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(54) Titel: **ROBOTIC PACKING SYSTEM AND METHOD FOR USE AT SLAUGHTERHOUSES**

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(57) Sammendrag:
This invention relates to a packaging plant for automatically packing meat products, and to a method for operating an automatic meat packaging plant. More specifically, the invention relates to a robotic packing system for use at slaughterhouses or in the meat packing industry for automatic packaging of meat products in waterproof foil, and subsequent placement of the wrapped meat product in cardboard boxes.

Fortsættes...

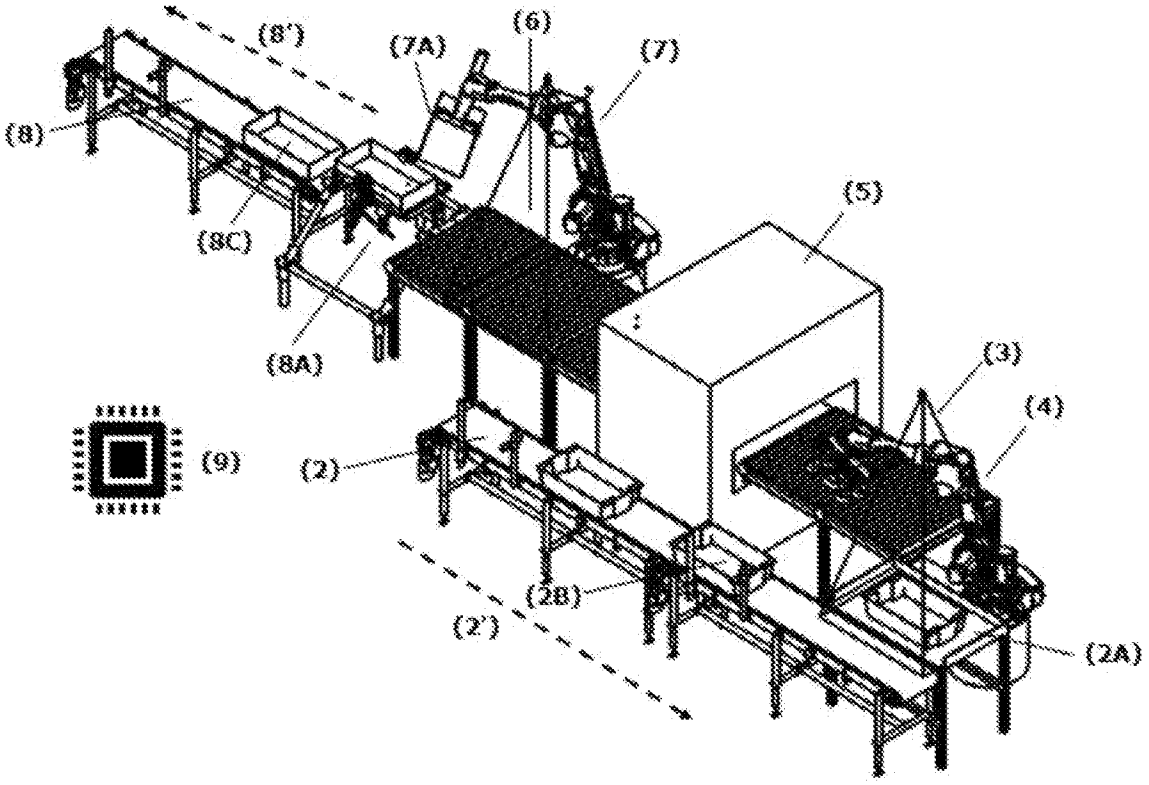

Fig. 1

TECHNICAL FIELD

This invention relates to a robotic packaging system for automatically packing meat products, and to a method for automatic packaging of meat products.

More specifically, the invention relates to a robotic packing system for use at slaughterhouses or in the meat packing industry for automatic packaging of meat products in waterproof foil, and subsequent placement of the wrapped meat products in cardboard boxes.

BACKGROUND ART

After processing meat products, the operation is usually completed by wrapping and packing the processed meat product in a suitable packing material. In this respect consideration must be given to the fact that pieces of meat release liquid that tend to contaminate the packaging material, often cardboard, used for the purpose, and therefore must be wrapped in a liquid-stopping foil, often a plastic foil, before it can be finally packed in cardboard boxes.

Moisture in cardboard boxes basically is undesirable, especially for bacterial reasons. Therefore, processed meat products are usually wrapped individually (IWP: Individually Wrapped Product) using a dedicated film wrapping machine, before being packed in boxes. However, special care must be taken to make sure that released moisture does not subsequently seep into the packaging.

US2015059290 describes a system for packaging a food product, including a conveying system for supporting and moving the food product.

SUMMARY OF THE INVENTION

The present invention relates a robotic packing system and a related method, for use at slaughterhouses or in the meat packing industry, for automatic packaging of meat products in waterproof foil and subsequent placement of the wrapped meat products in cardboard boxes.

It is an advantage of the system of the invention is that it works automatically and that it is able to wrap the meat products individually in such a way that released moisture does not subsequently seep out from the wrapping and into the packaging.

Thus, in its first aspect, the invention relates to a robotic packing system for use at slaughterhouses or in the meat packing industry for automatic packaging of a meat product (10) in foil (5D) and subsequent placement of the wrapped meat product in cardboard boxes (8C), which system is as characterised in the claims.

In another aspect, the invention provides a method, for use at for use at slaughterhouses/abattoirs or in the meat packing industry, for automatic packaging of a meat product (10) in waterproof foil (5D), and subsequent placement of the wrapped meat product in cardboard boxes (8C), which method is as characterised in the claims.

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.

DETAILED DISCLOSURE OF THE INVENTION

The system of the invention

In its first aspect, the invention relates to a robotic packing system for use at slaughterhouses or in the meat packing industry for automatic packaging of a meat product (10) in foil (5D) and subsequent placement of the wrapped meat product in cardboard boxes (8C).

