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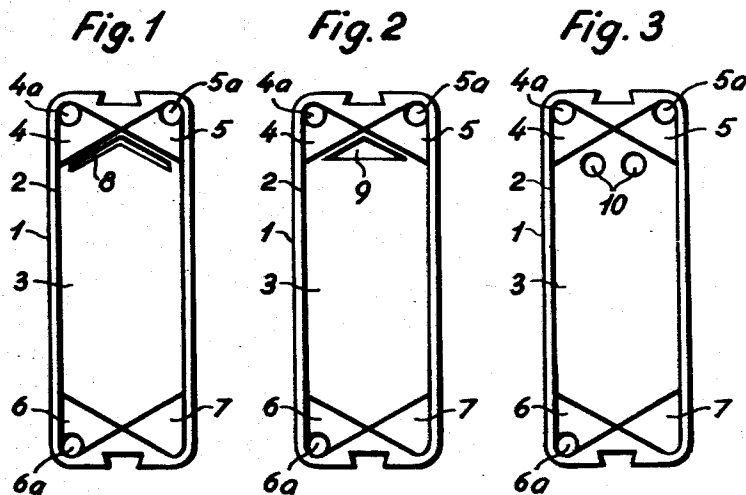
P. S. KNUDSEN

3,106,243

PLATE FOR HOLDING SECTION IN A PLATE HEAT EXCHANGER

Filed Nov. 24, 1958

4 Sheets-Sheet 1



INVENTOR.

PETER SKJØDE KNUDSEN

BY

Irwin D. Thompson

ATTY.

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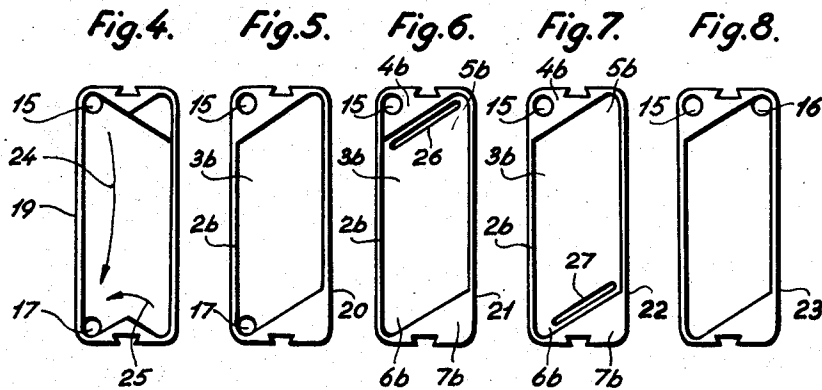
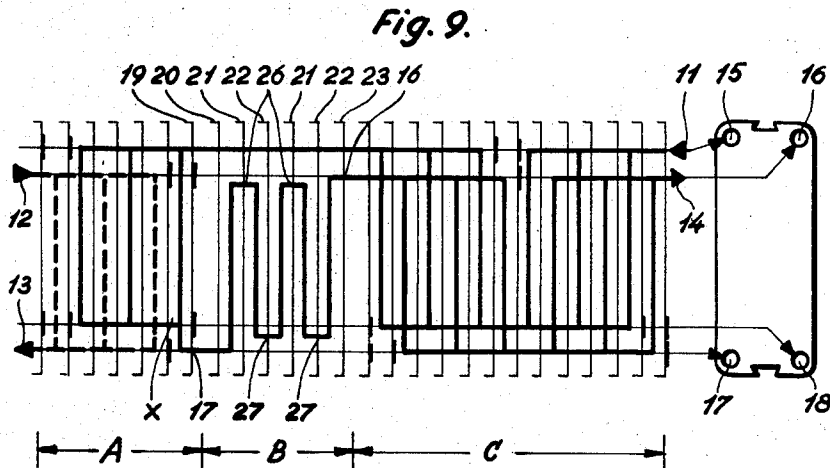
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INVENTOR.

PETER SKJØDE KNUDSEN
BY

Irwin L. Thompson

ATTY.

