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(54) **FREEZING PLATE**

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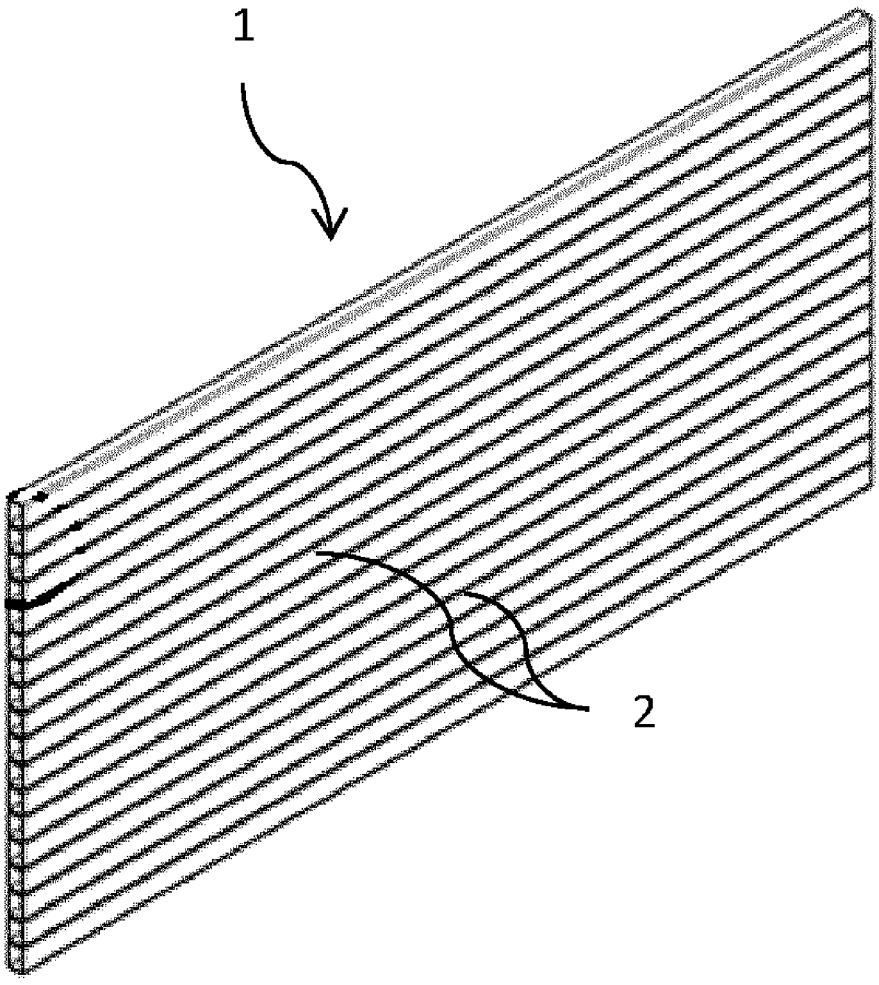
(57) **ABSTRACT**

A freezing plate including freezing tubes having a similar length extending in a longitudinal direction, where each of the tubes has top, bottom, first, and second sides, where the tubes are arranged adjacent and with their longitudinal direction next to each other. An inlet section, where at least part of the inlet section is arranged perpendicular to the longitudinal direction, where the inlet section includes an inlet cavity, which is in fluid communication with the inlet end through an aperture arranged along a longitudinal direction of the inlet section. An outlet section, where at least part of the outlet section is arranged perpendicular to the longitudinal direction, where the outlet section includes an outlet cavity, which is in fluid communication with the outlet end, through an aperture arranged along a longitudinal direction of the outlet section, where the inlet cavity is in fluid communication with the outlet cavity through a conduit.