The packing system of the invention may be characterised by comprising the following elements:

a. **a first combined imaging and picking station** (3), which imaging station comprises one or more imaging devices (3A, etc.), is located at the supply end of a supply conveyor belt (5B) of a foil wrapping station (5), and within operational distance relative to the first receiving robot (4), and which imaging station is in communication with a processing means (9), and configured for recognition of an incoming transport box (2B), and for determination of the relative position of each of the meat products contained in the transport box (2B);

b. **a first receiving robot** (4), located at an operational distance relative to the first combined imaging and picking station (3), which robot is in communication with the processing means (9), is mounted with a working tool (4A), and configured for picking up and collect the meat product (10) from the incoming transport box (2B) and moving it to the supply conveyor belt (5B) of the foil wrapping station (5);

c. **a foil wrapping station** (5) comprising a foil wrapping machine (5A), the supply- (5B) and a discharge- (5C) conveyor belt, for receiving the unwrapped meat product, and configured for wrapping the meat product using a substantially rectangular sheet of foil (5D), that may be delivered from a foil roll, which foil roll has a width greater than the length of the piece of meat (10) to be wrapped, whereby, after wrapping, the ends of the wrapping foil (10B') projects from the piece of wrapped meat; and

d. **a processing means** (9), in function with the first imaging station (3), the first receiving robot (4), and configured for processing data obtained from the first (3) imaging station, and for manipulating the first receiving robot (4); and

which system is *characterised by* further comprising the following elements:

e. **a second combined imaging and picking station** (6) comprising one or more imaging devices (6A), located at the discharge end of the conveyor belt (5C) of the foil wrapping station (5), and within operational distance relative to the second delivering robot (7), which imaging station is in communication with a processing means (9), and configured for recognition of the wrapped meat product, and for determination of the relative position of the wrapped meat product on the discharge conveyor belt (5C), for the second delivering robot (7) to pick up the wrapped meat product;

f. **a second delivering robot** (7), in communication with the processing means (9), mounted with a working tool (7A), and configured for picking up and collect the wrapped meat product from the second combined imaging and picking station (6) located at the discharge conveyor belt (5C) of the foil wrapping station (5), for delivery of the wrapped meat product to a packing zone (8A);

and wherein the supply- (5B) and discharge- (5C) conveyor belt of element c are configured for transporting a wrapped meat product to the second combined imaging and picking station (6);

the processing means (9) is in function with the second imaging station (6) and/or the second delivering robot (7) and configured for processing data obtained from the second imaging station, and of manipulating the first receiving robot (4); and

the packing zone (8A) of element e comprises **air nozzle means** (8B) configured for blowing an air stream emanating from below the conveyed meat product, so that the ends of the wrapping foil (10B') projecting from the wrapped meat product is blown upwards while the wrapped meat product, by the action of the second delivering robot (7), is being immersed into the cardboard box (8C);

so that the wrapping foil (10B') projecting from the wrapped meat product places itself/packs itself on top of the wrapped meat product in the cardboard box (8C), so as to secure that liquid originating from the meat product (10) remains within the foil wrapping.

In another embodiment, the system of the invention may be characterised by further comprising the following element:

an inlet conveyor belt (2), optionally in communication with the processing means (9), for supply of meat products, arriving in a transport box (2B) and delivery to a first combined imaging and picking station (3).

In a third embodiment, the system of the invention may be characterised by further comprising the following element:

an out-let conveyor belt (8), optionally in communication with the processing means (9), comprising a packing zone (8A), for receipt of the wrapped meat product and placement of the wrapped meat product into cardboard boxes (8C) for further redistribution.

In a yet further embodiment, the system of the invention further comprises **one or more sensors**, in communication with the processing means (9), and placed within operational distance of the inlet conveyor belt (2), and/or the supply-conveyor belt (5B), and/or the discharge-conveyor belt (5C), and/or the out-let conveyor belt (8), for tracking the incoming meat products (10), including unwrapped meat products, and/or plastic transport boxes (2B), and/or wrapped meat products, and/or cardboard boxes (8C).

The inlet/out-let conveyor belts

The inlet conveyor belt (2) for use according to the invention is for supply of meat products, usually arriving in a regular transport box (2B), to the first vision/imaging station (3).

The out-let conveyor belt (8) for use according to the invention is for receipt of the wrapped meat product and placement of the wrapped meat product into cardboard boxes (8C) for further redistribution.

According to the present invention, the out-let conveyor belt (8) comprises a packing zone (8A), which packing zone further comprises air nozzle means (8B), configured for blowing an air stream emanating from below the conveyed meat product, so that the ends of the wrapping foil (10B') projecting from the wrapped meat product is blown upwards while the wrapped meat product, by the action of the second delivering robot (7), is being immersed into the cardboard box (8C).

All conveyor belts for use according to the invention may be equipped with one or more position sensors, and/or encoders, which may in particular be a rotary encoders, in communication with, and receiving operational guidance from, the processing means (9). This ensures that the system can perform various functions, like controlling (determine and adjust) the speed of the conveyor belt and/or synchronization with the first (4) and/or the second (7) robot.

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.

In another embodiment, the system of the invention further comprises one or more sensors, placed within operational distance of the inlet conveyor belt (2), and/or the supply-conveyor belt (5B), and/or the discharge-conveyor belt (5C), and/or the out-let conveyor belt (8).

Often, when using food approved transport boxes (2B), e.g. SFK-boxes, these in-let boxes comes with build-in identification providers/ID tags/transponder, e.g. an RFID chip, that is able to identify the particular box and, by reference to a central database, its content, e.g. product type. For reading and translating this information, an identification reader/RFID-reader may be placed within operational distance of the in-let conveying belt (2). Such sensors will be able to pace the incoming boxes (2B) into the first combined vision/imaging and picking station/zone (3), where the system will know, by reference to reference to the central database, what type of product it is.

Also, the foil wrapping station (5) may be supplied with sensors, e.g. diffuse photo sensors, in order to pace the incoming products towards to the foil wrapping machine (5A).

Moreover, another sensor, e.g. a diffuse photo sensor, may be positioned along the discharge conveyor belt (5C), to transmit a signal to the processing means (9), that allows for operating the discharge conveyor belt (5C), e.g. in communication with an encoder operating the discharge conveyor belt (5C).

Yet another sensor, e.g. a diffuse photo sensor, may be positioned with operational distance of the out-let conveyor belt (8), for proper pacing of the outgoing boxes.

<u>The first and the second combined imaging and picking station</u>

In the context of this application, a vision/imaging station/zone represents a combination of hardware and software capable of providing operational guidance to other devices based on the capture and processing of images, and usually rely on digital sensors protected inside an imaging device, especially an industrial camera, with specialised optics to acquire images, so that computer hardware and software can process, analyse and measure various characteristics for decision making.

A vision system typically comprises lighting, a camera with a lens, an image sensor, a vision processing means, and communication means. The lens captures the image and presents it to the sensor in the form of light. The sensor in a machine vision camera converts this light into a digital image, which is then sent to the processor for analysis.

Lighting illuminates the part to be inspected and allows its features to stand out so they can be clearly seen by camera.