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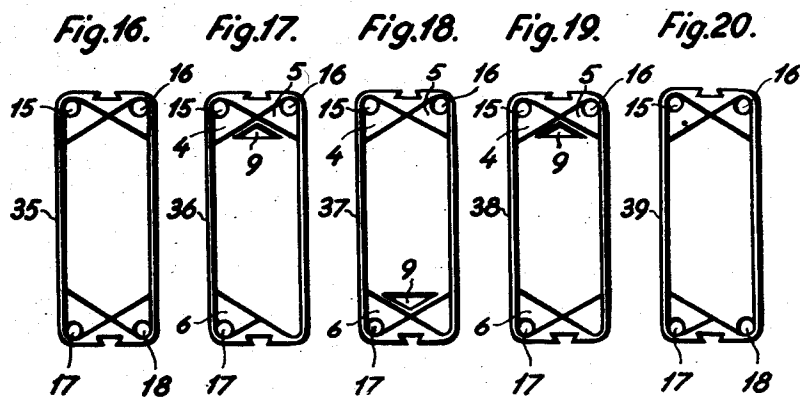
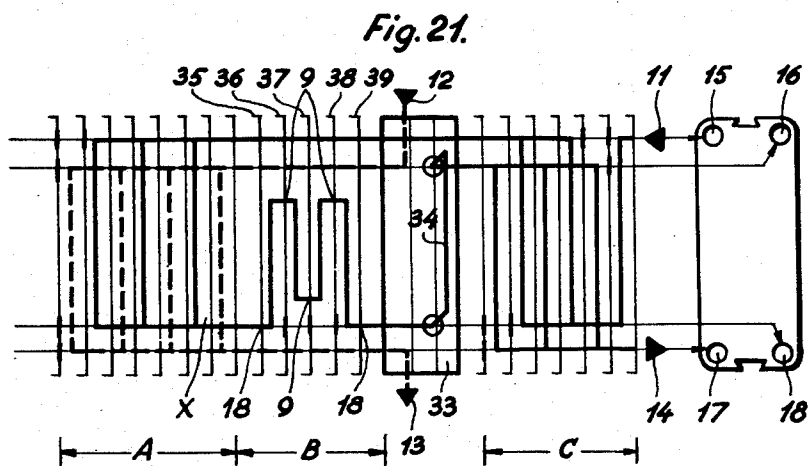
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INVENTOR.

PETER SKJØDE KNUDSEN
BY

Irwin S. Thompson
ATTY.

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PLATE FOR HOLDING SECTION IN A PLATE HEAT EXCHANGER

Peter Skjode Knudsen, Kolding, Denmark, assignor to
De Danske Mejeriers Maskinfabrik, A.m.b.A., Kolding,
Denmark

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4 Claims. (Cl. 165-167)

The invention relates to a plate designed to form a celled holding section of a plate heat exchanger, comprising a substantially quadrangular plate body with corner ducts, and a surface part defining a holding section cell and being surrounded by a packing, said part being provided with a passage for the medium passing the holding section.

The holding section serves to store the medium, which is to be processed in the heat exchanger, for a predetermined length of time, and the corner ducts serve to transport the medium from cell to cell or past a number of cells.

In known plates of this kind the said surface part, which is surrounded by a packing, is shaped as a parallelogram, two opposite corners of the parallelogram extending entirely to the corners of the plate. This arrangement has several disadvantages. The said corner portions cannot be available for the location of ducts bypassing the holding section. On the other hand, only the said two corner portions are available for the feeding of medium to the holding section or the draining off of medium therefrom. Consequently, when the holding section is placed in the plate heat exchanger, adverse conditions of flow may arise in certain plate spaces, and cells may be formed in the heat exchanger, in which only a comparatively slight exchange of heat will occur. The said disadvantages will be explained in more detail hereinafter by means of an example.

The object of the invention is to provide a plate designed to form a celled holding section, whereby optimal conditions of heat exchange and of flow may be available within the heat exchanger. According to the invention this object is attained by disposing the said surface part within a packing, which extends within not less than three of the four corner portions of the plate, in which said portions the corner ducts can be located.

It is thereby obtained that the number of ducts which in the plates can be directed past the holding section can be increased, and also that such corner portions can now be chosen for feeding or draining off medium to or from the holding section that the said adverse conditions of flow and poor exchange of heat can be avoided. This is due to the circumstance obtained by the invention that it will be possible to choose from an increased number of available corner ducts to guide the different streams of medium in the heat exchanger, as will be explained in the following by way of some examples.

According to the invention it may be expedient that the passage has edges, which extend over a substantial part of the width of the plate, and of which at least the edge lengths situated nearest to the packing extend parallel to the packing.

When this embodiment is used, the passages may in other words be oblong, and as the edge lengths situated nearest to the packing are to extend parallel to the packing, a prerequisite has been provided for avoiding the formation of dead space between the passages and the packing.

