

June 7, 1960

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2,939,686

DOUBLE PORT HEAT EXCHANGER PLATE

Filed Feb. 4, 1955

3 Sheets-Sheet 1

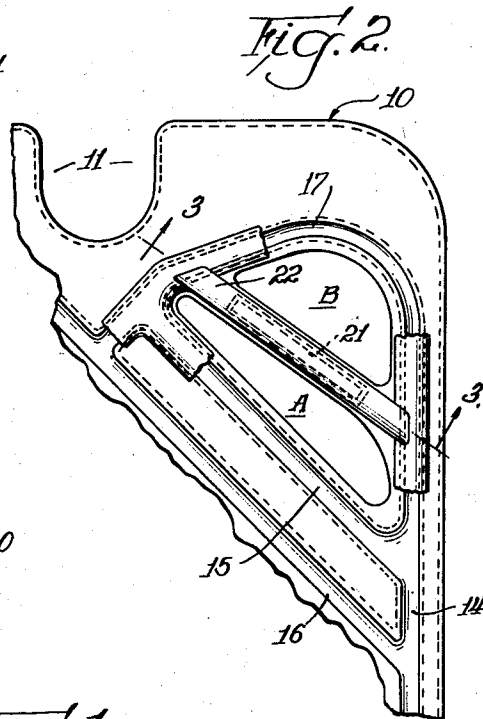
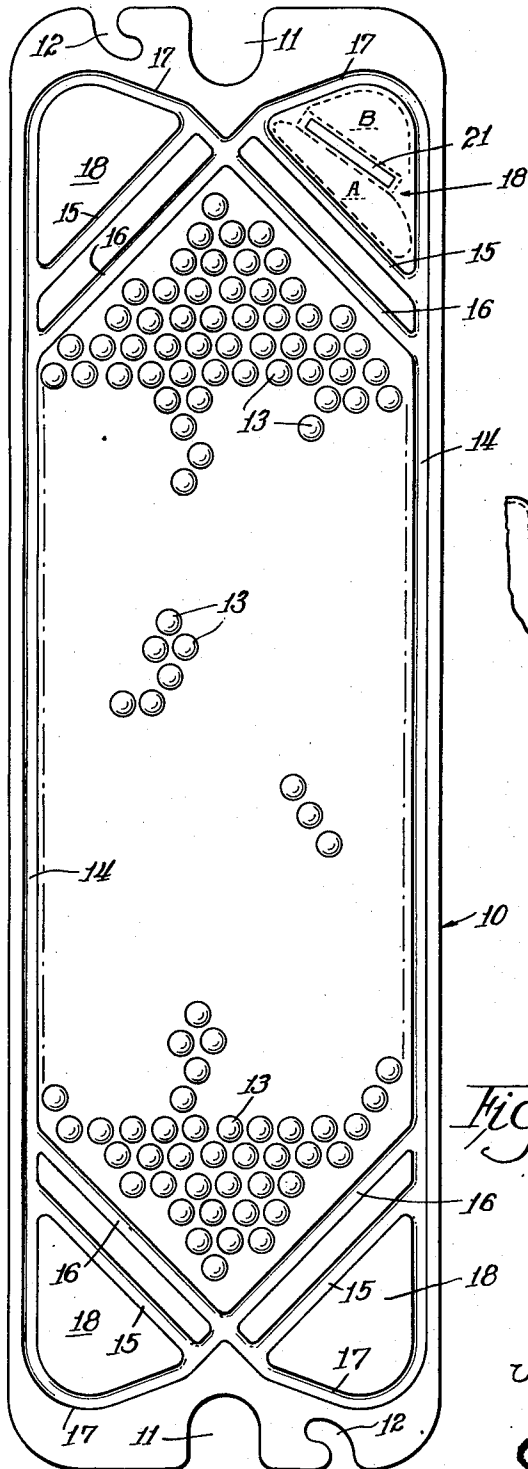


Fig. 1.

Fig. 2.