Processing may be accomplished by conventional processors, e.g. in a PC-based system, or in a standalone vision system, and is performed by software and may consist of several steps. First, an image is acquired from the sensor. In some cases, pre-processing may be required to optimize the image and ensure that all the necessary features stand out. 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.

The system of the invention comprises a first combined vision/imaging and picking station/zone (3), comprising one or more imaging devices (3A, etc.), located at an operational distance relative to the inlet conveyor belt (2) and the first receiving robot (4), and a second combined vision/imaging and picking station/zone (6), comprising one or more imaging devices (6A), located at an operational distance relative to the discharge conveyor belt (5C) of the foil wrapping station (5).

These imaging stations shall be in communication with the processing means (9), and shall be configured for recognition of i.a. the incoming transport box (2B), and for determination of the relative position of each of the meat products contained in the transport box (2B), for the first delivering robot (7) to pick up the wrapped meat product, and/or for determination of the relative position of the wrapped meat product for the second delivering robot (7) to pick up the wrapped meat product.

The vision hardware components for use according to the invention, such as sensors and processors, are commercially available, and machine vision systems can be assembled from single components, or purchased as an integrated system, with all components in a single device.

<u>The first (receiving) robot and the second (delivering) robot</u>

The system of the invention comprises a first receiving robot/manipulator (4), located at an operational distance relative to the first vision/imaging station (3), mounted with a working tool (4A), and configured for picking up and collect the incoming meat product (10) from the transport box (2B) and moving it to the supply conveyor belt (5B) of the foil wrapping station (5), and a second delivering robot/manipulator (7), mounted with a working tool (7A), and configured for picking up and collect the wrapped meat product from the discharge conveyor belt (5C) of the foil wrapping station (5) and moving it to the out-let conveyor belt (8).

Both robots, i.e. the first and the second robot, shall be in communication with the processing means (9), which processing means in turn is in operation with the one

or more imaging devices/cameras (3A, 6A) and configured for receiving and computing data obtained from these devices.

The robot for use according to the invention may be any available industrial robot e.g. gantry robots, free-arm robots, 6-axis robots, palletizing robots, flex-pickers, etc. In one embodiment, 6-axis, free-arm, robots, are used.

The foil wrapping station

The system of the invention comprises a foil wrapping station (5) comprising a foil wrapping machine (5A), a supply- (5B) and a discharge- (5C) conveyor belt, for receiving the unwrapped meat product, and configured for wrapping the meat product in foil, and transporting the wrapped meat product to the second vision/imaging station (6).

According to the invention, the foil wrapping machine (5A) shall be configured for wrapping the meat product using a substantially rectangular piece of foil (5D), that may be fed from a foil roll, which foil roll has a width greater than the length of the piece of meat (10) to be wrapped, whereby, after wrapping, the ends of the wrapping foil projects from the piece of wrapped meat.

Also, according to the invention, the packing zone (8A) of element g comprises an air nozzle (8B) configured for blowing an air stream emanating from below the conveyed meat product so that the ends of the wrapping foil projecting from the wrapped meat is blown upwards while the wrapped meat product is being moved from the out-let conveyor belt (8) and into the cardboard box (8C).

When these actions have been accomplished, the foil places itself/packs itself in the cardboard box (8C) so that any liquid originating from the meat product (10) remains within the wrapping.

Foil wrapping machines (5A) or individual firm wrapping machines (IWP) are commercially available from e.g. Marel, Denmark (Film Wrapper, Aranea), or from Frontmatec, Denmark (FWAL-150; FWAL-250).

The processing means

For automating processes, and guiding robots, etc., the system of the invention shall comprise one or more processing means (9). If two or more processing means are employed, these processors may be in inter-communication with each other.

The processing means (9) for use according to the invention shall be in function with the first imaging and picking station (3), and/or the second imaging and picking station (6), and/or the first receiving robot (4), and/or the second delivering robot (7), and configured for manipulating these robots.

Also, the processing means (9) for use according to the invention shall receive and compute data obtained from the one or more imaging devices/cameras (3A, 6A).

The processing means/controller/PC for use according to the invention may be any commercially available processor/PC, configured for communicating with the imaging stations (3, 6), the one or more imaging devices (3A, 6A), and in operation with, and capable of manipulating, the robots used according to the invention (4, 7).

In another embodiment, the system of the invention further comprises one or more sensors, placed within operational distance of the inlet conveyor belt (2) and/or the supply-conveyor belt (5B) and/or the discharge-conveyor belt (5C), and/or the outlet conveyor belt (8).

Working tools/end-effectors

A robotic end-effector is any object attached to the robot flange (wrist) that serves a function. This includes robotic grippers, robotic tool changers, robotic collision sensors, robotic rotary joints, robotic press tooling, compliance devices, robotic paint guns, material removal tools, robotic arc welding guns, robotic trans-guns, etc.

Robot end-effectors are also known as robotic peripherals, robotic accessories, robot tools, or robotic tools, end-of-arm tooling (EOA), or end-of-arm devices.

The working tool/end-effector for use according to the invention may be any commercially available working tool.

In one embodiment, the working tool/end-effector/end of arm tool of the first receiving robot (4) of the invention is the one illustrated in Fig. 5, which gripping tool may be characterised by comprising the following essential elements:

a. a connection means (4A1), for connection of the working tool to the first receiving robot (4);

b. a tool-base/fastening element/connection unit (4A2);

c. a coil spring for height adaptation, i.e., z-direction displacement (4A3);

d. a vacuum/suction cup connector unit suspended in ball joint (4A4); and

f. a suction cup (4A5).

In another embodiment, the working tool/end-effector (7A) of second delivering robot (7) for use according to the invention is the manipulatable pick-up/collecting/support means (7A) illustrated in Fig. 6, which gripping tool may be characterised by comprising the following essential elements:

a. pick-up/collecting/supporting plate (7A1), for picking up, supporting, and lifting a meat product (10);

b. linear aktuator (7A2) for advancing and retracting the supporting plate (7A1); and

c. tool base/fastening element/connection unit (7A3) for attachment to the second delivering robot (7).

The working tool/end-effector of the invention

The system of the invention may be equipped with conventional gripping tools. However, due to their physical properties, often being soft, flexible, shapeless, and slippery, meat products, whether unwrapped ort wrapped, generally are considered difficult to handle by standard gripping tools.

Therefore, the working tools/end-effectors for use according to the invention for picking up and collecting unwrapped or wrapped meat products should be carefully selected among gripping tools especially suited for handling meat objects.