In the following the invention will be explained in more detail, reference being had to the drawing where-

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FIGS. 1-3 show three different embodiments of a plate designed according to the invention,

FIGS. 4-9 show schematically a heat exchanger with a holding section having plates of the said known kind, FIGS. 4-8 showing the plates, and FIG. 9 showing a diagram of the heat exchanger,

FIGS. 10-15 show schematically one embodiment of a heat exchanger with a holding section having plates designed in conformity with the invention, FIGS. 10-14 showing the plates, and FIG. 15 showing a diagram of the heat exchanger, and

FIGS. 16-21 show schematically another embodiment of a heat exchanger with a holding section having plates according to the invention, FIGS. 16-20 showing the plates, and FIG. 21 showing a diagram of the heat exchanger.

FIGS. 1, 2, and 3 show a plate body 1. A number of such bodies serves for defining a celled holding section. It will be understood that said number of such bodies depends upon the number of cells which said holding section shall be provided with. The said body has packings 2, which surround partly a plain surface part 3, which is to serve to define a wall portion of a flow passage serving as a holding cell, partly corner portions 4, 5, 6, and 7, which are available for the location of corner ducts. The packings are placed in packing grooves, not shown, which are embossed in the plate body 1 and serve as distance pieces, which said grooves may be deeper than the grooves of the remaining plates, of which the heat exchanger concerned is to be constructed, so that the spaces between the plates in the holding section become wider than the spaces between the plates in the other part of the heat exchanger. In the shown embodiments each plate has three corner ducts, 4a, 5a, and 6a, respectively. In the surface part 3, which is surrounded by the packing, a passage has been provided, where through the medium which passes the holding section can flow from one side of the plate to the other side of the plate. In FIG. 1 the passage is an angular slot 8. In FIG. 2 the passage has the shape of an isosceles triangle. The numeral 9 denotes this passage. The edges of the passages, which are nearest to the packing, extend parallel to the packing. In the embodiment according to FIG. 3 the passage is formed of two juxtaposed holes 10. For reasons of conditions of flow techniques the apertures 8 and 9 may be preferable to circular holes.

The known plates mentioned in the foregoing are designed as schematically indicated in FIGS. 6 and 7. For good order's sake it is emphasized that the packing 2b, which surrounds the surface part 3b, for clearness has been shown attached to the plate body in the same way as the design according to FIGS. 1-3, whereas in practice the packing is placed in a separate distance frame, which is located between two plate bodies. It will be seen that the surface part 3b enclosed by the packing 2b and designed to define a cell in the holding section extends with two opposite corner portions 5b and 6b entirely to the corners of the plate body and in comparison with the plate bodies according to FIGS. 1-3 will cover the corner portions 5 and 6 thereof, so that only corner portions 4b and 7b corresponding to the corner portions 4 and 7 in FIGS. 1-3 are available for the location of corner ducts, through which medium can be led past the cells of the holding section.

It is true that it might be possible to provide the heat exchanger with further ducts, by-passing the holding section, in addition to the two ducts, which in the known plate can be located in the corner portions 4b and 7b. The fact is that it might be possible to direct a suitable number of pipes around this section. Such

an arrangement, however, necessitates that an expansion device be provided in the pipes, as the stack of plates will move during the heating and cooling of the apparatus. The available space makes it difficult to locate such an expansion device, apart from the fact that such expansion devices are costly.

FIG. 9 shows a flow diagram for a plate heat exchanger of conventional type having a number of plates defining flow areas. The heat exchanger comprises a pasteurization section A, a holding section B, and a regenerative section C. The holding section B is constructed with use of the plates shown in FIGS. 4-8. The feeding to the heat exchanger of the medium, which is to be processed, in the present instance raw milk, is shown by an arrow 11, the supply of steam to the pasteurization section is shown by an arrow 12, the draining off of condensate from the pasteurization section is shown by an arrow 13, and the draining off of processed milk from the heat exchanger is shown by an arrow 14. Corner ducts 15, 16, 17, and 18, formed of passage openings, are provided in the heat exchanger, and are available for guiding the different streams of medium.

The plates used for the holding section B are numbered 19, 20, 21, 22, and 23, respectively.

The raw milk fed through the duct 15 passes the regenerative section C, where it is heated in counter-current by the processed milk flowing away. The raw milk flows through the corner duct 15 on to the pasteurization section A, where it is pasteurized by means of the steam, which is supplied through the corner duct 16, whereas condensate is drained off through the corner duct 17. It will be realized that the media flows from cell to cell in directions opposite to one another.