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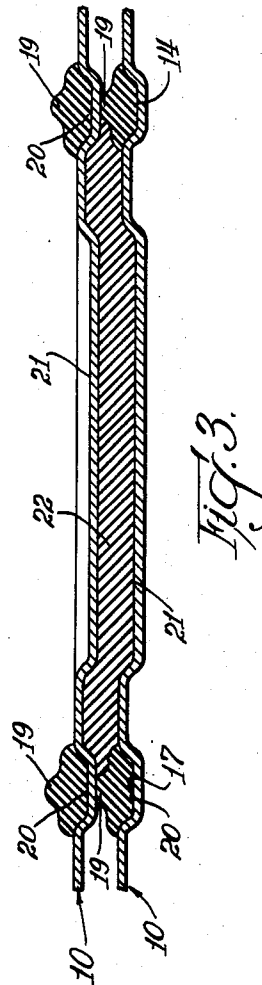
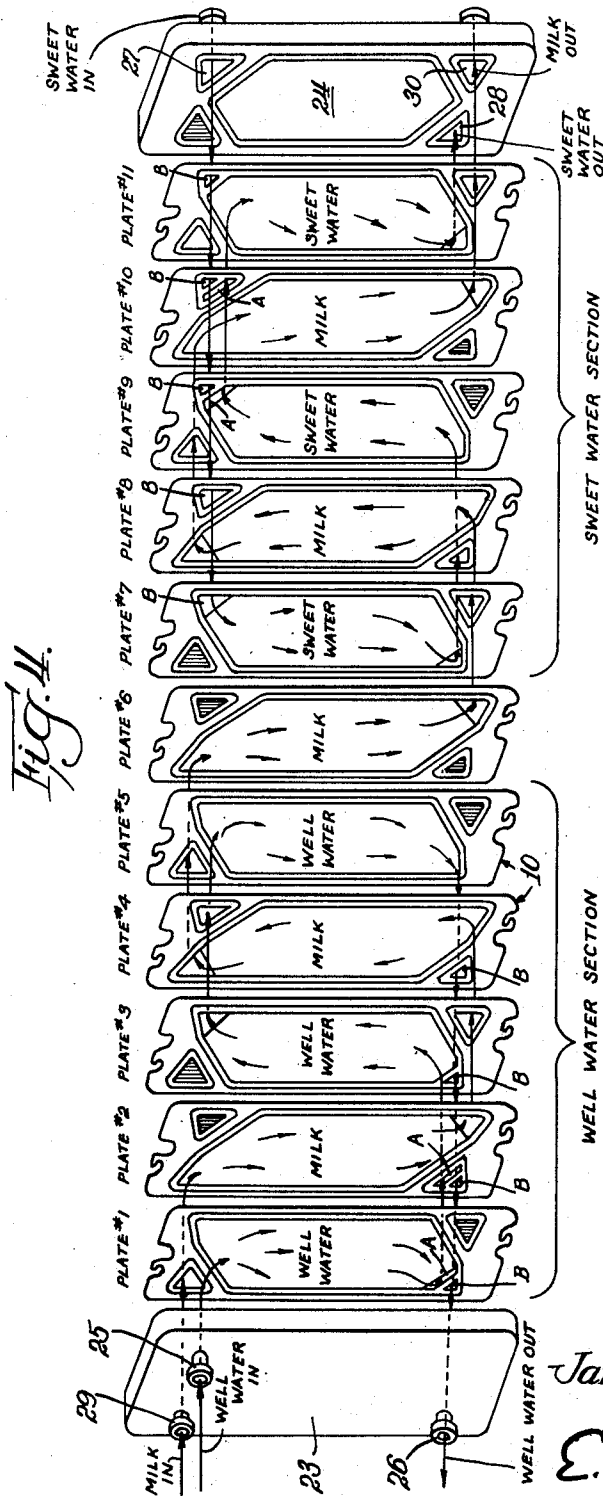
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