The method of the invention

In another aspect, the invention relates to a method, for use at for use at slaughterhouses/abattoirs or in the meat packing industry, for automatic packaging of a meat product (10) in waterproof foil (5D), and subsequent placement of the wrapped meat product in cardboard boxes (8C).

The method of the invention comprises the subsequent steps of:

i. supplying incoming, unwrapped, meat products, arriving in boxes (2B), to a first combined imaging and picking station (3), which imaging station comprises one or more imaging devices (3A, etc.), is located at the supply end of a supply conveyor belt (5B) of a foil wrapping station (5), and within operational distance relative to a first receiving robot (4), and which imaging station is in communication with a processing means (9), and configured for recognition of the incoming transport box (2B), and for determination of the relative position of each of the meat products contained in the transport box (2B);

ii. obtaining one or more images of the incoming, unwrapped, meat product, located in the transport box (2B), by use of the one or more imaging devices (3A, etc.) of the first imaging station, for analysis and computation by the processing means (9), and for communication to a first receiving robot (4);

iii. picking up and collect the unwrapped meat product from the transport box (2B), by manipulation of a first receiving robot (4), located at an operational distance relative to the first combined imaging and picking station (3), which robot is in communication with the processing means (9), is mounted with a working tool (4A), and configured for picking up and collect the unwrapped meat product from the incoming transport box (2B) and moving it to the supply conveyor belt (5B) of the foil wrapping station (5);

iv. supplying the unwrapped meat product to a foil wrapping station (5), configured for receiving the unwrapped meat product, wrapping the meat product in a foil

(5D) using a foil wrapping machine (5A), configured for wrapping the meat product using a substantially rectangular sheet of foil (5D), which foil has a width greater than the length of the piece of meat (10) to be wrapped, whereby, after wrapping, the ends of the wrapping foil (10B') projects from the piece of wrapped meat; and

which method is *characterised by* further comprising the subsequent steps of:

v. moving the wrapped meat product to a second combined imaging and picking station (6), located within operational distance relative to the discharge end of the foil wrapping station (5);

vi. obtaining one or more images of the wrapped meat product, by use of the one or more imaging devices (6A) of the second imaging station (6), for analysis by the processing means (9), and for communication to a second delivering robot (7);

vii. picking up and collect the wrapped meat product by manipulation of the second delivering robot (7), located within operational distance relative to the discharge end of the foil wrapping station (5), which robot (7) is in communication with the processing means (9), is mounted with a working tool (7A) configured for picking up and collect the wrapped meat product from discharge end of the foil wrapping station (5); and

viii. delivering the wrapped meat product to a packing zone (8A) comprising air nozzle means (8B) configured for blowing an air stream emanating from below the wrapped meat product, so that the ends of the wrapping foil (10B') projecting from the wrapped meat product is blown upwards while the wrapped meat product, by the action of the second delivering robot (7), is being immersed into the cardboard box (8C), to ensure that liquid originating from the meat product (10) remains within the foil wrapping and do not contaminate the cardboard box (8C).

In another embodiment, the method of the invention additionally comprises the use of an inlet conveyor belt (2), optionally in communication with the processing means (9), for supply of meat products, arriving in a transport box (2B) and delivery to a first combined imaging and picking station (3).

In a third embodiment, the method of the invention additionally comprises the use of an out-let conveyor belt (8), optionally in communication with the processing means (9), comprising the packing zone (8A), for receipt of the wrapped meat product and placement of the wrapped meat product into cardboard boxes (8C) for further redistribution.

In a fourth embodiment, the method of the invention additionally comprises the use of one or more sensors, in communication with the processing means (9), and placed within operational distance of the inlet conveyor belt (2), and/or the supply-conveyor belt (5B), and/or the discharge-conveyor belt (5C), and/or the out-let conveyor belt (8), for tracking the incoming meat products (10), including unwrapped

meat products, and/or plastic transport boxes (2B), and/or wrapped meat products, and/or cardboard boxes (8C).

The meat products

The system of the invention may be applied to various meat products, normally processed at slaughterhouses or in the meat packing industry.

Examples of meat products (10) contemplated according to the invention include e.g. pork belly, pork middle, pork neck, back-rib, fore-ends, shoulders, ham and leg.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig. 1 shows an example of the robotic packing system/packing station/packing plant of the invention: Inlet conveyor belt (2); Transport direction of inlet conveyor (2'); First picking station (2A); Plastic transport box/SKF box (2B); First combined vision/imaging and picking station/zone (3); First receiving robot/manipulator (4);Foil wrapping station (5); Second vision/imaging and picking station/zone (6); Second delivering robot/manipulator (7); Working tool/end-effector (7A); Out-let conveyor belt (8); Transport direction of out-let conveyor (8'); Packing station (8A); Cardboard boxes (8C); Processing means (9);

Fig. 2 shows an example of the robotic packing system/packing station/packing plant of the invention: First picking station (2A); First combined vision/imaging and picking station/zone (3); Imaging device/camera (3A); First receiving robot/manipulator (4); Working tool/end-effector (4A); Foil wrapping machine (5A); Supply conveyor belt (5B); Discharge conveyor belt (5C); Second vision/imaging and picking station/zone (6); Imaging device/camera (6A); Second delivering robot/manipulator (7); Working tool/end-effector (7A); Out-let conveyor belt (8); Packing station (8A); Cardboard boxes (8C);

Fig. 3 shows an example of the robotic packing system/packing station/packing plant of the invention: Inlet conveyor belt (2); First picking station (2A); First combined vision/imaging and picking station/zone (3); First receiving robot/manipulator (4); Working tool/end-effector (4A); Foil wrapping machine (5A); Supply conveyor belt (5B); Discharge conveyor belt (5C); Second vision/imaging and picking station/zone (6); Second delivering robot/manipulator (7); Working tool/end-effector (7A); Out-let conveyor belt (8); Packing station (8A); Cardboard boxes (8C);

Figs. 4A and 4B show a closer view of a part the robotic packing system/packing station/packing plant of the invention comprising the air nozzle means (A): Discharge

conveyor belt (5C); Second delivering robot/manipulator (7); Working tool/end-effector (7A); Out-let conveyor belt (8); Packing station (8A); Air nozzle means (8B);

Fig. 5 shows an example of a working tool/end-effector (4A) of first receiving robot (4) for use according to the invention: Connection means (4A1); Tool-base/fastening element/connection unit (4A2); Coil spring for height adaptation, i.e., z-direction displacement (4A3); Vacuum/suction cup connector unit suspended in ball joint (4A4); suction cup (4A5); Connection to vacuum-provider (4A6);

Fig. 6 shows an example of a working tool/end-effector (7A) of second delivering robot (7) for use according to the invention:

a. pick-up/collecting/supporting plate (7A1), for picking up, supporting, and lifting a meat product (10);

b. linear aktuator (7A2) for advancing and retracting the supporting plate (7A1);

c. tool base/fastening element/connection unit (7A3) for attachment to the second delivering robot (7); and

Figs. 7A and 7B illustrate the principle of wrapping a meat product in foil (5D) in such a way that foil protrudes from the ends of the wrapped meat product (10) and, by help of an air stream originating from the air nozzle means (8B), the foil ends (10B') are blown upwards, allowing any liquids to remain inside the wrapping while the product is later stored.