Seeing that only the corner portions, wherein the corner ducts 16 or 17 can be located, will be available for inflow and outflow to and from the holding section, the milk will have to be admitted through a corner duct 17. As in the pasteurization section use is already made of a duct 17 for the outflow of condensate, heating medium can only be conducted on one side of the milk-carrying plate space X nearest to the holding section, viz. between the plate 19 and the preceding plate to the left in the drawing, whereby the heating surface of the said plate space is halved. Besides, the conditions of flow between the plate 19 and the said preceding plate will become adverse as indicated by arrows 24 and 25 in FIG. 4. It will be seen that the milk from above as well as in the lateral direction must flow to the hole 17, which forms the entrance to the holding section B, whereby the risk arises that a zone is created in the said plate space, wherein the milk flows slowly or even remains stationary. Thereby the exchange of heat is reduced, as well as the milk may burn.

Thereupon the milk flows from cell to cell in the holding section B through passages 26 and 27 located in the plates in the surface part 3b, which is surrounded by the packing 2b, and the milk leaves the holding section through the hole 16.

The embodiment of the heat exchanging apparatus shown in FIGS. 10-15 has a holding section B, which is constructed with the use of plates according to the invention. The said apparatus is of the conventional plate type heat exchanger having a number of gasket carrying plates defining flow areas. As regards the design of the passage from cell to cell in the holding section the plate is of the kind shown in FIG. 2. One of the corner portions of the plate, viz. the corner portion 4, is utilized to form a throughgoing corner duct 15, viz. the duct for raw milk 11, which through this corner duct flows from the regenerative section C to the pasteurization section A, whereas two corner portions, 7 and 5 respectively, are utilized for feeding milk to the holding section through the hole 18 and draining off milk from the holding section through the hole 16, respectively. It will be seen that the feeding of milk

to the holding section can now be effected through the duct 18, in contradistinction to the embodiment according to FIG. 9, where feeding must be effected through the duct 17. The duct 17 is thus available for receiving heating medium also on the right side of the milk-carrying plate space X in the pasteurization section A nearest to the holding section B, and in this space it will be possible in the normal way to feed and drain off the milk at diametrically opposite places of the plate, so that the conditions of flow in the plate space will be normal.

The plates for the holding section are numbered 28, 29, 30, 31, and 32, see FIGS. 10-14, which in the heat exchanger are built into the arrangement, shown in the flow diagram FIG. 15.

FIG. 21 shows the flow diagram for another embodiment of a heat exchanger according to the invention, also of the said conventional type as shown in FIG. 15, wherein three of the plates in the holding section B, said plates being of the constructional form shown in FIG. 2, are designed for transport of medium past the holding section B, the corner portions 4, 5, and 6 of the plates being provided with passage openings to form the necessary corner ducts 15, 16, and 17. The corner duct 15 takes the raw milk from the regenerative section C past the holding section B to the pasteurization section A, whereas the corner duct 16 takes the steam from the pasteurization section A past the holding section B to a coupling element, disposed between the regenerative section C and the holding section B, and the corner duct 17 takes the condensate from the pasteurization section A past the holding section B to the same coupling element 33. The use of such an embodiment of the heat exchanger might be considered, e.g. in cases when two independent heat exchanging apparatuses are mounted on a common frame. An external piping at the coupling element 33 between the duct 18 and the duct 16 is denoted 34. In this example, too, the milk-carrying plate space X in the pasteurization section A, nearest to the holding section B, is surrounded on either side by heating medium, and the feeding and draining off of milk to and from this space are effected in diametrically opposite corner portions, viz. through the ducts 15, and 18, respectively.

The plates used for the holding section B are numbered 35, 36, 37, 38, and 39, see FIGS. 16-20, and the arrangement of the plates appears from the flow diagram FIG. 21.

When in this embodiment the coupling element 33 is placed to the right of the holding section B and not as might seem obvious to the left thereof, it is due to the fact that a change-over valve is inserted after the holding section in apparatuses with automatic pasteurization control. This valve starts operating, when the temperature of the milk leaving the holding section falls below a predetermined level, and returns the milk to the storage tank of the plant. In any case there must be an intermediate plate between the holding section B and the regenerative section C, whereas in the shown arrangement a coupling element 33 can be saved between the pasteurization section A and the holding section B.

As compared with known arrangements, wherein one corner duct only is available for transport of fluid past the holding section, the plate proposed according to the invention affords a substantially increased number of possibilities for the composition of plates in the apparatus.

It is clear that a person skilled in the art will be able to produce a multiple of further modifications within the scope of the invention. The fluid openings could for instance be arranged in another way as shown in the examples, seeing that also embodiments having two corner ducts by-passing the holding section will fall within the scope of the invention.