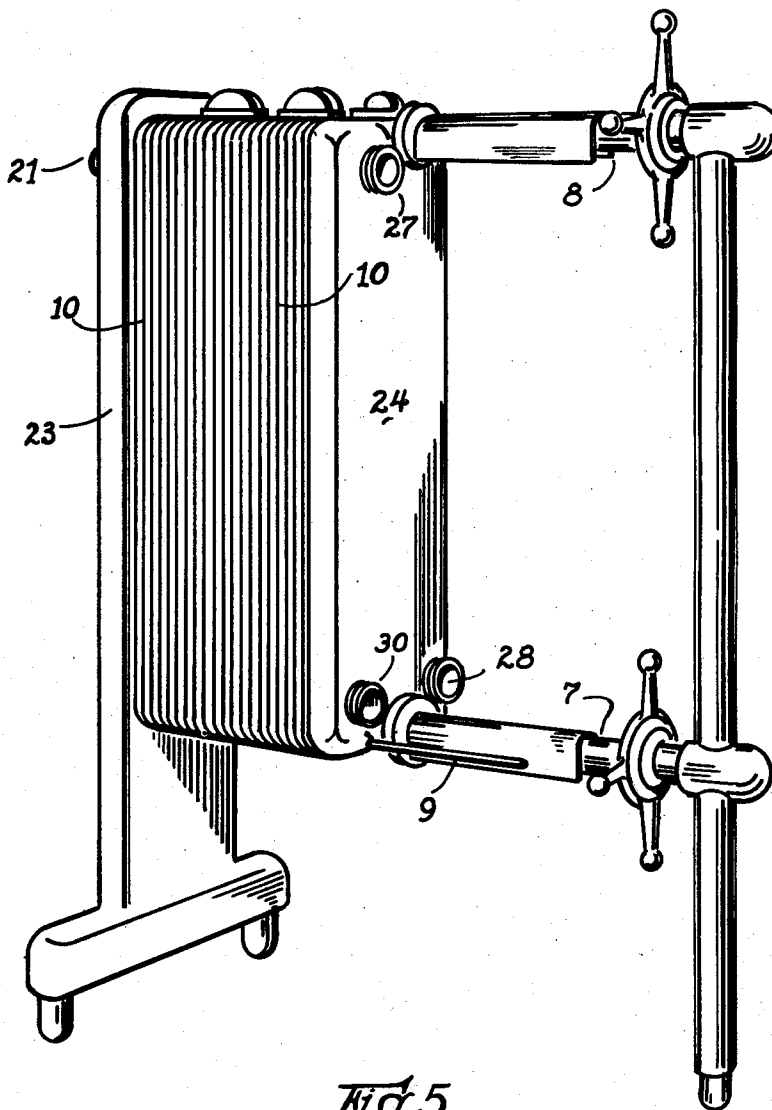


Fig. 5

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DOUBLE PORT HEAT EXCHANGER PLATE

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2 Claims. (Cl. 257-245)

My invention relates to a heat exchanger plate with a double port and has reference more particularly to plates of this character provided with auxiliary flow passages which permit a heat exchange medium to flow through a selected series of plates and back from a mid-point in a plate assembly without provision of a terminal unit at that point.

Heat exchangers of the type to which my invention relates are disclosed in Dalzell Patents Nos. 2,281,754 and 2,610,834 and in Newhall Patents Nos. 2,619,329, 2,621,028, and 2,639,126.

Heat exchange plates of this character are usually of rectangular shape with ports in one or more corners. The surfaces of the plates are usually embossed or otherwise configured to provide flow-disturbing, heat exchange surfaces; and both the heat exchange areas and the ports are bordered with gaskets to hold adjacent plates a predetermined distance apart in liquid-tight relation.

A number of such plates are interposed and compressed in face-to-face relation between a fixed end member and a movable end member, the ports and gaskets of the successive plates being so arranged that a plurality of flow paths are provided through selected ports to predetermined spaces between plates. Thus a liquid to be heated or chilled—such as milk, for example—may be channeled through the fixed end member and aligned ports to a space between plates, then through other aligned ports to the second space therebeyond, and so on to the movable end member where it is discharged.

