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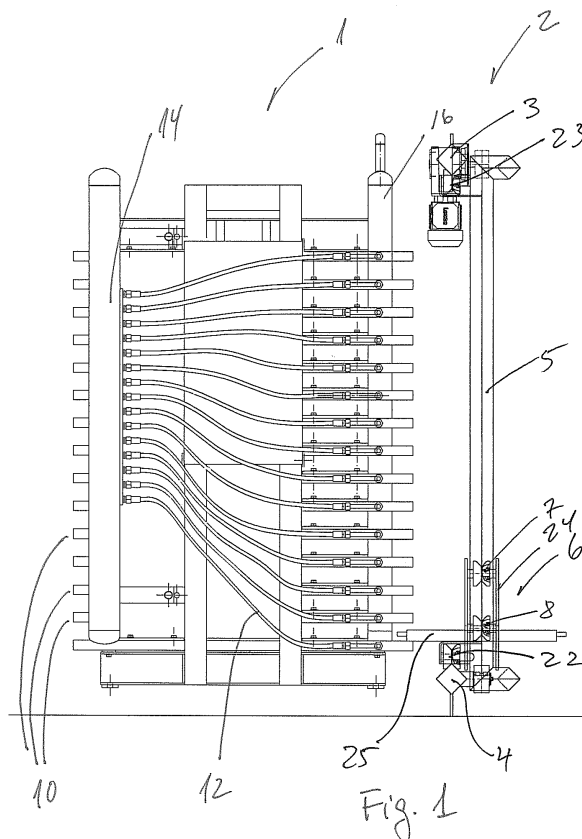
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(54) **Freezer including a robot**

(57) Installation for automatic loading and unloading of one or more plate freezers, where the installation comprises a first loading and unloading robot (2), where said robot comprises means for placing and/or removing the objects to be frozen

where the one or more freezers (1) may be loaded and unloaded from the same or opposite sides where the robot (2) is manoeuvrable along the loading/unloading side of the freezers, and further that the objects to be frozen has a depth corresponding to half the distance between the opposite sides of the freezer.



Description

Field of the Invention

[0001] The present invention relates to an installation for automatic loading and unloading of one or more horizontal plate freezers.

Background of the Invention

[0002] Horizontal plate freezers as such are known in the art and are mainly used for freezing products already packaged in boxes or the like. In the art also vertical plate freezers are known. Apart from the freezing elements, that is to say the elements which provides the freezing effect are arranged horizontally in a horizontal plate freezer, as opposed to the vertical arrangement of the freezing plates in a vertical plate freezer, the operation of these two types of freezers is very different. Reference hereafter will be made to a plate freezer which shall be understood as a freezer having horizontally oriented freezing plates.

[0003] In this application the invention will be explained with reference to the use of plate freezers in the fish industry, but it should, however, be obvious that the present invention may be applied to any industry where comparable products are to be frozen industrially.

[0004] A plate freezer is typically built by horizontally arranging a number of freezing plates one on top of the other where spacing means are arranged between each plate. By placing the object to be frozen on a plate and lowering the plate above, the object to be frozen is thereby arranged in between and in thermal contact with two active freezing plates, such that contact freezing is provided. By both having the lower and upper plates in thermal contact with the object to be frozen, a relatively effective freezing process may be achieved. In the art a number of different plate freezers are known, but common to all of them is the basic principle of cooling the freezing plates, whereby the thermal energy from the products may be removed in order to freeze the products placed on the freezing plates. Different means for elevating and separating the freezing plates are suggested in a number of different plate freezer constructions. For the scope of the present invention the detailed construction of the plate freezer is not interesting, but preferred freezers have a hydraulic system in order to elevate the freezing plates and thereby releasing the objects to be frozen.

[0005] An example of a horizontal plate freezer is disclosed in US 4,553,406 where a number of freezing plate elements are arranged superposed one above the other in a stack. Means are provided for relative elevating one plate member relative to the plate immediately above or below, in order to allow access to the frozen products or in order to place products to be frozen in the freezer. Furthermore means are provided for automatically emptying/filling the freezer.