Having thus fully described my invention I claim as new and desire to secure by Letters Patent:

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1. A plate-type heat exchanger for heat exchange between a fluid to be treated and a heating fluid comprising a heater section, holding section and regenerative section disposed in end-to-end relation; each section comprising a plurality of plates provided with ports, said plates being arranged in face-to-face spaced relation with certain of said ports in adjacent plates in said heater section being aligned with each other to provide passages for said heating fluid and said fluid to be treated and certain of said ports in adjacent plates in said holding section and said regenerative section being aligned with each other to provide passages for said fluid to be treated, gasket members peripherally sealing adjacent plates to define passages between adjacent pairs of plates in said heater section, said holding section and said regenerative section; said passages in said heater section as defined by said gaskets alternately arranged to communicate with the passages as defined by the ports in said heater plates to provide individual passages from one end of the plates to the other end thereof for the heating fluid and the fluid to be treated, the passage of said heating section adjacent said holding section as defined by said gasket members being provided for said heating fluid; said passages in said holding section as defined by said gaskets arranged to communicate with the passages as defined by the ports in said holding plates to provide individual passages from one end portion of the plates to the other end portion thereof for said fluid to be treated egressing from said heater section; said passages in said regenerative section as defined by said gaskets alternately arranged to communicate with the passages as defined by the ports in said regenerative plates to provide individual passages from one end of the plates to the other end thereof for said fluid to be treated passing toward said heater section and for said fluid to be treated egressing from said holding section; said plates, ports and gasket members together defining two separate continuous passageways in said heat exchanger, said continuous fluid passageways including a passageway through the passages in said heat exchanger for said heating fluid and a further passageway through the passages in said regenerative section, said holding section and said heating section for the fluid to be treated; said further passageway having an inlet port and an outlet port in the last plate of said regenerative section remote from said holding section and leading from the inlet port through the regenerative section, the holding section, the heating section and then back through the holding section and the regenerative section to the outlet port; the continuous passageway in the heating section having an inlet and outlet port in one of the plates of the heat exchanger for the heating fluid.

2. A plate-type heat exchanger according to claim 1 in which the one plate in which the inlet and outlet ports for the heating fluid is a coupling element and is located in the holding section remote from the heating section so that heating fluid passes from the inlet port through the passages in the holding section defined by certain of the ports therein through the heating section and then back through the holding section to the outlet port.

3. A plate-type heat exchanger according to claim 1 in which the holding section has intermediate plates forming the passages therein as defined by said gasket members, each intermediate plate having a port near one end thereof disposed opposite to the port near one end of an adjacent intermediate plate.

4. A plate-type heat exchanger for heat exchange between a fluid to be treated and a heating fluid comprising

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a regenerative section, holding section and heater section disposed in end-to-end relation including a plurality of rectangular plates arranged in face-to-face spaced relation; each plate of said regenerative section and heater section having a port in at least one corner which provides longitudinal passages in said heat exchanger, said holding section having one end plate provided with ports in diagonal corners thereof and another end plate provided with ports in corners of the same end thereof, the ports of the end plates being in communication with certain of the ports of said regenerative section and heater section, said holding section having at least one intermediate plate provided with a port in at least one corner and a port near one end thereof; gasket members peripherally sealing adjacent plates in said regenerative and heater sections to provide transverse passages between adjacent plates in communication with said longitudinal passages and to provide transverse passages in said holding section in communication with one of the ports in the diagonal corner of the one end plate of said holding section; the port near the one end of the intermediate plate and one of the diagonal ports of the other end plate of the holding section; said gasket members, ports and plates forming two continuous fluid passageways in said heat exchanger, one of said continuous fluid passageways being provided in said heat exchanger for said heating fluid, the one of the continuous fluid passageways having an inlet port and an outlet port in one of the plates of the heat exchanger and leading from the inlet port through one of the longitudinal passages formed by the corner ports, through alternative transverse passages between adjacent plates to another of said longitudinal passages of said heater section, and then to the outlet port; the other of said continuous fluid passageways being provided in said regenerative section, holding section and heater section for said fluid to be treated, the other of the continuous fluid passageways having an inlet port and an outlet port in one of the plates of the regenerative section and leading from the inlet port through one of the longitudinal passages formed by the corner ports, through alternative transverse passages between adjacent plates to another of said longitudinal passages of said regenerative section, through the longitudinal passage in said holding section, through a further longitudinal passage in said heater section, through further alternative transverse passages between adjacent plates to a still further longitudinal passage in said heater section, directly to said transverse passages of said holding section so that the further alternative transverse passage in said heater section adjacent said holding section for the fluid to be treated has an alternative transverse passage for the heating fluid therebetween, then through a further longitudinal passage in said regenerative section, through further transverse passages to a still further longitudinal passage in said regenerative section to said outlet port thereof.

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