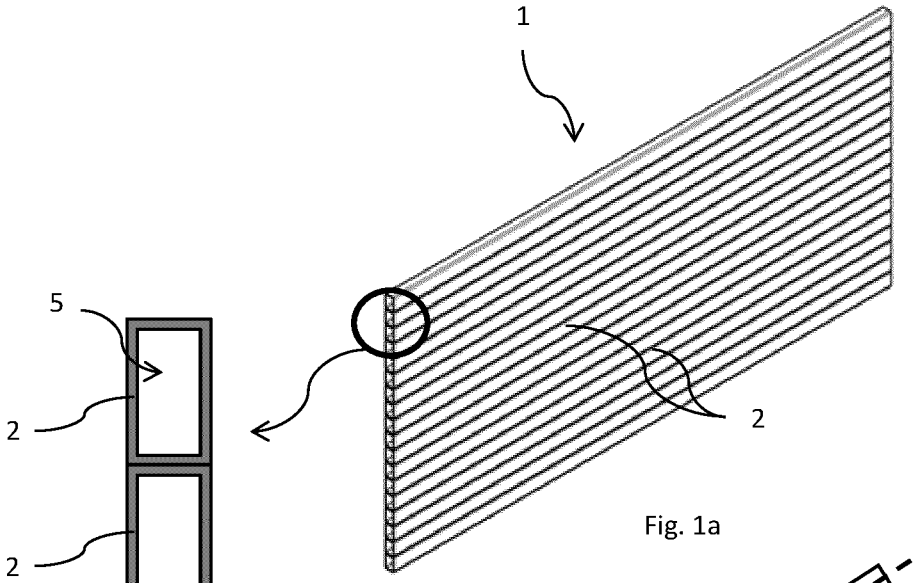


Fig. 1a

Fig. 1b

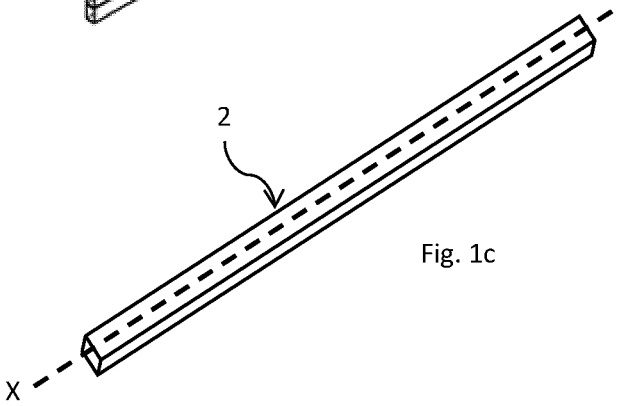


Fig. 1c

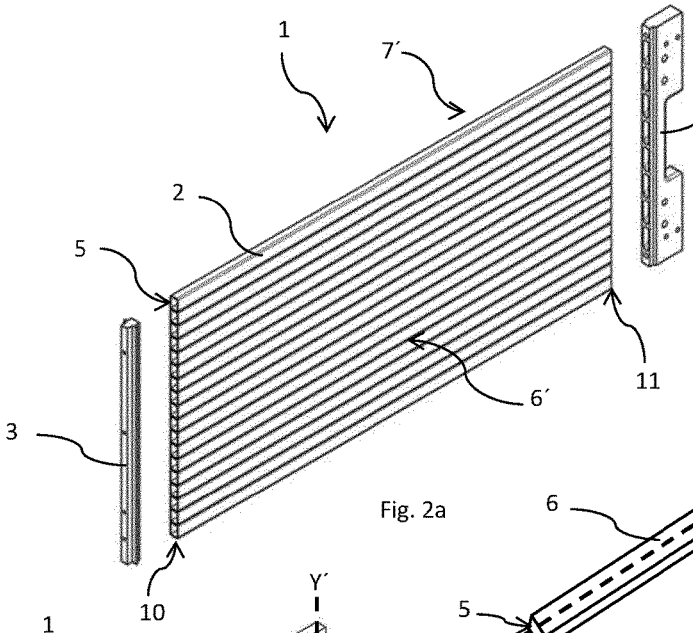


Fig. 2a

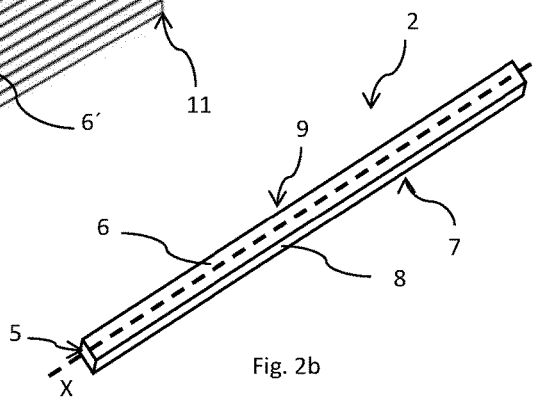


Fig. 2b

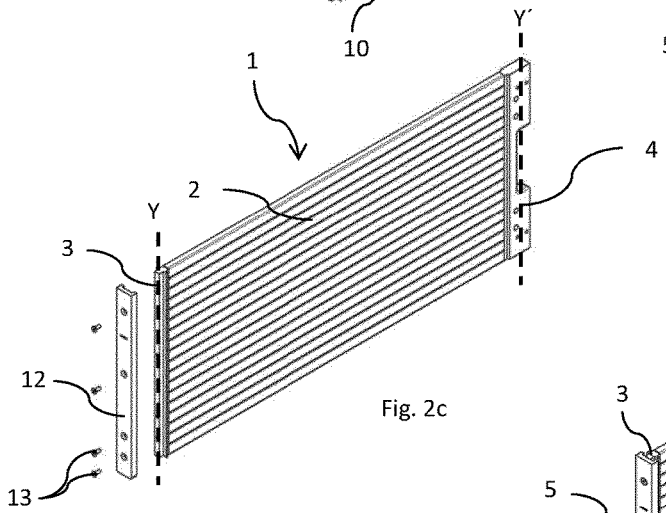


Fig. 2c

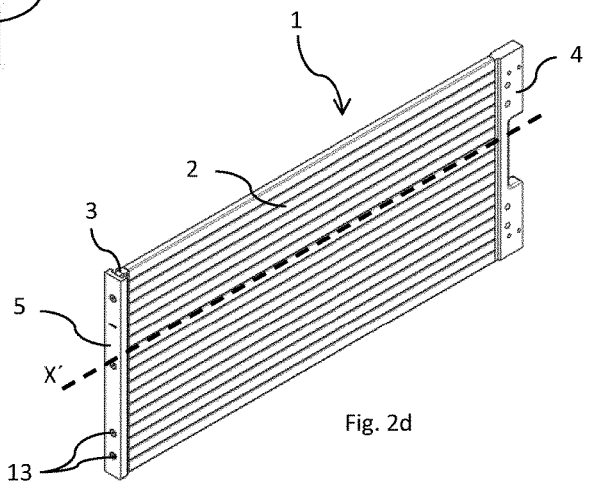


Fig. 2d

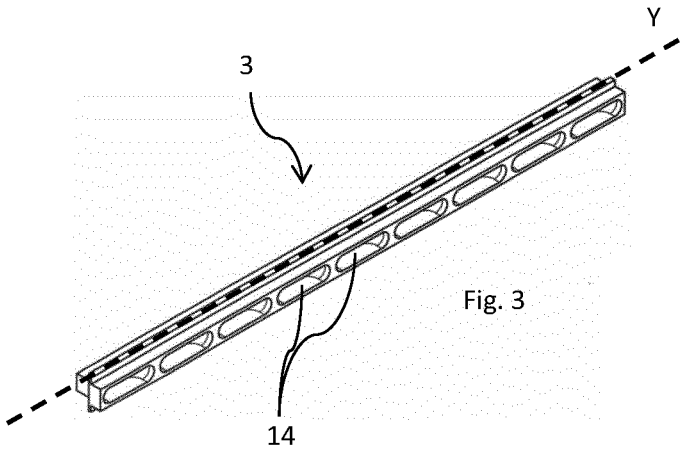


Fig. 3

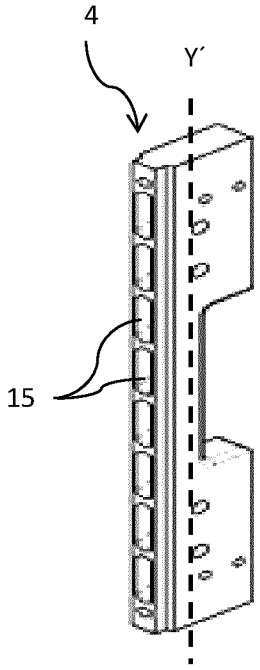


Fig. 4

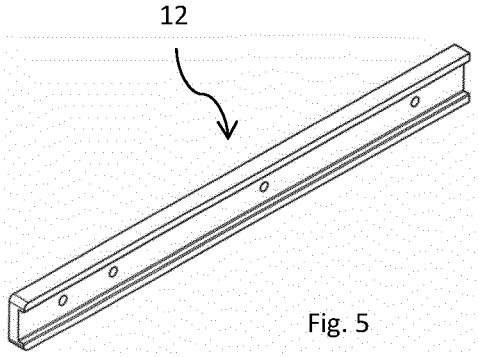


Fig. 5

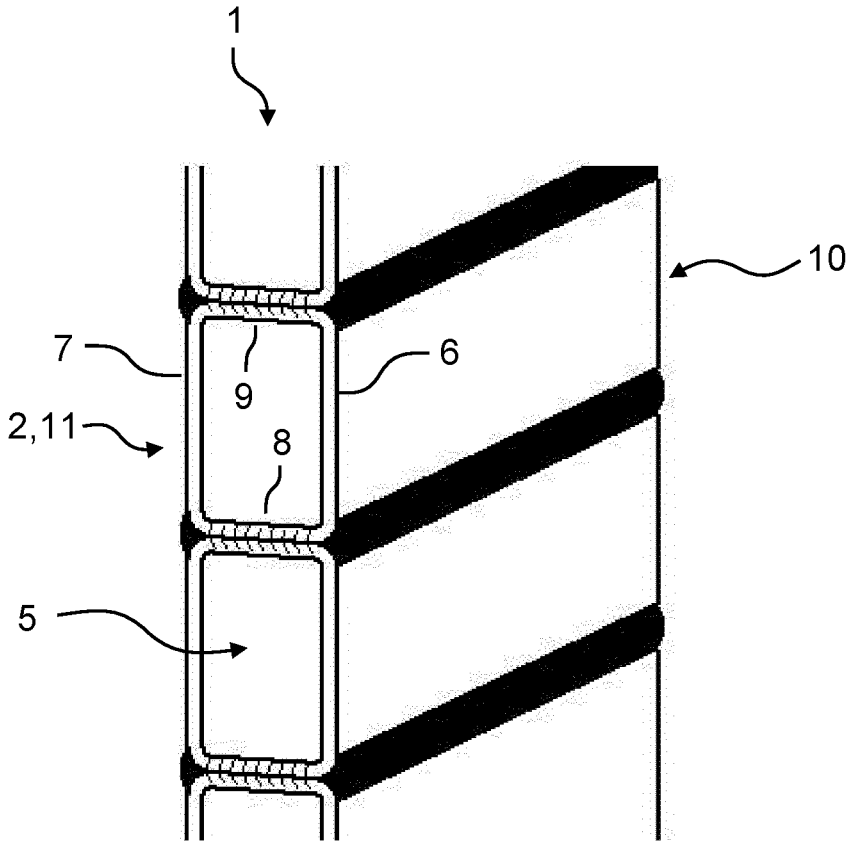


Fig. 6

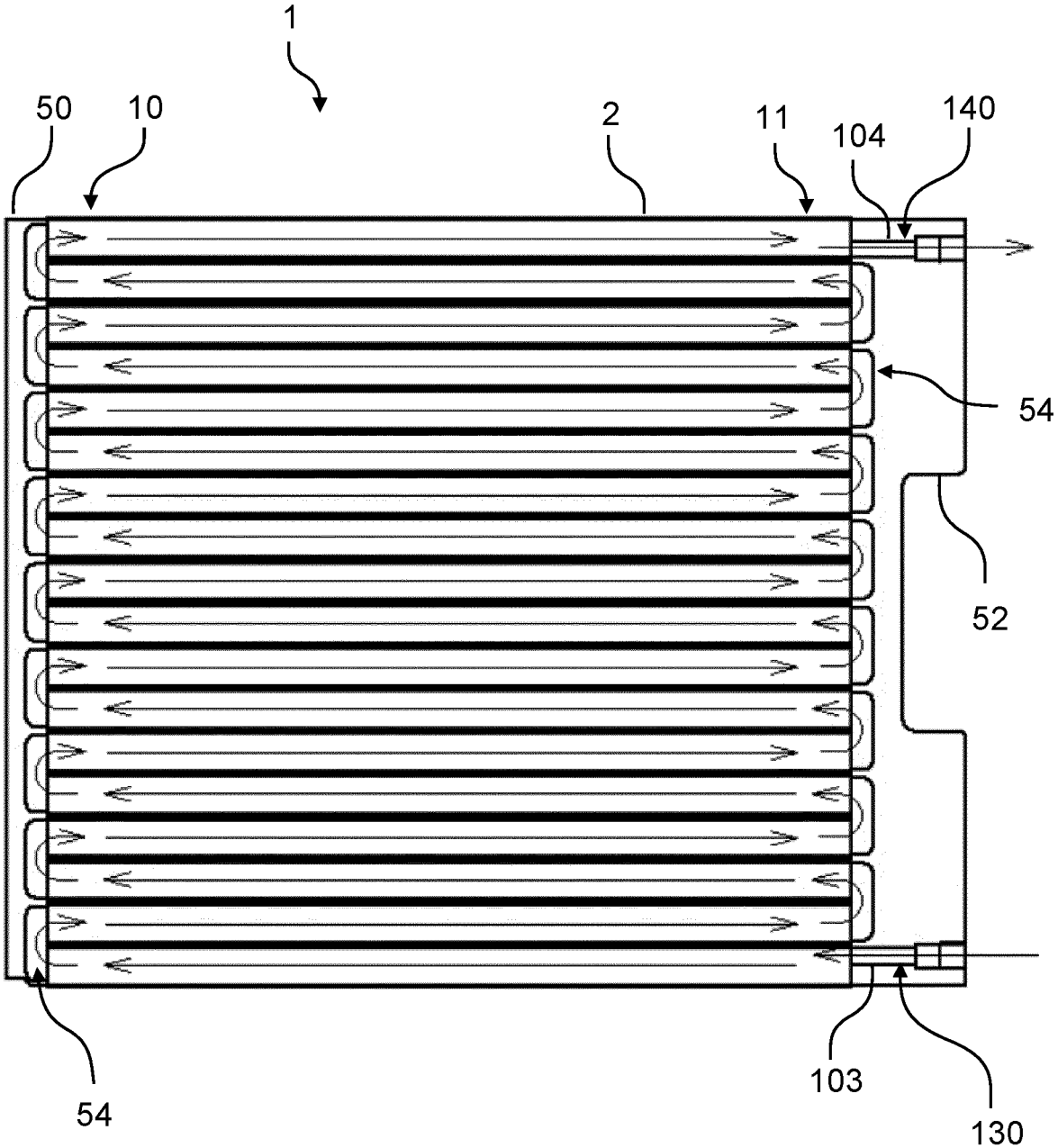


Fig. 7

FREEZING PLATE

FIELD OF DISCLOSURE

[0001] The disclosure relates to a freezing plate for use when freezing food articles in an industrial freezing installation.

BACKGROUND OF THE DISCLOSURE

[0002] Freezer plates are used in a variety of industrial freezing installations, usually in the food processing industry. The freezing plates are preferably made of aluminium, due to the favourable thermal conductivity, low costs, manufacturing experience and industrial acceptance of aluminium freezer plates.

[0003] The document US 2002/0195234 A1 describes an evaporator freezer plate for use in a plate freezer utilizing carbon dioxide as the refrigerant has a duct with an elliptical shaped cross section. The high pressure of the refrigerant causes stress to the aluminium. The elliptical ducts are formed in the freezer plate, which is solid, but for the presence of the ducts passing through the freezer plate. The duct, which has an elliptical cross-section, is designed to maintain a stress level in the plate body at a level substantially below the yield strength of the aluminium from which the plate body is constructed. The ducts are serpentine, preferably seven parallel passages with six 180 degree turns through each freezer plate. The elliptical ducts in freezer plates are designed in order to maintain aluminium as a material when using a refrigerant as carbon dioxide even though the disadvantage of the strength of the material is well known. The inlet and outlet headers are provided with two channels to reduce stress in the material and the transition of refrigerant from the ducts to the inlet and outlet. This provides a factor of safety to the system.

[0004] Furthermore, equipment based on aluminium material used in freezing installation in the food industry has some other critical disadvantage as well. Aluminium may react to food articles, especially acidic and alkaline food articles. Due to international trade, new regulations, and increased consumer demand for safer food, the food industry worldwide has been forced to create and standardize improved safety practices. The International Organization for Standardization (ISO) published a new auditable standard (ISO 22000) that defines HACCP's role in food safety and states the requirements for companies that desire to exceed the regulations for food safety. In addition, a report by Industrial & Institutional Cleaning Chemicals shows that disinfectants and sanitizers are expected to record the fastest growth among industrial and institutional cleaning chemical types, and it is predicted that gains will be driven by increased safety and health concerns over the spread of infectious diseases and risks associated with foodborne pathogens, chemicals, or toxins.

OBJECT OF THE DISCLOSURE