[0006] The typical dimension of a plate freezer provides for plates which are 2-2.5 m wide and 1-1.5 m deep. Usually, the trays or crates used for freezing the products will have a width a fraction of the width of the freezer, but a length corresponding to the depth of the freezer, i.e. 1-1.5 m. Typically, the height of each tray will be approximately 5-10 cm, such that when the product to be frozen is fish, each tray will contain 15-20 kg of fish. These sizes are usually selected such that workers may handle the trays in a rational manner.

[0007] Traditionally, these types of freezers are used for onboard freezing on fishing vessels where the fish are pre-processed, frozen and put in a storage freezer until further handling on land. The arrangement of freezers on the factory deck of these types of vessel requires a substantial amount of space in that typically five freezers will be arranged on each ship in order to be able to provide enough freezing capacity such that rational and continuous production on the factory deck may be achieved.

[0008] With the block sizes mentioned above, i.e. each tray containing 15-20 kg, a thorough freezing of these trays usually takes approximately three hours per freezer. Therefore, it is necessary to have a number of freezers in order to be able to have at least one freezer which at all times is more or less empty in order to be able to arrange the trays in the freezer, a couple of freezers which are actively freezing the products and then a couple of freezers which are open and in the process of being emptied. In this manner of production usually five freezers are acknowledged as being the minimum amount of freezers in order to be able to provide the freezing capacity necessary for a continuous production of frozen fish.

[0009] As space is at a premium on board fishing vessels, the space allocated around the freezers is kept at a minimum. This, however, requires that the freezer itself which typically takes up 2.5 by 1.5 m also needs a zone in front and possibly behind the freezer of the same size in order to be able to load and unload the trays as well as a room to manoeuvre and space for freezer equipment such as pipes, valves etc, such that altogether one freezer requires between three and four times its own effective freezing area in order for the people operating the freezers to be able to carry out the tasks.

Object of the Invention

[0010] It is an object of the present invention to provide an installation where the space requirements are minimized and where the heavy load put on the workers handling the 15-20 kg or more heavy trays is drastically reduced in order to improve the overall working environment.

Description of the Invention

[0011] The present invention addresses this by provid-

ing an installation for the automatic loading and unloading of one or more horizontal plate freezers, where the installation comprises a first loading and unloading robot, where said robot comprises means for placing and/or removing the objects to be frozen; where one or more freezers may be loaded and unloaded from the same or opposite sides and where the robot is manoeuvrable along the loading/unloading side of the freezer and further that the objects to be frozen has a depth corresponding to half the distance between the opposite sides of the freezer.

[0012] Firstly the installation of a robot which may be manoeuvred, i.e. programmed to travel along the loading and/or unloading side of one or more freezers, and respectively place or remove the objects to be frozen such as trays from the plates at all elevations in the freezer will drastically reduce the need for manpower during this stage of the process. This in turn limits the workers exposure to injuries and possible wear stresses and strains. The robot will be able to handle trays at all elevations such that the horizontal plate freezers in theory may have any height. This is not possible where the freezers has to be filled/emptied by manual means, as there are limits to the unaided reach, and that lifting objects repeatedly from low elevations or high elevations has proven to cause work related injuries. By having overcome this hurdle, due to the implementation of a robot, the area may be utilised more effectively, as the freezer designer is not bound by height-wise limitations, and therefore may design the freezer without regard to these aspects.

[0013] The use of trays having the dimensions mentioned above is a compromise between how much fish a single tray may accommodate, how much weight may be lifted and handled by a worker, and how thick a layer of product such as fish may be frozen rationally as well as other factors.

[0014] The thickness of the layer of product is determined by the freezing capability of the freezer, as the products are in thermal contact, such that the ability to remove heat between the plate surface and the product determines the freezing ability. As the working principle of horizontal plate freezers is thermal conductivity, it is important to have contact with as much of the product as possible, therefore, very thick layers of product is undesirable. On the other hand, for handling purposes it is desirable to have a certain thickness and a block size corresponding to a tray size that may rationally be handled by a worker. Over time trays having a depth of 1.5 - 2 m, approximately 25 - 30 cm in width and 5 - 8 cm in depth have been developed so that the effective load, which a worker has to handle, will be in the range of 15-20 kg. If trays that are longer and narrower contain the same amount of fish, it will be harder to handle the trays and likewise, if the trays are deeper, so that the thickness of the fish layer will increase, it will take longer time to reach a satisfactory thorough freezing of the product, which will reduce the capacity of the installation. If the trays were smaller, the worker would have to reach inside the freez-

er, which may be possible at normal working heights between waist height and shoulder height. However, below and above these heights, it is very difficult to reach trays in the second or even the third row, had the freezer had a sufficient depth in this direction. Therefore, trays that have the dimensions as mentioned above have been developed.