List of reference signs

This is a listing of various elements relating to the present invention. Alternative/synonymous designations are separated by slashes.

1	The robotic packing system/packing station/packing plant
2	Inlet conveyor belt
2'	Transport direction of inlet conveyor
2A	First picking station
2B	Transport box/plastic transport box/SKF box
3	First vision/imaging station/zone
3A	Imaging devices/one or more cameras
4	First receiving robot/manipulator
4A	Working tool/end-effector/end of arm tool of first receiving robot (4)
4A1	Connection means, for connection to the flange of the first receiving robot (4)
4A2	Tool base/fastening element/connection unit
4A3	Coil spring for height adaptation, i.e., z-direction displacement
4A4	Vacuum/suction cup connector unit suspended in ball joint
4A5	Suction cup

4A6	Connection to vacuum-provider
5	Foil wrapping station
5A	Foil wrapping machine/IWP machine
5B	Supply conveyor belt
5C	Discharge conveyor belt
5D	Foil/plastic foil
5E	Foil roll
6	Second vision/imaging station/zone
6A	Imaging devices/one or more cameras
7	Second delivering robot/manipulator
7A	Working tool/end-effector/end of arm tool of second delivering robot (7)
7A1	Tool base/fastening element/connection unit
7A2	Linear aktuator
7A3	Tool base/fastening element/connection unit
8	Out-let conveyor belt
8′	Transport direction of out-let conveyor
8A	Packing station
8B	Air nozzle means
8C	Cardboard boxes
9	Processing means
10	Meat product/work piece
10B′	Wrapping foil protruding the ends of the wrapped meat product

Patentkrav

1. **Et robotpakkesystem**, til brug på slagterier eller i kødpakkeindustrien, til automatisk emballering af et kødprodukt (10) i folie og efterfølgende anbringelse af det indpakkede kødprodukt i papkasser (8C), hvilket pakkesystem omfatter følgende elementer:

a. **en primær kombineret billedgenkendelses- og plukkestation** (3), hvilken billedgenkendelses-station omfatter en eller flere billedgenkendelses anordninger (3A, etc.), er placeret ved tilførselsenden af et forsyningstransportbånd (5B) for en folieindpakningsstation (5) og inden for driftsafstand i forhold til en primær modtagende robot (4), og hvilken billedgenkendelses-station er i kommunikation med et procesbehandlingsmiddel (9) og er konfigureret til genkendelse af en indkommende transportkasse (2B) og til bestemmelse af den relative position for ethvert kødprodukt indeholdt i transportkassen (2B);

b. **den primære modtagende robot** (4), som er placeret i en driftsafstand i forhold til den primære kombinerede billedgenkendelses- og plukkestation (3), hvilken robot er i kommunikation med procesbehandlingsmid7let (9), er monteret med et arbejdsværktøj (4A), og er konfigureret til at opsamle og indsamle kødproduktet (10) fra den indkommende transportkasse (2B) og flytte det til forsyningstransportbåndet (5B) af folieindpakningsstationen (5);

c. **folieindpakningsstationen** (5), som omfatter en folieindpakningsmaskine (5A), et forsynings- (5B) og et frigivelses- (5C) transportbånd til modtagelse af det uindpakkede kødprodukt, og som er konfigureret til at pakke kødproduktet under anvendelse af et i det væsentlige rektangulær folie-ark (5D), der leveres fra en folierulle, hvilken folierulle har en bredde, der er større end længden af det kødprodukt (10) der skal pakkes ind, hvorved enderne af indpakningsfolien efter indpakning (10B') stikker ud fra det indpakkede kødstykke; og

d. **procesbehandlingsmidlet** (9), som er i funktion med den primære billedgenkendelsesstation (3), den primære modtagende robot (4), og som er konfigureret til at behandle data opnået fra den primære billedgenkendelsesstation (3), og til at manipulere den primære modtagende robot (4);

hvilket system er *kendetegnet ved* yderligere at omfatte de følgende elementer:

e. **en sekundær kombineret billedgenkendelses- og plukkestation** (6) omfattende en eller flere billedgenkendelses anordninger (6A, 6B, etc.), som er placeret ved frigivelsesenden af transportbåndet (5C) af folieindpakningsstationen (5), og inden for driftsafstand i forhold til en sekundær afleveringsrobot (7), hvilken billedgenkendelsesstation er i forbindelse med procesbehandlingsmidlet (9), og er konfigureret til genkendelse af det indpakkede kødprodukt og til bestemmelse af den

relative position af det indpakkede kødprodukt på frigivelsestransportbæltet (5C) til den sekundære afleveringsrobot (7) til at opsamle det indpakkede kødprodukt; og

f. **den sekundære afleveringsrobot** (7), som er i kommunikation med procesbehandlingsmidlet (9), monteret med et arbejdsværktøj (7A), og er konfigureret til at opsamle og indsamle det indpakkede kødprodukt fra den sekundære kombinerede billedgenkendelses- og plukkestation (6) som er placeret ved frigivelsestransportbåndet (5C) af folieindpakningsstationen (5), til aflevering af det indpakkede kødprodukt til en emballeringszone (8A);

og hvor forsynings- (5B) og frigivelses- (5C) transportbåndet af element c er konfigureret til at transportere et indpakket kødprodukt til den sekundære kombinerede billeddannelses- og plukkestation (6);

procesbehandlingsmidlet (9) er i funktion med den sekundære billedgenkendelsesstation (6) og/eller den sekundære afleveringsrobot (7) og er konfigureret til at behandle data opnået fra den sekundære billedgenkendelsesstation og til at manipulere den primære modtagende robot (4); og

emballeringszonen (8A) af element f omfatter **en luft-dyse anordning** (8B), som er konfigureret til at blæse en luftstrøm der udgår fra under det transporterede kødprodukt, således at enderne af indpakningsfolien (10B'), der stikker ud fra det indpakkede kødprodukt, blæses opad, mens det indpakkede kødprodukt ved påvirkning af den sekundære afleveringsrobot (7) nedsænkes i papkassen (8C);

således at indpakningsfolien (10B'), der stikker ud fra det indpakkede kødprodukt, placerer sig/pakker sig oven på det indpakkede kødprodukt i papkassen (8C), til sikring for at væske fra kødproduktet (10) forbliver i folieindpakningen.