[0005] The object of the disclosure is to provide a safe and robust freezing plate for use in a freezing installation in the food industry, where the freezer plate may easily be manufactured and maintained. Furthermore, the object is to reduce the spread of infectious diseases and risks associated with foodborne pathogens, which may occur in industrial freezing installation.

[0006] At the same time it is also the object of the disclosure to provide an agile production method to provide freezer plates.

DESCRIPTION OF THE DISCLOSURE

[0007] The present disclosure addresses this by providing a freezing plate for freezing food articles in an industrial freezing installation, comprising:

[0008] at least one quadrilateral freezing tube provided in stainless steel, where the quadrilateral freezing tubes having a substantially equal length extending in a longitudinal direction, where the quadrilateral freezing tube has a top side, a bottom side, a first side and a second side, where the quadrilateral freezing tubes are arranged adjacent and with their longitudinal direction next to each other forming a freezing plate, where an inlet end and an outlet end is arranged in either end of said freezing tubes;

[0009] an inlet section, where at least part of said inlet section is arranged perpendicular to the longitudinal direction of said quadrilateral freezing tubes, where the inlet section comprises an inlet cavity, which is in fluid communication with said inlet end of said at least one quadrilateral freezing tube through one or more apertures arranged along a longitudinal direction of the inlet section,

[0010] an outlet section, where at least part of said outlet section is arranged perpendicular to the longitudinal direction of said quadrilateral freezing tube, where the outlet section comprises an outlet cavity, which is in fluid communication with said outlet end of said at least one quadrilateral freezing tubes, through one or more apertures arranged along a longitudinal direction of the outlet section, where the inlet cavity of the inlet section is in fluid communication with the outlet cavity of said outlet section through at least one conduit of said quadrilateral freezing tubes.

[0011] The multiple quadrilateral freezing tubes may be attached to each other by welds extending along the entire length of the tubes in the longitudinal direction.

[0012] I.e. the present disclosure may comprising multiple quadrilateral freezing tubes, an inlet section and an outlet section.

[0013] I.e. the multiple quadrilateral freezing tubes have an inlet end and an outlet end.

[0014] I.e. the quadrilateral freezing tubes may be arranged adjacent and parallel to each other forming a freezing plate.

[0015] I.e. the inlet section may comprise at least one inlet cavity in fluid communication with the inlet end of at least one of said multiple quadrilateral freezing tube through one aperture arranged along a longitudinal direction of the inlet section.

[0016] I.e. the outlet section may comprise an outlet cavity in fluid communication with the outlet end of at least one of the multiple quadrilateral freezing tubes through one aperture arranged along a longitudinal direction of the outlet section.

[0017] I.e. the inlet cavity of the inlet section may be in fluid communication with the outlet cavity of the outlet section through at least one conduit of said multiple quadrilateral freezing tubes.