[0015] However, with the present invention trays having half the depth of traditional trays and half the depth of the freezer may advantageously be used as the space in front or behind the freezer may be limited to the length of the tray, as the robot will be able to reach for trays or placing trays in the second row without being exposed to the strange limitations to which a human worker will be subjected to. In addition to the space saving, as only half as much space is needed in front and behind the freezers, the invention also provides further advantages because the overall space requirements on the entire factory deck may be utilized as the trays are smaller and thereby easier to handle in a limited space.

[0016] In a further advantageous embodiment of the invention an array of substantially identical freezers are arranged, where the freezers' loading and/or unloading sides are arranged along the same axis, and where guidance means for guiding the robot along the array of freezers are arranged parallel to the axis along which the freezers are arranged,

and further that the robot(s) are arranged on rails on either side of an array of freezers, and that on the other side of the rails from the freezers, conveyor belts are arranged

[0017] With this arrangement one robot may service a number of freezers. As already explained above, it is often advantageous to have five freezers arranged in an array in order to maintain a continuous production process with enough capacity. During a production cycle it approximately takes 3 hours for a conventional plate-freezer to freeze fish arranged in a tray. Thus, five freezers provides for one freezer being in the process of being emptied, one freezer being in the process of being filled and three freezers in the process of freezing the products. In this manner, it is always possible to maintain a steady production at the factory deck. By arranging the robot i.e. mounted on rails on the floor and in the ceiling along the front side of the array of freezers, one robot may service the whole array of freezers, in respect to loading as well as in respect to unloading. Furthermore, the embodiment foresees a factory layout where more and/or larger freezers are used so one robot will only be able to carry out the loading process and a second robot will carry out the unloading process. In these layouts it may be desirable to either have two robots mounted on the same side of the freezers where one robot is designated loading-robot and the second robot is designated unloading-robot and at the production cycle progresses the designations may switch depending on which freezers are to be loaded or unloaded. In this manner, it is not necessary to provide the robots with the facilities to pass each other on the

rails. Alternatively, the array of freezers may be arranged on the factory deck so that it is possible to have one robot travelling on the front side of the freezers and a second robot travelling on the rear side of the freezer so that the robot travelling in front of the freezers will be the loading-robot and the robot travelling on the rear side will be the unloading-robot.

[0018] Further embodiments provides additional advantages such as the means for placing and/or removing the objects to be frozen provided in connection with the robot are operable in three dimensions: in a first dimension along guiding means arranged parallel to the loading/unloading side of the freezers; in a second dimension perpendicular to the guidance means and parallel to the loading/unloading side of the freezers, in a third dimension perpendicular to the loading/unloading side of the freezers, and that

a second robot is provided, and where the first robot is designated loading robot and the second robot designated unloading robot, where said first robot is arranged for travel along the loading side of an array of plate freezers and the second robot is arranged for travel along the unloading side of the array of plate freezers, where both robots comprises means for engaging and moving the objects to be frozen into or out of respectively the plate freezer, according to pre-programmed routines.

[0019] In a still further preferred advantageous embodiment of the invention the objects to be frozen are provided with unique electronic identification tags, where a central computer collects data relating to each tag. The tags may be programmed and applied to the objects according to one or more of the following characteristics: size of the object, species, date, time, freezer identification number, duration and/or intensity of freezing, catch position and catch time.

[0020] By providing each tray or batch of fish with an electronic tag in theory it is possible to track each fish from it is caught until it is sold in the supermarket. The computer system may correlate the tag with position and time data from the fishing vessels navigational system together with information concerning the species of fish so that the unique parameters follow that particular fish throughout the entire process. Data from the production line i.e. freezing cycles etc. may also be added to the unique tag attached to the particular tray or batch of fish.