Correspondingly, a heat exchange medium such as heated or chilled water is circulated through the fixed end member into a flow path between heat exchange plates similar to but alternating with the flow path of the milk. Thus each layer of milk between adjacent heat exchange plates is sandwiched between two layers of heat exchange medium.

Frequently, it is desired to use two heat exchange media, such as tap water for preliminary cooling of previously heated milk, and chilled water for final cooling. For this purpose, it has heretofore been necessary to provide a centrally located terminal block to provide outlets for the respective heat exchange media flowing to said terminal block from the fixed and movable end members respectively.

The principal object of my invention is to provide a heat exchange plate adapted for use in conventional press type heat exchange apparatus but designed to permit return flow of heat exchange medium from a selected intermediate location in an assembly of plates thus obviating the use of a costly intermediate terminal block.

It is a further object of my invention to enhance the adaptability of heat exchange plates to various applications at low cost and without reducing the available heat exchange area by providing double ports in certain locations, these and other objects being accomplished as hereinafter described, reference being had to the accompanying drawings in which

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Fig. 1 shows a heat exchange plate embodying my invention;

Fig. 2 is an enlarged view of a double ported corner of the plate shown in Fig. 1;

Fig. 3 is a view on the line 3-3 of Fig. 2;

Fig. 4 is a view of a series of heat exchange plates and end members, the plates being separated to show gasketing and flow paths; and

Fig. 5 is a perspective view of a heat exchanger of the type to which my invention relates, showing the supporting structure for the heat exchange plates.

Referring now to the drawing, the heat exchange plates to which my invention relates are designated generally by the reference numeral 10 and are of substantially rectangular form as shown in Fig. 1. Each plate 10 is provided at each end with centered notches 11, and arcuate slots 12 adjoining said notches 11.

The plates 10 are so designed that either notch 11 may be at the bottom and such notch 11 in that position is designed to rest on a supporting rod 7 (Fig. 5) the notch 11 at the top then serving to straddle an aligning rod 8 corresponding to the supporting rod. The slot 12 at the top of the plate 10 engages an auxiliary rod 9 which cooperates with the aligning rod 8 to permit tilting the plates 10 out of position for cleaning. The rods 7, 8 and 9 are carried by suitable supporting means such as that shown in Fig. 5.

The heat exchange surfaces of the respective plates 10 are provided with substantially hemispheric embossments or knobs 13 which serve the purposes of providing a flow disturbing surface across which the liquid to be cooled must flow, affording more heat exchange area, and spacing the plates apart. To accomplish the latter purpose, the knobs 13 may be arranged in a symmetrical pattern but sufficiently off center so that when alternate plates are inverted, the knobs 13 of one plate 10 bear against an unembossed portion of the next adjoining plate 10.

Each plate 10 is provided with a plurality of gasket grooves, there being lengthwise grooves 14 along each side of the heat exchange area containing the knobs 13. Intersecting diagonal grooves 15 are provided near the ends of said grooves 14 to define the wedge-shaped ends of the heat exchange area. Similar diagonal gasket grooves 16 are spaced from said grooves 15 and communicate with the tangential extensions of relatively arcuate grooves 17 to enclose substantially triangular port spaces 18. The grooves 14, 15, 16, and 17 are interconnecting so that any selected gasket pattern may be applied to each plate 10.

The gaskets are strips of rubber or neoprene or other suitable compressible material having a base 20 adapted to be seated and preferably secured by means of some adhesive material such as a thermosetting plastic in the gasket grooves 14, 15, 16, and 17. The tops of the gasket strips 19 are rounded and serve to bear against the under side of the groove channels of the next adjoining plate 10.