[0018] Hollow profiles, such as tubes and pipes, are provided in many different forms, dimensions and material in use for many different purposes. The hollow profiles are often produced in large scale and the costs are therefore

reduced in relation to small scale production of customized products. The hollow profiles may have standard forms and dimensions and available in different prefabricated lengths. Producing the hollow profiles is a well-known technic, e.g. extrusion or moulding depending on the chosen material.

[0019] The present disclosure uses hollow profiles as parts for freezing plates, where the profiles easily may be cut down in predefined lengths suitable for this specific application. The hollow profile, such as a freezing tube, has an inner dimension and an outer dimension. The inner dimension is the cross sectional dimension of the conduit through the freezing tube. The outer dimension is equal to the inner dimension and the wall thickness of the material. The wall of the material is forming an outer surface and an inner surface, where the wall surrounds the conduit. The inner surface is the circumference of the conduit. The outer surface of the freezing tube may have a similar cross sectional shape as the cross sectional shape of the inner surface of said freezing tube, if the thickness of the material providing the wall is uniform in a cross sectional view.

[0020] The outer surface of the freezing tube may have a cross sectional shape different from the cross sectional shape of the inner surface of said freezing tube, if the thickness of the material providing the wall differs from the thickness in a cross sectional view. This may in some freezing installation application be preferred. The material of the hollow profiles may preferably be stainless steel.

[0021] The freezing plates may easily be used in industrial freezers and freezing installations, where the freezing plates are capable of freezing food articles. The freezing plate is both cost-effective and robust. The surface on both sides of the freezing plate ensures that the freezing plate is easy to clean and sterilize, and therefore presents a high quality of hygiene easy maintainable. There is a direct correlation between ease of cleaning and productivity. If the freezing installation is easier to clean and sterilize, the productivity of the freezing installation will increase.

[0022] The production of stainless steel hollow profiles is well known. The cross sectional shape of stainless steel hollow profiles may be formed in many different shapes. The conduit through the hollow profiles may often have the same cross sectional shape as the outer circumference of the hollow profiles.

[0023] In many freezing applications aluminium is chosen as a freezing plate material, due to the favourable thermal conductivity, manufacturing experience and industrial acceptance of aluminium freezer plates. But the aluminium has some critical disadvantage in relation to the strength of the material and the interaction with food articles.

[0024] Furthermore, one of the key features in the industrial freezing processing and freezing/packaging equipment is that it is wash-down certified. In many food processing plants, especially meat packaging, wash-down means the equipment must withstand a rigorous cleaning process, which entails using hot (minimum 140° F.), high-pressure (up to 1000 psi) water sprays, and caustic, acid-based detergents dispensed through spray and foam systems in addition to hand cleaning. The main criterion for wash-down certified equipment is stainless steel construction. The main criterion is not reached for the equipment constructed from aluminium. In contrast to anodized aluminium, stainless steel resists corrosion and localized chloride attacks from both cleaning agents and aggressive ingredients such as high levels of chloride salts and high acid contents like those found for example in tomato paste and ketchup. Stainless steel can be electro-polished for a uniquely flat, mirror-like surface. For example the surface of stainless steel may first be mechanically polished, then immersed in a polishing solution, followed by the application of an external electric current. This process levels the microscopic highs and lows on the surface of the metal and results in very low values, i.e., roughness. A smoother surface is clinically cleaner because bacteria have little to cling to on the surface of the metal.

[0025] Another advantage of stainless steel over aluminium is the strength. Stainless steel is a stronger and harder material than aluminium. Due to aluminium alloys' lower strength, the surface of aluminium alloys is more vulnerable to scrapes, dents and nicks which can be more difficult to clean and serve as initiation sites for corrosive attack by cleaning agents used in the food industry. If the cleaning agent or food ingredient penetrates the normal protective oxides of the metal, bare metal is exposed and there is an increased likelihood for further pitting of the metal. Once pitting occurs, catastrophic corrosion starts and the metal will deteriorate. The surface may absorb dangerous bacteria and pathogens from the food, and metallic ions from the alloy will contaminate any food products that come in contact with the freezing and packing equipment. Even though stainless steel has a higher density than aluminium, the material wall in the profile may be chosen thinner compared to an aluminium profile, because the stainless steel is a stronger material, which will compensate for the high weight of stainless steel. The life cycle cost advantages of stainless steel over aluminium outweigh the incremental additional cost.

[0026] The aluminium based products get scratches and dents more easily as compared to steel based products. Steel is strong and less likely to warp, deform or bend under the weight, force, cold or heat. Aluminium has a high oxidation and corrosion resistance mainly due to the passivation layer on the surface. When the passivation layer on the surface of aluminium is removed, for example when exploit to extreme acidic or base environments, Aluminium may corrode rapidly with catastrophic results. The aluminium may directly or indirectly spread infectious diseases and risks associated with foodborne pathogens, chemicals, or toxins, causing food poisoning.

[0027] The freezing tubes may be manufactured in stainless steel. The freezing tubes may be arranged parallel adjacent next to each other forming a freezing plate. The stainless steel freezing tubes may be welded, adhered or clamped together in the longitudinal direction, or attached to each other in some other preferable way.

[0028] The quadrilateral freezing tube may have a top side and a bottom side, which is equal in width. The quadrilateral freezing tube may also have a first side and a second side, which is equal in height. A first quadrilateral freezing tube's top side and bottom side may be equal in width as a second quadrilateral freezing tube's top side and bottom side. Also a first quadrilateral freezing tube's top side and bottom side may be different in width, than a second quadrilateral freezing tube's top side and bottom side, and the quadrilateral freezing tube's first side and second side may at the same time be equal in height, as the second quadrilateral freezing tube's first side and second side.

[0029] When the hollow profiles are substantially in height the surface of the freezing plate may be smooth, when the food articles are handled, and also easy to clean afterwards.

[0030] In one embodiment of the freezing plate, the multiple quadrilateral freezing tubes may be attached to each other by welds extending along the entire length of the top side and the bottom side of the tubes in the longitudinal direction.

[0031] The welds being on the opposite sides on of the tubes may have the advantage of securing a smooth, easy to clean surface of the freezing pate on both the top surface and the bottom surface.

[0032] In a still further advantageous embodiment of the disclosure said inlet section is attached to said inlet end of said two or more freezing tubes, and said outlet section is attached to said outlet end of said two or more freezing tubes by at least one first fastening means.

[0033] The inlet section has a longitudinal direction, which is arranged perpendicular to the longitudinal direction of the freezing tubes. The outlet section has also a longitudinal direction, which is arranged perpendicular to the longitudinal direction of the freezing tubes. The inlet section and the outlet section may be fastened by using at least one first fastening means.

[0034] The refrigeration fluid may be led into the inlet cavity in the inlet section. The refrigeration fluid may then be distributed into the conduits by one or more apertures in the inlet section. The apertures are arranged along the longitudinal direction of the inlet section. The apertures enclose at least one of the inlet ends of the freezing tubes.

[0035] The outlet section may also be provided with one or more apertures, which are arranged along the longitudinal direction of the outlet section. The apertures enclose at least one of the outlet ends of the freezing tubes. The refrigeration fluid may then be gathered from the conduits of the freezing tubes into the outlet cavity, through one or more apertures in the outlet section, and lead away from the freezing plates.

[0036] Depending on the configuration of the fluid communication between the freezing tubes, the one or more apertures in the inlet and outlet section the freezing plate may have a serial configuration of the freezing tubes, a parallel configuration or a combination hereof. A serial configuration may refer to that the freezing tubes are serial connected with the outlet end of one tube being connected to the inlet end of a subsequent connected freezing tube. A parallel configuration may refer to that two or more freezing tubes are connected with the inlet end to a common inlet cavity such that a fluid may be distributed in parallel flows into each tube.

[0037] In a further advantageous embodiment of the disclosure said freezing tubes are attached to each other using at least one second fastening means arranged between and/or on the adjacent sides of the freezing tubes.

[0038] The freezing tubes may easily be fastened to each other by using at least one second fastening means. This will ensure a solid freezing plate with very little or none space between the freezing tubes. If there is no cavity or recess between the freezing tubes, dirt or food residues will not get stocked. The freezing plate will therefore be easy to clean after use and thereby maintain a high hygiene quality.