[0021] As an alternative to provide each object to be frozen with an electronic tag, each tray is provided with a tag, which may remain with the tray for the trays lifetime. All data relating to the products are then entered in the system relating to the tray. During packaging of the products frozen as a block in the tray, that particular block is provided with the data collected during processing, i.e. species of fish, position caught, weight, number of fish, size, temperature during processing etc. In this manner the packages may be stored in the freezer with similar packages, such that the contents of the storage is always detailed, and at the same time the log monitoring the

catch may be coordinated with the fish processed.

[0022] In some situations data may also be communicated to a central data base as in certain waters there are quotas for the amount of certain species, which one may catch. Therefore, in order to keep control on the accumulated catch of i.e. a fishing fleet, the real time data relating to the species' size and number of fish of that particular species may be communicated to a database, which in turn keep track of the remaining quota and at the end of quota communicates this to the fishing fleet so that over fishing is avoided.

[0023] The invention furthermore relates to a method for operating an installation according to the principles described above wherein trays are containing a predetermined amount of fresh fish, meat, or the like is conveyed by means of a conveyor, to a horizontal plate freezer installation, where said installation may comprise a plurality of plate freezers arranged in an array where said conveyor is arranged at least along one side of the freezers and optionally a second conveyor arranged along the opposite side of the freezers, and where one or more robots are operable along the array of freezers in three dimensions, such that the robots are able to collect trays from one conveyor, place the trays according to pre-determined position data on the horizontal plates of each freezer in the array, and that the same or another robot is able to collect the trays from the horizontal plates of the freezer according to pre-determined position data, and place the trays on a conveyor, for transport away from the freezing installation.

Description of the Drawing

[0024]

Figure 1 illustrates a side view of an installation comprising a horizontal plate freezer 1 and a robot 2.

[0025] The plate freezer installation 1 comprises a number of freezing plates 10 where each plate is arranged horizontally and superposed upper and/or lower plates 10, so that the freezing plates 10 form a stack of plates. Each freezing plate is by means of flexible pipes 12 supplied with a cryogenic liquid which is distributed to the freezing plates 10 by the distribution column 14. The freezing plates 10 are arranged at a predetermined distance between each other, which distance may be varied in order for the freezing plates to be elevated or lowered in order to come into or be brought out of contact with the trays, such that trays (not illustrated) may be inserted in between two freezing plates.

[0026] In the open unloaded position as illustrated in figures 1 and 2 the distance between two superposed freezing plates 10 is larger than the height of the trays used to freeze the products. In this manner it is possible to insert a tray between two superposed freezing plates 10 and thereafter the plates are lowered such that they are in thermal contact with the underside and the upper

side of the tray for thermal conduction such that the freezing plates may remove thermal energy from the products to be frozen during the freezing process. The translation of the freezing plates is guided by the towers 14, 16 such that the freezing plates 10 remain superposed in a vertical stack.

[0027] In the open position as illustrated in figure 2 distance keeping means 20 are provided in order to maintain the freezing plates in their relative translated states whereby it is possible to insert trays between two superposed horizontal freezing plates 10.

[0028] The means necessary for elevating the freezing plates and lowering the freezing plates during the opening and closing respectively of the freezer are not illustrated and as such are not important for the proper working of the present invention in that any type of horizontal plate freezer comprising means for elevating and lowering of the horizontal freezing plates will be usable within the scope of the present invention.

[0029] On the right hand in Fig. 1 is illustrated the robot 2. The robot 2 is in this embodiment arranged such that it may travel horizontally on reels 3, 4 which reels 3, 4 are arranged parallel to the front ends of the plate freezer 1.

[0030] On the robot 2 is provided a frame 5 which frame also serves as guiding means for the robot's servicing unit 6. The servicing unit is provided with pullies 7, 8 whereby the servicing unit 6 may travel vertically along the frame members 5. The horizontal movement is as already explained above guided by the reels 3, 4 where guiding pullies 22, 23 provide for a stable movement in the horizontal direction.

[0031] The servicing unit 6 comprises a frame 24 which frame comprises means for manipulating the tray manipulating unit 25. The tray manipulating unit 25 may be constructed in a number of different ways depending on the trays which are used in connection with the plate freezers, and the manipulating units may be replaceable such that for certain types of trays a certain type of manipulating means 25 are arranged on the robot, whereas for other types of trays other manipulating units 25 are used. Typically, the manipulating unit 25 will comprise some kind of gripping means for gripping the tray and lifting it onto a plate member, where the gripping means may pull the tray onto the plate member or push a tray of the plate member depending on the task to be performed. Alternatively, the manipulating means 25 may comprise a set of forks which will engage either side of a tray in order to guide the tray into the correct position either on the conveyor or in the plate freezer and means for pushing the tray off the fork arms.