2. Robotpakkesystemet ifølge krav 1, hvilket system yderligere omfatter **et indløbstransportbånd** (2), eventuelt i kommunikation med procesbehandlingsmidlet (9), til tilførsel af kødprodukter som ankommer i transportkassen (2B) og afleveres til den primære kombinerede billedgenkendelses- og plukkestation (3).

3. Robotpakkesystemet ifølge krav 1, hvilket system yderligere omfatter et afledningstransportbånd (8), eventuelt i forbindelse med procesbehandlingsmidlet (9), som omfatter emballeringszonen (8A), til modtagelse af det indpakkede kødprodukt og placering af det indpakkede kødprodukt i papkasserne (8C) for videre fordeling.

4. Robotpakkesystemet ifølge krav 1, hvilket system yderligere omfatter **en eller flere sensorer** (13A, 13B, etc.), som er i kommunikation med procesbehandlingsmidlet (9) og er placeret inden for driftsafstand fra indløbstransportbåndet (2), og/eller forsyningstransportbåndet (5B), og/eller

frigivelsestransportbåndet (5C), og/eller afledningstransportbåndet (8), til sporing af de indkommende kødprodukter (10), inklusive de uindpakkede kødprodukter og/eller plasttransportkasserne (2B), og/eller de indpakkede kødprodukter og/eller papkasserne (8C).

5. En metode til anvendelse på slagterier eller i kødpakningsindustrien, til automatisk emballering af kødprodukter (10) i vandtæt folie (5D), og efterfølgende anbringelse af det indpakkede kødprodukt i en papkasse (8C), hvilken metode omfatter de efterfølgende trin:

i. levering af de indkommende, uindpakkede kødprodukter, der ankommer i en transportkasse (2B), til en primær kombineret billedgenkendelses- og plukkestation (3), hvilken billedgenkendelsesstation omfatter en eller flere billedgenkendelses anordninger (3A, osv.), er placeret ved tilførselsenden af et forsyningstransportbånd (5B) af en folieindpakningsstation (5), og inden for driftsafstand i forhold til en primær modtagende robot (4), og hvilken billedgenkendelsesstation er i kommunikation med et procesbehandlingsmiddel (9) og er konfigureret til genkendelse af den indkommende transportkasse (2B) og til bestemmelse af den relative position af hvert af kødprodukterne som er indeholdt i transportkassen (2B);

ii. opnåelse af et eller flere billeder af det indkommende, uindpakkede kødprodukt, som er placeret i transportkassen (2B), ved brug af en eller flere billedgenkendelses anordninger (3A, osv.) i den primære billedgenkendelsesstation til analyse og beregning af procesbehandlingsmidlet (9) og til kommunikation til den primære modtagende robot (4);

iii. opsamling og indsamling af det uindpakkede kødprodukt fra transportkassen (2B) ved manipulation af den primære modtagende robot (4), der er placeret i en driftsafstand i forhold til den primære kombinerede billedgenkendelses- og plukkestation (3), hvilken robot er i kommunikation med procesbehandlingsmidlet (9), er monteret med et arbejdsværktøj (4A), og er konfigureret til at opsamle og indsamle det uindpakkede kødprodukt fra den indkommende transportkasse (2B) og flytte det til forsyningstransportbåndet (5B) på folieindpakningsstationen (5);

iv. levering af det uindpakkede kødprodukt til folieindpakningsstationen (5), som er konfigureret til at modtage det uindpakkede kødprodukt, indpakning af kødproduktet i den vandtætte folie (5D) ved hjælp af en folieindpakningsmaskine (5A), konfigureret til indpakning af kødproduktet ved hjælp af et i det væsentlige rektangulært folie-ark (5D), hvilken folie har en bredde, der er større end længden af det kødstykke (10), der skal indpakkes, hvorved enderne af indpakningsfolien (10B') efter indpakning stikker ud fra stykket af indpakket kød; og

hvilken metode er *karakteriseret ved* yderligere at omfatte de på hinanden følgende trin:

v. at flytte det indpakkede kødprodukt til en sekundær kombineret billedgenkendelses- og plukkestation (6), placeret inden for driftsafstand i forhold til frigivelsesenden af folieindpakningsstationen (5);

vi. opnåelse af et eller flere billeder af det indpakkede kødprodukt ved brug af en eller flere billedgenkendelses anordninger (6A, 6B, etc.) af den sekundære billedgenkendelsesstation (6), til analyse ved hjælp af procesbehandlingsmidlet (9) og til kommunikation til en sekundær afleveringsrobot (7);

vii. opsamling og indsamling af det indpakkede kødprodukt ved manipulation af den sekundære afleveringsrobot (7), der er placeret inden for driftsafstand i forhold til frigivelsesenden af folieindpakningsstationen (5), hvilken robot (7) er i forbindelse med procesbehandlingsmidlet (9), som er monteret med et arbejdsværktøj (7A), der er konfigureret til at opsamle og indsamle det indpakkede kødprodukt fra frigivelsesenden af folieindpakningsstationen (5); og

viii. aflevering af det indpakkede kødprodukt til en pakkezone (8A) som omfatter en luft-dyse anordning (8B), der er konfigureret til at blæse en luftstrøm, der udgår fra under det indpakkede kødprodukt, således at enderne af indpakningsfolien (10B') stikker ud fra det indpakkede kødprodukt blæses opad, mens det indpakkede kødprodukt ved påvirkning af den sekundære afleveringsrobot (7) nedsænkes i papkassen (8C), for at sikre, at væske, der stammer fra kødproduktet (10), forbliver i folieindpakningen og foruren ikke papkassen (8C).

6. Fremgangsmåden ifølge krav 5, hvilken fremgangsmåde yderligere omfatter anvendelsen af et indløbstransportbånd (2), eventuelt i forbindelse med procesbehandlingsmidlet (9), til levering af kødprodukterne, der ankommer i transportkassen (2B) og aflevering til den primære kombinerede billedgenkendelses- og plukkestation (3).