[0039] Food quality and shelf life of a food article is very important and is often related to the hygiene of the freezing installation. The shelf life of a food may be defined as the time period within which the food is safe to consume and/or has an acceptable quality to consumers. The hygiene will by easily maintained during and after production, when for example the freezing tubes are fastened together. The food quality will be affected, since the freezing of blocks of the food articles may be more uniform, and not exposed to unwanted bacteria, which causes the food articles to deteriorate during storage.

[0040] In a still further advantageous embodiment of the disclosure said first and/or second means are provided by welding.

[0041] The inlet section and the outlet section may be fastened by using at least one first fastening means, the fastening means may include welding the inlet and outlet sections to the ends of the freezing tubes. Alternatively, the inlet and outlet sections any be adhered or clamped to opposite ends of the freezing tubes, and thereby forming a freezer plate. The freezing tubes may be welded to each other in the longitudinal direction or part of the longitudinal direction to form a freezer plate with plan and smooth surfaces. Alternatively, the freezing tubes may be adhered or clamped together or partly adhered or clamped together.

[0042] Hence, the freezing tubes may be welded to each other in the longitudinal direction along the entire length of the tubes as opposed to only in part of the longitudinal direction. Furthermore, the freezing tubes may be welded to each other by welding along the entire length of the top side and the bottom side of the tubes in the longitudinal as the second fastening means may be arranged between and/or on the adjacent sides of the freezing tubes.

[0043] In a further advantageous embodiment of the disclosure, the freezing plate comprises at least one U-turn connection in fluid communication with the outlet end of one of said multiple quadrilateral freezing tubes and the inlet end of another of said multiple quadrilateral freezing tubes.

[0044] The freezing tubes connected through the U-turn connection may be arranged adjacent to each other in direct contact or arranged with other freezing tubes arranged between them.

[0045] The U-turn connection may have any arbitrary form adapted for guiding the flow such that it is turned substantially 180 degrees from one freezing tube to another freezing tube arrange directly next to each other or with one or more freezing tubes arranged between them.

[0046] The one or more U-turn connections may be integrated into other parts comprised in the freezing plate. Alternatively, the U-turn connections may be implemented as separate parts. The U-turn connections may be provided in stainless steel, in a polymer based product or a mix of plurality materials.

[0047] One effect of the U-turn connections may be that a serial connection of one or more freezing tubes may be achieved, such that the fluid e.g. refrigerant is guided through multiple freezing tubes in an S-shaped flow from inlet to outlet.

[0048] In yet a further advantageous embodiment of the disclosure comprising the U-turn connections, the freezing plate may comprising an end section arranged perpendicular to the longitudinal direction of the quadrilateral freezing tubes and one external connection section arranged perpendicular to the longitudinal direction of the quadrilateral freezing tubes. The external connection section may comprise at least one inlet section with an inlet cavity and at least one outlet section with an outlet cavity.

[0049] The end section and the external connection section may be arranged in opposite ends of multiple freezing tubes when arranged in a plane, parallel and adjacent to each other.

[0050] One effect of this embodiment may be that the inlet section and outlet section is arranged at the same end of the freezing plate, such that the freezing plate may be connected to an external fluid supply at the same end. E.g. the freezing plate may be set into a holder having an inlet and outlet coupling for the fluid e.g. the refrigerant.

[0051] In a further advantageous embodiment of the disclosure, the fluid is a refrigeration fluid also known as a refrigerant.

[0052] The refrigeration fluid is passing through the conduit in the freezing tubes. The refrigeration fluid is distributed through parallel arranged conduits, where each conduit is provided by each freezing tube from an inlet end to an outlet end of the freezing tubes.

[0053] To reduce the energy consumption of the freezing installation, the conduit cross sectional dimension may be as large as possible, for example by reducing the thickness of the material in the freezing tube. If the freezing tube has a larger conduit, the flow rate through the conduit may be reduced, and still provide the same amount of cooling capacity. This reduces the energy consumption of the freezing installation.

[0054] In a further advantageous embodiment of the disclosure at least one extension profile is arranged adjacent to said freezing plate.

[0055] An extension profile may be arranged adjacent to the inlet section or adjacent to one of the freezing profiles. The extension profile may be a u-formed profile, when attached to the inlet section, the extension profile may be used as a protection means.

[0056] The extension profile may also be provided with a function as connecting means between a first and a second freezing plate, connecting the first and a second freezing plate together. The extension profile may also be provided with a function as guide rail guiding the freezing plate to the correct position in the freezing installation. The extension profile may be fastened to the freezing plate using fastening means such as screws, bolts, clips etc.

[0057] The present disclosure also relates to a freezing installation for freezing food articles, comprising at least one freezing plate.

[0058] The industrial freezing installation is capable of freezing food articles using the freezing plates. The freezing plate comprises two or more freezing tubes having a longitudinal direction. The freezing tubes are arranged adjacent to each other and thereby forming a freezing plate. The freezing tubes have a hollow profile, which has a conduit arranged between an inlet end and an outlet end of the freezing tube. The conduit has a similar cross sectional shape as the freezing tube.

[0059] The freezing plate also comprises an inlet section. The inlet section is partly arranged perpendicular to the longitudinal direction of the freezing tube or tubes.

[0060] The inlet section comprises an inlet cavity, which may be in fluid communication with a recyclable refrigerant system, which provides fluid refrigerant to the inlet system through connecting means. The refrigerant flow is controlled by controlling means arranged as an internal or external control unit. The control unit is in wired or wireless communication with the freezing installation. The refrigerant may flow though the connecting means arranged on and/or in the inlet section and into the inlet cavity. The inlet cavity may be in fluid communication with said inlet end of the freezing tube or tubes through one or more apertures arranged along a longitudinal direction of the inlet section.

[0061] The freezing plate also comprises an outlet section. The outlet section may partly be arranged perpendicular to the longitudinal direction of said freezing tube in the opposite end of the inlet section. The outlet section comprises an outlet cavity, which is in fluid communication with said inlet though at least one freezing tube. The refrigerant flows through one or more apertures arranged along a longitudinal direction of the outlet section into the outlet cavity. From the outlet section connection means are provided so the refrigerant is led away from the freezing plate.

[0062] The freezing tube, the inlet section and the outlet section may be provided in stainless steel, and the freezing tubes may be formed as quadrilateral freezing tubes. The quadrilateral freezing tube has a top side, a bottom side, a first side and a second side. The quadrilateral freezing tubes may be different from each other or similar, when viewed in a cross sectional view. The quadrilateral freezing tubes may be arranged parallel next to each other. The quadrilateral freezing tubes may be welded together with a first side of a first quadrilateral freezing tube adjacent to a second side of a second quadrilateral freezing tube, forming a substantially plan top freezing plate surface and a substantially plan bottom freezing plate surface.

[0063] The freezing tube, the inlet section and the outlet section may all be provided in stainless steel, since stainless steel is strong and also less reactive with food articles than aluminium. The inlet section and the outlet section may also be provided in a polymer based product or a mix of plurality materials.

[0064] The present disclosure also relates to a method of manufacturing a freezing plate according to one or more of the disclosed embodiments of a freezing plate or parts hereof.

[0065] Method of manufacturing a freezing plate comprising following steps

[0066] a) providing a plurality of quadrilateral freezing tubes in stainless steel

[0067] b) arranging the quadrilateral freezing tubes parallel in a longitudinal direction of the freezing tubes, and placing the freezing tubes next to each other forming a substantially plan top freezing plate surface and a substantially plan bottom freezing plate surface,

[0068] c) providing an inlet section and an outlet section,

[0069] d) arranging at least part of said inlet section to an inlet end of said freezer plate,

[0070] e) arranging at least part of said outlet section to an outlet end of said freezer plate,

[0071] f) connecting said quadrilateral freezing tubes either to each other along parallel lateral longitudinal sides, or connecting the quadrilateral freezing tubes to said inlet section and said outlet section, or connecting said quadrilateral freezing tubes to each other along parallel lateral longitudinal sides, and connecting the quadrilateral freezing tubes to said inlet section and said outlet section;

[0072] where the inlet section is in fluid communication with said outlet section through the conduit of said quadrilateral freezing tubes, where in use a refrigerant is capable of flowing into the inlet section, through the freezing tubes, and out of the outlet section.