[0032] In this configuration the robot 2 is able to operate in a three-dimensional room where a first plane is defined by an X and Y-axis where the x-axis is parallel to the front side of the plate freezer defined by the reels 3, 4 and a Y-plane parallel to the front of the plate freezers, but perpendicular to the reels 3, 4 where the robot is guided by the frame 5 which doubles as guide wheels

for the servicing unit 6. In a direction perpendicular to this X-Y plane the robot may due to the provision of the servicing unit place or pull trays onto or off the freezing plates 10, whereby the robot as explained above is fully versatile to service a plate freezer as illustrated in figures 1 and 2.

[0033] In further embodiments a similar robot 2 may be arranged on the opposite side of the freezer such that the two robots may cooperate in order to fill and empty the plate freezers whereby a more rational, speedier and thereby increased productivity is achieved with the construction.

[0034] In figure 3 is illustrated an example of the layout on a factory deck where five plate freezers 1.1, 1.2, 1.3, 1.4, 1.5, are arranged in an array. On either side of the plate freezer 1 are provided guide rails 3, 4 such that a robot 2 as illustrated and described with respect to figures 1 and 2 may travel along the rails 3, 4 in order to service the plate freezers 1. On either side of the rails 3, 4 are provided a conveyor 30, 31. The servicing unit 6 as described above with reference to figure 1 is able to pick a tray from the conveyor and place it between the freezing plates 10 in the plate freezer or vice versa pick a tray from the plate freezer 1 and place it on the conveyor 30, 31. In this manner the processed fish may be placed in trays which are placed on the conveyor 30 and conveyed into the reach of the robot 2 where after the robot will place the tray in the appropriate place in one of the plate freezers 1. At the same time a second robot arranged on the opposite sides of the plate freezers may collect trays which have already been frozen and place these on the other conveyor 31 and convey the frozen trays to an emptying station, packaging station and to a storage freezer compartment. In this manner the process relating to placing and retrieving the products from the freezers has been completely automated by provision of two robots as illustrated with reference to figure 3. With reference to figures 1, 2 and 3 the robot has been explained as having certain specific features such as the pullies, servicing unit etc., but it will be obvious to a skilled person having realised the advantages achievable with a robot according to the present invention that other equivalent technical means may be used without departing from the inventive concept.

[0035] By providing the trays with electronic chips and the robot with an electronic chip reader it may be possible to guide the servicing unit 6 into any desired position and retrieve a specific tray in order to place or retrieve the tray in the freezer. In this manner it is possible also during this step of procedure relating to treatment of the fish product to assure and recognise the exact position, time, temperature etc. relating to that particular batch of fish which is present in the tray.

Claims

1. Installation for automatic loading and unloading of one or more plate freezers,

where the installation comprises

a first loading and unloading robot, where said robot comprises means for placing and/or removing the objects to be frozen

