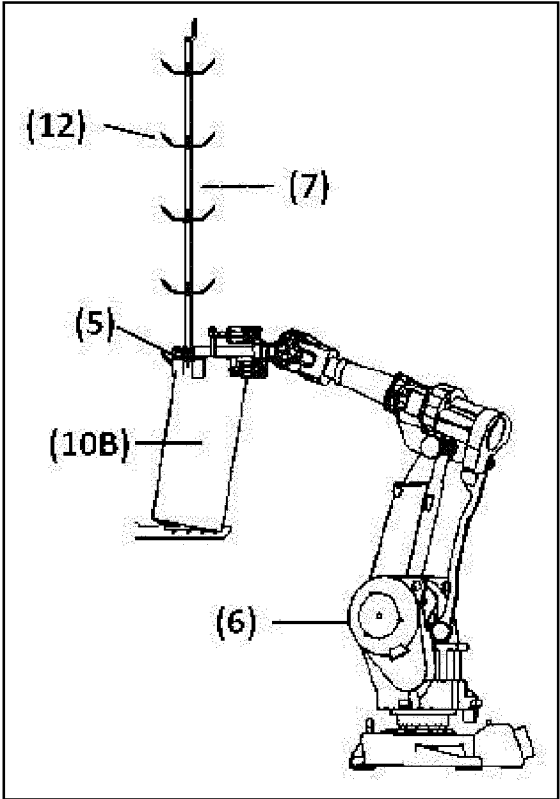


Fig. 8