[0073] Connecting said quadrilateral freezing tubes to each other, may be performed by attaching the quadrilateral freezing tubes to each other by welding along the entire length of the tubes in the longitudinal direction.

[0074] In general, attaching, connecting and fastening are used interchangeably throughout this description having the same meaning and may include welding.

[0075] The method may be advantageous in that a safe and robust freezing plate for use in the food industry is achieved. A freezer plate, which may easily manufactured and maintained. Furthermore, the obtained freezing pate may reduce the spread of infectious diseases and the risks associated with foodborne pathogens, which may occur in industrial freezing installation.

[0076] The method may be advantageous in that an agile production method to provide freezer plates may be achieved.

[0077] In one embodiment of the method the step of connection said quadrilateral freezing tubes to each other by welding along the entire length of the tubes, is performed by simultaneous welding in the longitudinal direction along two adjacent tubes from the top freezing plate surface and from the bottom freezing plate surface.

[0078] I.e. from the top side of the freezing tubes and the bottom side of the freezing tubes.

[0079] Due to the heat dissipating in stainless steel and the thermal conductivity of stainless steel, the simultaneous welding on opposite sides of the freezing tubes may reduce deformation of the tubes due to any heat dissipation during the welding process. Furthermore, any stress in the tubes or the welds may be reduced or levelled out across the tubes due to this method.

[0080] When assembling a freezing plate, the two or more freezing tubes may be provided in substantially similar length, to form a square or rectangular freezing plate. The freezing tubes may be a pre-constructed hollow profile, where the conduit has a similar cross sectional shape as the cross sectional shape of said freezing tube's outer surface.

[0081] The freezing tubes having a longitudinal direction may be arranged parallel along the longitudinal direction of the freezing tubes. The freezing tubes may then be arranged next to each other, side by side. The freezing tubes together may then form a substantially plan top freezing plate surface, and a substantially plan bottom freezing plate surface, which has an inlet end and an outlet end. The freezing tubes may be fastened together using the appropriate fastening means for the application. The inlet section and the outlet section may also be provided and arranged so that the inlet section is adjacent to the inlet end of the freezing tubes and the outlet section is adjacent to the outlet end of the freezing tubes. The inlet section and an outlet section may be fastened to respectively the inlet end and the outlet end of the freezing plate. A fluid connection may be provided from the inlet cavity in the inlet section to the outlet cavity of said outlet section, through the conduit of said freezing tubes. The fluid connection provides a path for the fluid flow, which in use is flowing through the freezing plate and freezing the food articles.

[0082] The hollow profiles may easily be provided, so the profiles fit the freezing plate application. If the freezing plate must be provided in different length, the profiles may then easily be cut in the predefined length. If the freezing plate needs to be higher or lower, the profiles may then be ordered in an appropriate cross section dimension. If the freezing plate needs to be wider or narrower, the number of profiles may be increased or reduced according to the new specifications of the freezing plate. There is no need to provide new moulds or other tools, to make a change of the freezing plate dimension.

[0083] The present disclosure provides a cost-effective and solid freezing plate for use in the food industry, where the freezer plate may easily be manufactured and maintained. The present disclosure also provides a more agile, easy and cost-effective production method of manufacturing different dimension of freezer plates than presented above.

[0084] The disclosure has now been explained with reference to a few embodiments which have only been discussed in order to illustrate the many possibilities and varying designs possibilities achievable with the freezing plates provided for freezing installation according to the present disclosure.

DESCRIPTION OF THE DRAWING

[0085] The embodiments of the disclosure are described in the following with reference to:

[0086] FIGS. **1***a* , *b* and *c*: Illustrating one embodiment of a freezing plate comprising freezing tubes.

[0087] FIG. **2***a, b, c* and *d*: Illustrating one embodiment of an assembly of a freezing plate comprising freezing tubes, an inlet section and an outlet section, and an extension profile.

[0088] FIG. **3**: Illustrating one embodiment of an inlet section.

[0089] FIG. **4**: Illustrating one embodiment of an outlet section.

[0090] FIG. **5**: Illustrating one embodiment of an extension profile.

[0091] FIG. **6**: Illustrating the one embodiment of welds attaching the freezing tubes to each other.

[0092] FIG. **7**: Illustrating a cross section of one embodiment of a freezing plate comprising U-turn connections.

[0093] Like reference numerals refer to like elements throughout. Like elements will, thus, not be described in detail with respect to the description of each figure. It should also be noted that the figures are only intended to facilitate the description of the exemplified embodiments. They are not intended as an exhaustive description of the claimed disclosure or as a limitation on the scope of the claimed disclosure. In addition, an illustrated example needs not have all the aspects or advantages shown. An aspect or an advantage described in conjunction with a particular example is not necessarily limited to that example and can be practiced in any other examples even if not so illustrated, or if not so explicitly described.

DETAILED DESCRIPTION OF THE DISCLOSURE No Item

[0094] **1** freezing plate

[0095] **2** freezing tube

[0096] **3** inlet section

[0097] **4** outlet section

[0098] **5** conduit

[0099] top side of freezing tube

[0100] **6'** top freezing plate surface

[0101] **7** bottom side of freezing tube

[0102] **7'** bottom freezing plate surface

[0103] **8** first side of freezing tube

[0104] **9** second side of freezing tube
[0105] **10** inlet end of freezing tube
[0106] **11** outlet end of freezing tube
[0107] **12** extension profile
[0108] **30** inlet cavity
[0109] **40** outlet cavity
[0110] **50** end section
[0111] **52** external connection section
[0112] **54** U-turn connection
[0113] **103** inlet section
[0114] **104** outlet section
[0115] **130** inlet cavity
[0116] **140** outlet cavity
[0117] X longitudinal direction of freezing tube
[0118] X' longitudinal direction of freezing plate
[0119] Y longitudinal direction of inlet section
[0120] ' longitudinal direction of outlet section

[0121] Embodiments of the disclosure is explained in the following detailed description. It is to be understood that the disclosure is not limited in its scope to the following description or illustrated in the drawings. The disclosure is capable of other embodiments and of being practiced or carried out in various ways.

[0122] FIGS. **1***a, b* and *c*: illustrates a freezing plate **1** comprising in this example eighteen quadrilateral hollow profiles arranged so that the profiles may act as freezing tubes **2** in a freezing plate **1**. The eighteen freezing tubes **2** have all substantially similar length which determines the length of the freezing plate **1**. The length of the freezing tubes **2** defines a longitudinal direction X. The eighteen freezing tubes **2** are all arranged adjacent next to each other forming a freezing plate **1**. The freezing tubes **2** has a conduit **5** arranged between the ends of each of the freezing tubes **2**. The circumference of conduit **5** has a similar cross sectional shape as the cross sectional shape of said freezing tube's outer surface, which is shown in FIG. **1***b*. The difference between the dimensions of the cross sectional shape of the conduit **5** and the freezing tube's **2** outer surface depends on the thickness of the material used for the profiles. The thickness of the chosen material, where the material provides the freezing tube's **2** wall, is uniform in a cross sectional view.

[0123] FIG. **2***a, b, c* and *d*: illustrates the assembly of a freezing plate **1** comprising of freezing tubes **2**, an inlet section **3** and an outlet section **4**. A plurality of quadrilateral freezing tubes **2**, substantially squarish (square shaped), is substantially equal in width. Each of the freezing tubes has a top side **6** and a bottom side **7**, which is equal in width. Each of the freezing tubes has a first side **8** and a second side **9**, which all are equal in height. Furthermore, the freezing tubes **2** have also a substantially similar length, where the length provides a longitudinal direction X.

[0124] The freezing tubes **2** are arranged parallel along the longitudinal direction X of the freezing tubes **2**. The freezing tubes **2** are arranged next to each other, side by side. The freezing tubes **2** form a rectangular freezing plate **1**, also having a longitudinal direction X' given by the longitudinal direction X of the freezing tubes **2**. When the freezing tubes **2** are provided with the same height, the top sides **6** of the freezing tubes **2** provide a plan top freezing plate surface **6'**, and the bottom sides **7** of the freezing plates **2** provide a plan bottom freezing plate surface **7'**.