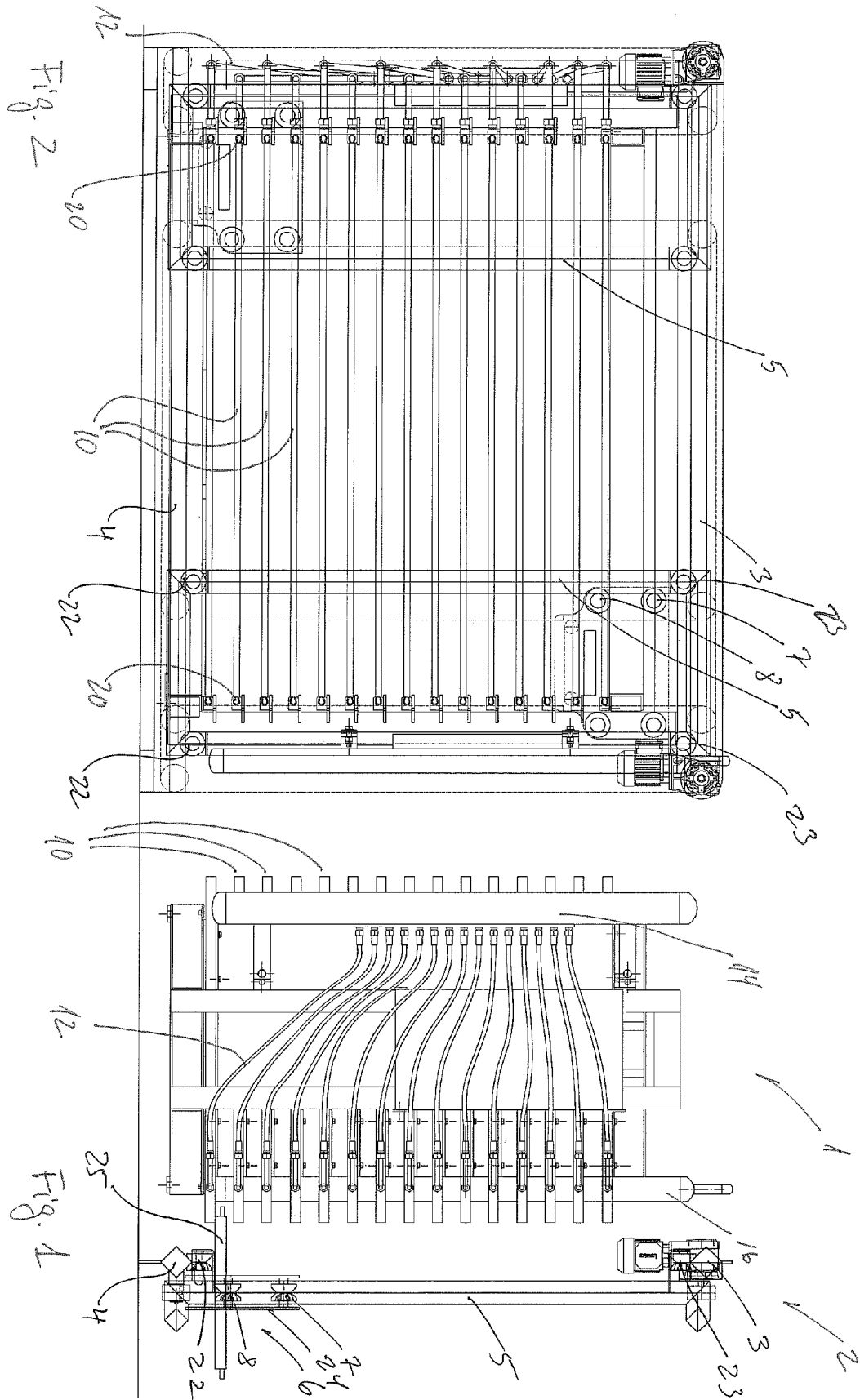
where the one or more freezers may be loaded and unloaded from the same or opposite sides 5