7. Fremgangsmåden ifølge krav 5, hvilken fremgangsmåde yderligere omfatter anvendelsen af et afledningstransportbånd (8), eventuelt i forbindelse med procesbehandlingsmidlet (9), som omfatter pakkezonen (8A), til modtagelse af det indpakkede kødprodukt og placering af det indpakkede kødprodukt i papkasser (8C) for yderligere distribution.

8. Fremgangsmåden ifølge krav 5, hvilken fremgangsmåde yderligere omfatter anvendelsen af en eller flere sensorer (13A, 13B, etc.), i forbindelse med procesbehandlingsmidlet (9), og placeret inden for driftsafstand fra

indløbstransportbåndet (2), og/eller forsyningstransportbåndet (5B), og/eller et frigivelsestransportbånd (5C), og/eller afledningstransportbåndet (8), til sporing af de indkommende kødprodukter (10), inkl. de uindpakkede kødprodukter og/eller plasttransportkasserne (2B), og/eller de indpakkede kødprodukter, og/eller papkasserne (8C).

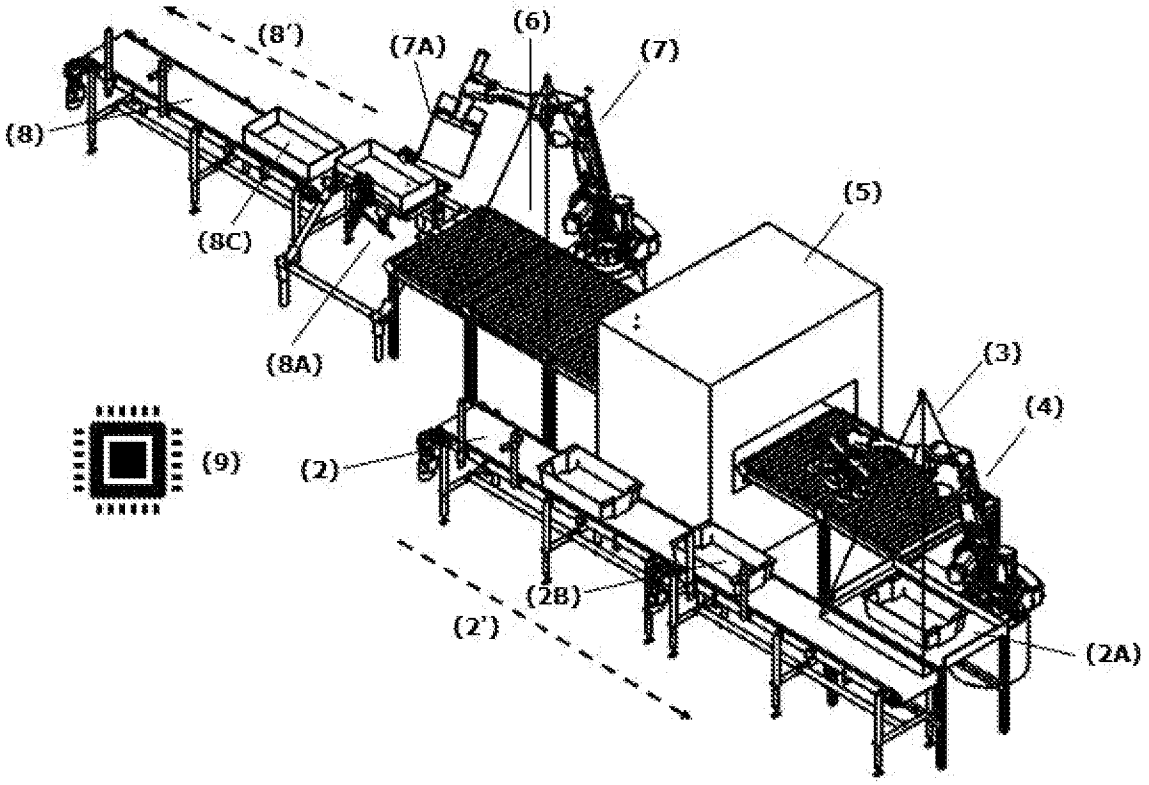

Fig. 1

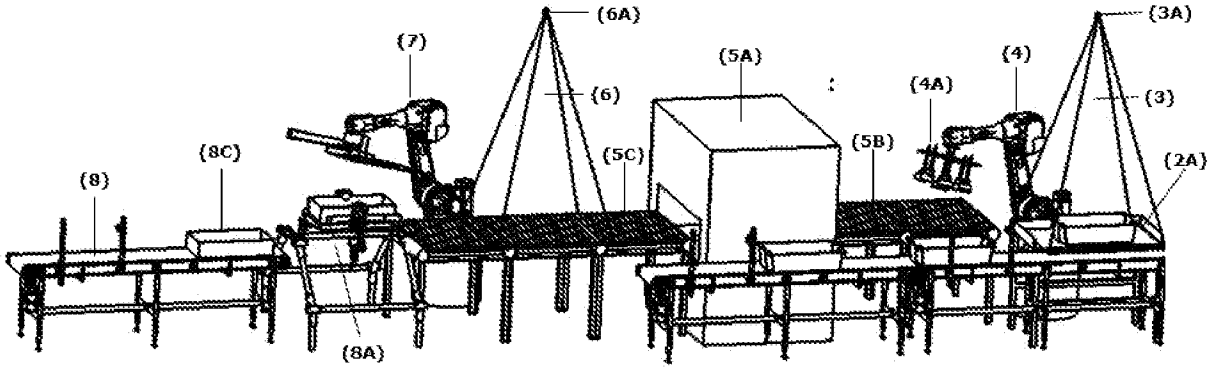

Fig. 2

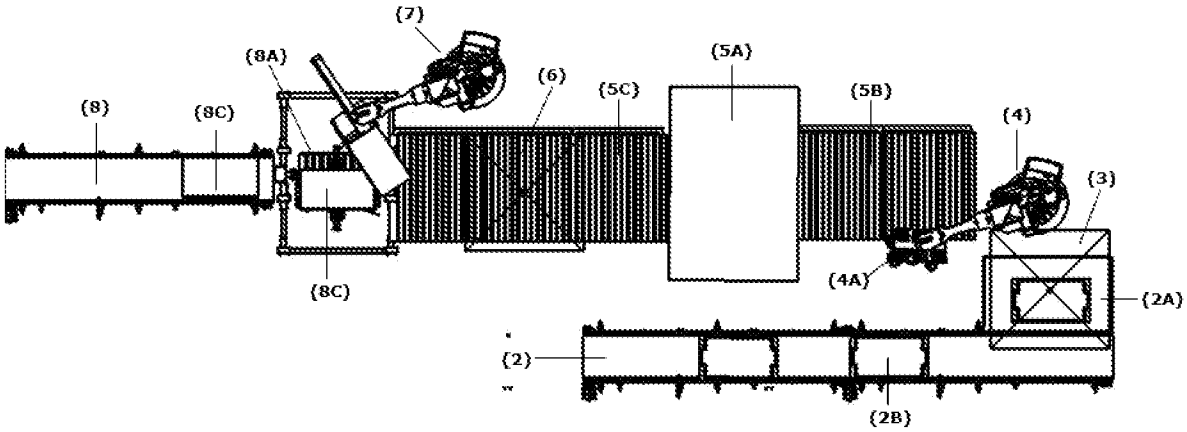

Fig. 3

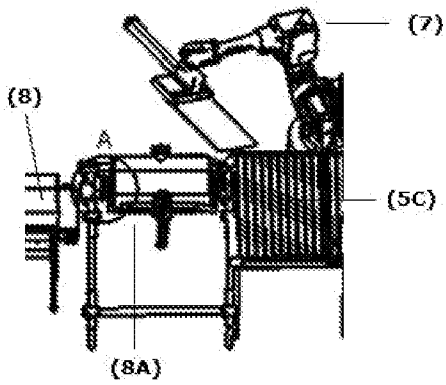

Fig. 4A

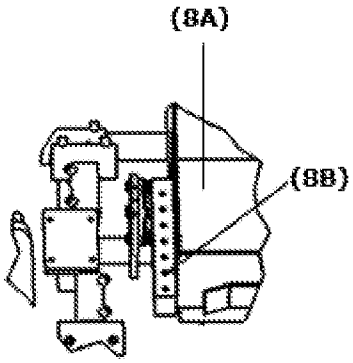

Fig. 4B

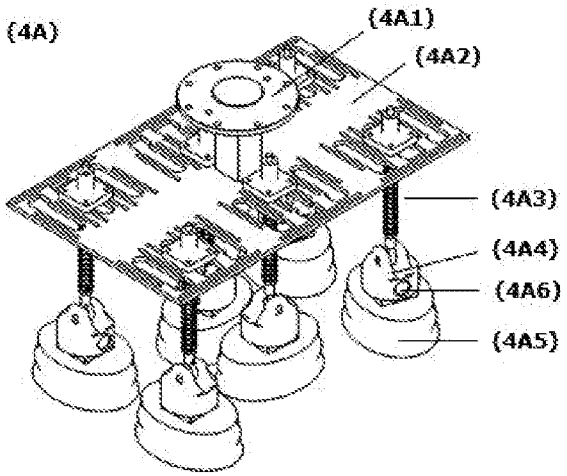

Fig. 5

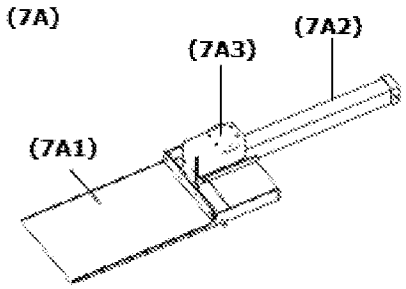

Fig. 6

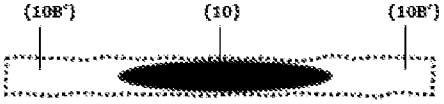

Fig. 7A

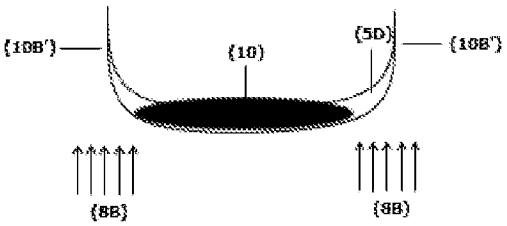

Fig. 7B

DANISH PATENT AND TRADEMARK OFFICE

SEARCH REPORT - PATENT	Application No. PA 2021 00030

1. ☐ Certain claims were found unsearchable (See Box No. I).

2. ☐ Unity of invention is lacking prior to search (See Box No. II).

A. CLASSIFICATION OF SUBJECT MATTER

B65B 25/06 (2006.01), B25J 9/00 (2006.01), B65B 5/04 (2006.01), B65B 59/00 (2006.01), B65G 47/90 (2006.01)

According to International Patent Classification (IPC)

B. FIELDS SEARCHED

PCT-minimum documentation searched (classification system followed by classification symbols)

IPC/CPC: B25J, B65B, B65G

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

DK, NO, SE, FI: IPC-classes as above.

Electronic database consulted during the search (name of database and, where practicable, search terms used)

EPODOC, WPI, FULLTEXT (ENGLISH)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant for claim No.