[0125] The freezing tubes **2** may be chosen as pre-constructed hollow profiles. The freezing tubes **2** may be of stainless steel and may be welded together to form the freezing plate **1**. The conduit **5** inside the freezing tube **2** has a similar cross sectional shape as the cross sectional shape of the outer surface of the freezing tube **2**.

[0126] The freezing tubes **2** form a freezing plate **1**, which has an inlet end and an outlet end. The freezing tubes **2** are fastened together using the appropriate fastening means for the application. The inlet section **3** is arranged so that the inlet section **3** is adjacent to the inlet end **10** of one or more of the freezing tubes **2** and the outlet section **4** is arranged adjacent to the outlet end **11** of one or more of the freezing tubes **2**. The inlet section **3** and an outlet section **4** have a longitudinal direction Y, Y' and are arranged perpendicular to the freezing tubes **2**. The inlet section **3** and an outlet section **4** are fastened to respectively the inlet end and the outlet end of the freezing plate **1**.

[0127] A fluid connection is provided from the inlet cavity in the inlet section **3** to the outlet cavity of said outlet section **4**, through the conduit **5** of said freezing tubes **2**. The fluid connection provides a path for the fluid or refrigerant flow, which in use is flowing through the freezing plate **1** and freezing the food articles.

[0128] An extension profile **12** is provided at the inlet end **10** arranged adjacent to the inlet section **3**. The extension profile **12** is fastened to the inlet section using screws.

[0129] The length of the freezing plate **1** is mainly given by the length of the freezing tubes **2**. The freezing tubes **2** may be provided in different length depending on the desired length of the freezing plate **1** for a given purpose. The freezing tube **2** profiles may then easily be cut in the predefined length and a plurality of freezing tubes **2** may be welded together to form the desired size of the freezing plate **1**. If the thickness of the freezing plate **1** is desired to be increased or decreased, the profiles may then be chosen in an appropriate cross section dimension. If the freezing plate **1** needs to be wider or narrower, the number of freezing tubes **2** may be increased or reduced according to the specifications on the freezing plate **1**.

[0130] FIG. **3** illustrates an inlet section. The inlet section has a longitudinal direction Y and may be arranged perpendicular to the freezing tubes. Other applications or designs of freezing plates may choose to arrange the inlet section otherwise. The inlet section comprises an inlet cavity and inlet opening means to receive the refrigerant, which is not shown on the FIG. **3**. One or more apertures **14** are arranged along a longitudinal direction Y of the inlet section **3**. The apertures **14** are in fluid communication with the inlet opening means through the inlet cavity inside the inlet section **3**. Each one of the apertures **14** is capable of providing refrigerant to one or more freezing tubes at the same time.

[0131] FIG. **4** illustrates an outlet section **4**. The outlet section **4** has a longitudinal direction Y', and may be arranged perpendicular to the freezing tubes in the opposite end of the inlet section **3**, showed in FIG. **3**. Other applications or designs of freezing plates may choose to arrange the outlet section otherwise. The outlet section **4** comprises an outlet cavity and outlet opening means to dispatch the refrigerant away from the outlet section, which is not shown on the FIG. **4**. One or more apertures **15** are arranged along a longitudinal direction Y' of the outlet section **4**. The apertures **15** are in fluid communication with the inlet opening means through the inlet cavity inside the inlet

section **3**. Each one of the apertures **15** is capable of receiving refrigerant from one or more freezing tubes at the same time.

[0132] Hence a parallel or a serial configuration of the freezing tubes may be achieved. Furthermore, the freezing plate may comprises multiple sections each having a serial or parallel configuration of the freezing tubes.

[0133] FIG. **5** illustrates an extension profile. An extension profile **12** is provided at the inlet end **10** arranged adjacent to the inlet section **3**. The extension profile **12** is a u-formed profile, which may be used as a protection means. The extension profile **12** is fastened to the inlet section using screws. The extension profile **12** may have another shape specified for the purpose of the extension profile **12**, such as guide rail, connection means between the freezing plates and/or protection means.

[0134] FIG. **6** illustrates a section of an embodiment of multiple freezing tubes **2** attached to each other by welds.

[0135] The quadrilateral freezing tubes **2** are substantially equal lengths. Each freezing tube **2** having a top side **6**, a bottom side **7**, a first side **8**, a second side **9**, an inlet end **10** and an outlet end **11**. The freezing tubes **2** are arranged adjacent to each other and in parallel such that one freezing tube is connected to an adjacent freezing tube by the a first side **8** of one tube **2** and the second side **9** of the other tube **2**.

[0136] The freezing tubes are arranged in one plane such that they form a freezing plate **1** with a top freezing plate surface **6'** and a bottom freezing plate surface **7'** as illustrated in FIG. **2***a*.

[0137] In the illustrated embodiment, the freezing tubes are welded together by welds extending in the longitudinal direction along the entire length of the tubes **2**. In particular, they are welded together along the joints arising in the connection of two adjacent freezing tubes **2** along the entire length of the top side **6** and the bottom side **7** of the tubes in the longitudinal direction. The welding on both sides of the tubes and in the entire length achieves for a hygienic and an easy to clean surface without crevices in the top freezing plate surface or the bottom freezing plate surface.

[0138] The welding on both sides of two tubes **2** to be attached to each other, may be performed simultaneous in the same direction, such that any deformation of the tubes due to heat dissipation arising during the welding process may be reduced.

[0139] The freezing tubes are furthermore welded together at the inlet ends **10** and the outlet ends **11**. The orientation of the tubes **2** in that matter depends on which configuration of the flow direction obtained in the freezing plate, and hence are defined by the remaining assembly of the freezing plate not illustrated in this figure.

[0140] The end welds are illustrated by the arched lines along the joints arising in the connection of two adjacent freezing tubes **2** along their ends. The end welds may add to the hygienic design of the freezing plate by eliminating any diffusion of fluids entering between the attached freezing tubes.

[0141] FIG. **7** illustrates a cross section of one embodiment of a freezing plate **1** comprising U-turn connections **54**. The freezing plate is configured for a serial fluid flow.

[0142] The freezing plate **1** comprises multiple quadrilateral freezing tubes **2**, an end section **50**, an external connection section **52** and multiple U-turn connections **54**.

[0143] The multiple quadrilateral freezing tubes **2** are attached to each other along adjacent sides of the tubes **2** in the entire length such that a planar freezing plate is obtained.

[0144] The end section **50** is arranged perpendicular to the longitudinal direction of the quadrilateral freezing tubes **2**. The external connection section **52** is also arranged perpendicular to the longitudinal direction of the quadrilateral freezing tubes **2** but in the opposite end of the multiple freezing tubes.

[0145] The external connection section **52** comprises an inlet section **103** with an inlet cavity **130** and an outlet section **104** with an outlet cavity **140**.

[0146] The multiple U-turn connections **54** are comprised in the end section **50** and in the external connection section **52**. Each U-turn connection **54** are arranged in fluid communication with the outlet end **11** of one of said multiple quadrilateral freezing tubes **2** and the inlet end **10** of another of said multiple quadrilateral freezing tubes **2**.

[0147] In this embodiment the freezing plate comprises a single inlet section **103** and a single outlet section **104** and U-turn connections **54** connection adjacent tubes such the a serial flow is achieved when in use. The orientation of the tubes **2** in regard to the inlet end **10** and the outlet end **11** is defined by the configuration of the flow in the freezing plate which is illustrated by the open-head arrows shown in the figure.

[0148] In other embodiments of the freezing plate **1**, the U-turn connections **54** may connect two freezing tubes **2** not being adjacent to each other e.g. separated by one or more freezing tubes **2**. Furthermore, the freezing plate may comprise multiple inlet sections **103** and outlet sections **104**, the freezing tubes **2** may be connected in fluid communication with only a smaller number of the multiple freezing tubes, such that two or more separate fluid flows are achieved in the freezing plate. Furthermore, the freezing plate may be configured with a combination of parallel and serial fluid flows.