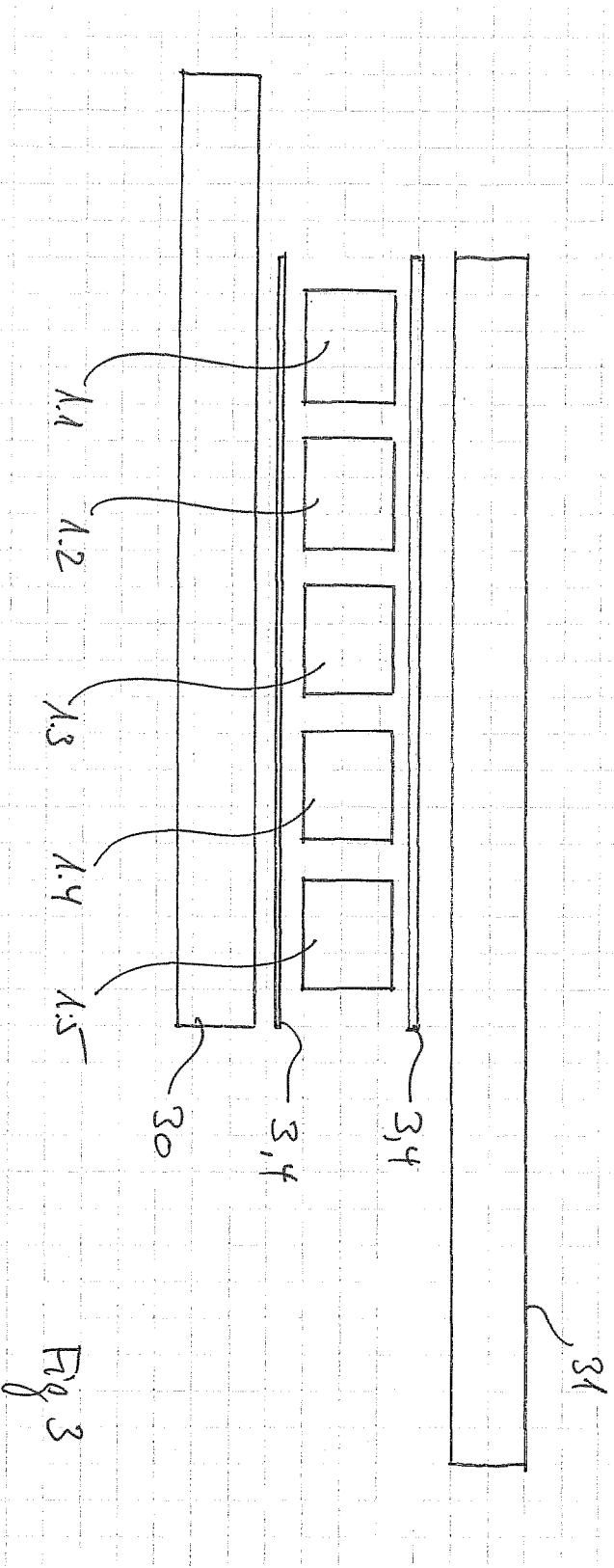
where the robot is manoeuvrable along the loading/unloading side of the freezers, and further that the objects to be frozen has a depth corresponding to half the distance between the opposite sides of the freezer. 10

2. Installation according to claim 1 wherein an array of substantially identical freezers are arranged, where the freezers' loading and/or unloading sides are arranged along the same axis, and where guidance means for guiding the robot along the array of freezers are arranged parallel to the axis along which the freezers are arranged. 15
3. Installation according to any preceding claim wherein the robot(s) are arranged on rails on either side of an array of freezers, and that on the other side of the rails from the freezers conveyor belts are arranged. 20
4. Installation according to any preceding claim wherein the means for placing and/or removing the objects to be frozen provided in connection with the robot are operable in three dimensions: in a first dimension along guiding means arranged parallel to the loading/unloading side of the freezers; in a second dimension perpendicular to the guidance means and parallel to the loading/unloading side of the freezers, in a third dimension perpendicular to the loading/unloading side of the freezers. 25 30 35
5. Installation according to any preceding claim wherein the objects to be frozen are provided with unique electronic identification tags, where a central computer collects data relating to each tag, where the tags may be programmed and applied to the objects according to one or more of the following characteristics: size of the object, species, date, time, freezer identification number, duration and/or intensity of freezing, catch position and catch time. 40 45
6. Installation according to any preceding claim wherein the objects to be frozen arranged in trays, where each tray is provided with a unique electronic identification tag, where a central computer collects data relating to each tag, where the identification tag correlates data for the objects in the tray relating to one or more of the following characteristics: size of the objects, species, date, time, freezer identification number, duration and/or intensity of freezing, catch position and catch time. 50 55
7. Installation according to claim 1 wherein a second

robot is provided, and where the first robot is designated loading robot and the second robot designated unloading robot, where said first robot is arranged for travel along the loading side of an array of plate freezers and the second robot is arranged for travel along the unloading side of the array of plate freezers, where both robots comprises means for engaging and moving the objects to be frozen into or out of respectively the plate freezer, according to pre-programmed routines.

8. Method for operating an installation according to any of claims 1 to 6 wherein trays containing a predetermined amount of fresh fish, meat, or the like is conveyed to a plate freezer installation, where said installation may comprise a plurality of plate freezers arranged in an array by means of a conveyor, where said conveyor is arranged at least along the array of freezers in three dimensions, such that the robots are able to collect trays from one conveyor, place the trays according to pre-determined position data on the horizontal plates of each freezer in the array, and that the same or another robot is able to collect the trays from the horizontal plates of the freezer according to pre-determined position data, and place the trays on a conveyor, for transport away from the freezing installation.





REFERENCES CITED IN THE DESCRIPTION

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