A	US 2015/059290 A1 (EWERT, B et al.) 5 March 2015 See paragraphs [0017]-[0024] and figure 1	1-8
A	JP 2007/210677 A (FURUKAWA SEISAKUSHO KK) 23 July 2007	1-8
A	US 3024114 A (MCCONVILLE, T P) 6 March 1962	1-8
A	GB 2330819 A (CRADDOCK, W G V) 5 May 1999	1-8

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

* Special categories of cited documents:	"P" Document published prior to the filing date but later than the priority date claimed.
"A" Document defining the general state of the art which is not considered to be of particular relevance.	"T" Document not in conflict with the application but cited to understand the principle or theory underlying the invention.
"D" Document cited in the application.	"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.
"E" Earlier application or patent but published on or after the filing date.	"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.
"L" Document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified).	"&" Document member of the same patent family.
"O" Document referring to an oral disclosure, use, exhibition or other means.	

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08 June 2021

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SEARCH REPORT - PATENT		Application No. PA 2021 00030
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant for claim No.

SEARCH REPORT - PATENT	Application No. PA 2021 00030

Box No. I Observations where certain claims were found unsearchable

This search report has not been established in respect of certain claims for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched, namely:

2. ☐ Claims Nos.:
because they relate to parts of the patent application that do not comply with the prescribed requirements to such an extent that no meaningful search can be carried out, specifically:

3. ☐ Claims Nos.:
because of other matters.

Box No. II Observations where unity of invention is lacking prior to the search

The Danish Patent and Trademark Office found multiple inventions in this patent application, as follows:

SEARCH REPORT - PATENT	Application No. PA 2021 00030
SUPPLEMENTAL BOX	
Continuation of Box [.]	