[0149] In regard to the exemplary embodiments described above with reference to the accompanying figures, the present examples may have different forms and should not be construed as being limited to the descriptions set forth. Accordingly, the examples are merely described, by referring to the figures, to explain aspects. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0150] In the figures, thicknesses of a plurality of layers and areas are illustrated in an enlarged manner for clarity and ease of description thereof.

[0151] The spatially relative terms "lower" or "bottom" and "upper" or "top", "below", "beneath", "less", "above", and the like, may be used herein for ease of description to describe the relationship between one element or component and another element or component as illustrated in the drawings. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation, in addition to the orientation depicted in the drawings.

[0152] The terminology used herein is for the purpose of describing particular examples only and is not intended to be limiting. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms, including "at

least one," unless the content clearly indicates otherwise. "At least one" is not to be construed as limiting "a" or "an." It will be further understood that the terms "comprises," "comprising," "includes" and/or "including," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0153] "About" or "approximately" as used herein is inclusive of the stated value and means within an acceptable range of deviation for the particular value as determined by one of ordinary skill in the art, considering the measurement in question and the error associated with measurement of the particular quantity (i.e., the limitations of the measurement system). For example, "about" may mean within one or more standard deviations, or within ±30%, 20%, 10%, 5% of the stated value.

[0154] Unless otherwise defined, all terms used herein (including technical and scientific terms) have the same meaning as commonly understood by those skilled in the art to which this disclosure pertains. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined in the present specification.

1. A freezing plate for freezing food articles in an industrial freezing installation, comprising:

quadrilateral freezing tubes having substantially equal lengths extending in a first longitudinal direction and each of the quadrilateral freezing tubes comprising a top side, a bottom side, a first side, a second side, an inlet end and an outlet end, wherein said quadrilateral freezing tubes are arranged adjacent and parallel with each other along said first longitudinal direction next to each other forming a freezing plate;

an inlet section, where at least part of said inlet section is arranged perpendicular to said first longitudinal direction, where said inlet section comprises an inlet cavity in fluid communication with said inlet end of one of said quadrilateral freezing tubes through a first aperture arranged along a second longitudinal direction of said inlet section;

an outlet section, where at least part of said outlet section is arranged perpendicular to said first longitudinal direction, wherein said outlet section comprises an outlet cavity in fluid communication with said outlet end of said one of said quadrilateral freezing tubes through a second aperture arranged along a third longitudinal direction of said outlet section;

such that said inlet cavity of said inlet section is in fluid communication with said outlet cavity of said outlet section through a conduit of said quadrilateral freezing tubes; and

wherein said quadrilateral freezing tubes are provided in stainless steel and are attached to each other by welds extending along an entire length of said quadrilateral freezing tubes in said first longitudinal direction.

2. The freezing plate according to claim **1**, wherein said quadrilateral freezing tubes are attached to each other by welds extending along an entire length of said top side and an entire length of said bottom side of said quadrilateral freezing tubes in said first longitudinal direction.

3. The freezing plate according to claim **1**, where said inlet section and said outlet section are attached to said quadrilateral freezing tubes by a fastener.

4. The freezing plate according to claim **3**, wherein said fastener is provided by welding.

5. The freezing plate according to claim **1**, where a circumference of said conduit has a similar cross-sectional shape as cross-sectional shape of an outer surface of said quadrilateral freezing tubes.

6. The freezing according to claim **1**, further comprising a U turn connection in fluid communication with said outlet end of said one of said quadrilateral freezing tubes and said inlet end of another of said quadrilateral freezing tubes.

7. The freezing plate according to claim to **6**, further comprising:

an end section arranged perpendicular to said first longitudinal direction; and

an external connection section arranged perpendicular to said first longitudinal direction of said quadrilateral freezing tubes, said external connection section comprising an inlet section with an inlet cavity and an outlet section with an outlet cavity.

8. The freezing plate according to claim **1**, where a fluid that is a refrigerant is present within said quadrilateral freezing tubes.

9. The freezing plate according to claim **1**, further comprising an extension profile.

10. A freezing installation for freezing food articles, comprising:

a body;

a freezing plate located in the body, wherein the freezing plate comprises:

quadrilateral freezing tubes having substantially equal lengths extending in a first longitudinal direction and each of the quadrilateral freezing tubes comprising a top side, a bottom side, a first side, a second side, an inlet end and an outlet end, wherein said quadrilateral freezing tubes are arranged adjacent and parallel with each other along said first longitudinal direction next to each other forming a freezing plate;

an inlet section, where at least part of said inlet section is arranged perpendicular to said first longitudinal direction, where said inlet section comprises an inlet cavity in fluid communication with said inlet end of one of said quadrilateral freezing tubes through a first aperture arranged along a second longitudinal direction said inlet section;

an outlet section, where at least part of said outlet section is arranged perpendicular to said first longitudinal direction, wherein said outlet section comprises an outlet cavity in fluid communication with said outlet end of said one of said quadrilateral freezing tubes through a second aperture arranged along a third longitudinal direction of said outlet section;

such that said inlet cavity of said inlet section is in fluid communication with said outlet cavity of said outlet section through a conduit of said quadrilateral freezing tubes; and

wherein said quadrilateral freezing tubes are provided in stainless steel and are attached to each other by

welds extending along an entire length of said quadrilateral freezing tubes in said first longitudinal direction.

11. A method of manufacturing a freezing plate comprising:

quadrilateral freezing tubes having substantially equal lengths extending in a first longitudinal direction and each of the quadrilateral freezing tubes comprising a top side, a bottom side, a first side, a second side, an inlet end and an outlet end, wherein said quadrilateral freezing tubes are arranged adjacent and parallel with each other along said first longitudinal direction next to each other forming a freezing plate;

an inlet section, where at least part of said inlet section is arranged perpendicular to said first longitudinal direction, where said inlet section comprises an inlet cavity in fluid communication with said inlet end of one of said quadrilateral freezing tubes through a first aperture arranged along a second longitudinal direction said inlet section;

an outlet section, where at least part of said outlet section is arranged perpendicular to said first longitudinal direction, wherein said outlet section comprises an outlet cavity in fluid communication with said outlet end of said one of said quadrilateral freezing tubes through a second aperture arranged along a third longitudinal direction of said outlet section;

such that said inlet cavity of said inlet section is in fluid communication with said outlet cavity of said outlet section through a conduit of said quadrilateral freezing tubes; and

wherein said quadrilateral freezing tubes are provided in stainless steel and are attached to each other by welds extending along an entire length of said quadrilateral freezing tubes in said first longitudinal direction, the method comprising: following steps:

providing said quadrilateral freezing tubes in stainless steel;

arranging said quadrilateral freezing tubes parallel in said first longitudinal direction of the freezing tubes, and placing said quadrilateral freezing tubes next to each other forming a substantially planar top freezing plate surface and a substantially planar bottom freezing plate surface;

providing said inlet section and said outlet section;

arranging at least part of said inlet section to said inlet end of said one of said quadrilateral freezing tubes;

arranging at least part of said outlet section to said outlet end of said one of said quadrilateral freezing tubes;

connecting said quadrilateral freezing tubes either to each other along parallel lateral longitudinal sides, or connecting said quadrilateral freezing tubes to said inlet section and said outlet section, or connecting said quadrilateral freezing tubes to each other along parallel lateral longitudinal sides, and connecting said quadrilateral freezing tubes to said inlet section and said outlet section,

wherein said inlet section is in fluid communication with said outlet section through said conduit of said quadrilateral freezing tubes, such that where in use a refrigerant is capable of flowing into said inlet section, through said quadrilateral freezing tubes, and out of said outlet section and wherein attaching said quadrilateral freezing tubes to each other are performed by welding along said entire length of said quadrilateral freezing tubes in said first longitudinal direction.

12. The method according to claim **11**, wherein the connecting said quadrilateral freezing tubes to each other by welding along said said entire length of the tubes is performed by simultaneous welding in said longitudinal direction along two adjacent tubes from said planar top freezing plate surface and from said planar bottom freezing plate surface.

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