In accordance with my invention, one of the port spaces 18, such as that in the upper right hand corner of the plate 10 shown in Fig. 1, is provided with two separately gasketed ports, a primary port B and a secondary port A, each indicated by dotted lines, with a divider groove 21 therebetween, which groove 21 preferably does not extend in either direction as far as the respective tangential extensions of the arcuate groove 17. The divider groove 21 is adapted to receive a gasket strip 22 which extends in sealing relation between gaskets 19 in the tangential extensions of the arcuate groove 17.

The plates 10 are normally formed by stamping sheet metal such as stainless steel or the like in the embossed form as shown in Fig. 1 but without punching out any of the port spaces. Particular port spaces are punched

out at the time a group of plates 10 are being set up. Thus, in practicing the present invention, when the arrangement of a particular plate assembly has been worked out, each plate has certain port spaces 18 and ports A and B punched out to provide for the predetermined flow pattern, and the plates are then gasketed to provide for flow from opposed ports across the faces thereof and also to seal off certain ports to by-pass certain spaces between plates.

Referring now to Fig. 4, I shall describe the flow in a typical plate arrangement wherein my double port plates are used. The separation of the plates in Fig. 4 permits convenient viewing of the port and gasket arrangements of the successive plates and the flow pattern therethrough.

The fixed end member is designated by the reference numeral 23 and is provided with a milk inlet, a well water inlet, and a well water outlet as shown. At the opposite end a movable end member 24 is provided, containing a milk outlet, a sweet water inlet, and a sweet water outlet as shown. The term "sweet water," which is well known in the dairy and heat exchanger industries, refers to ice-chilled water which is used as a cooling medium in the place of brine. Sweet water can be cooled only to the temperature of ice and not below. For this reason it is ideally suited to chilling milk since it cannot be cooled sufficiently to freeze the milk. Brine, on the other hand, is usually cooled to a temperature considerably below the freezing point of water and, if used to cool milk, would tend to freeze it along the heat exchange surfaces.

Well water is used for preliminary cooling of the milk as it passes through the first group of plates, while the sweet water is the medium which provides the final cooling of the milk as it continues to flow through the remainder of the plates.

Well water is introduced into the plate assembly through an inlet 25 in the fixed end member 23, the inlet 25 being opposite the non-ported upper right corner of plate No. 1. Said non-ported corner of plate No. 1, the heat exchange area thereof, and port A of the double-ported lower left corner of said plate are surrounded by a gasket which serves to channel well water from inlet 25 across the face of plate No. 1 to port A thereof.

Plate No. 2 has a double port in the lower left corner, port A thereof being gasketed so that well water passing through port A of plate No. 1 goes directly through port A of plate No. 2 to plate No. 3. The latter has a lower left corner adapted for double porting, but the port A area is not punched out, said area being surrounded along with the heat exchange area of said plate and a punched out port in the upper right corner thereof by a gasket. Thus well water passing through port A of plate No. 2 is channeled across the heat exchange area of plate No. 3 and out through the port in the upper right corner thereof.

The port in the upper right corner of plate No. 4 is gasket surrounded so that well water goes directly there-through to plate No. 5. The latter has the port areas in the upper right and lower left corners surrounded along the heat exchange area thereof by a gasket so that well water passing through the upper right corner port of plate No. 4 passes downwardly across plate No. 5 to the lower left corner. From that point, the well water passes back through gasketed ports B in the lower left corners of plates Nos. 4, 3, 2, and 1, respectively, to the outlet 26 in the fixed end member 23.

It will be understood that except for the ports B in the double-ported corners of said plates, as contemplated in my invention, a conventional terminal block would have had to be provided at plate No. 5 to provide an outlet for the well water. By virtue of said double ports, however, the well water passes back to the fixed end member 23 for discharge.

From the movable end member 24 at the opposite end of the plate assembly, sweet water is introduced through

inlet 27. In a preferred arrangement, the sweet water passes through aligned ports B of plates Nos. 11, 10, 9, 8, and 7, respectively, to the space between plates Nos. 6 and 7 where it passes downwardly to the lower left corner of plate No. 7. The port in the lower left-hand corner of plate 8 is surrounded by a gasket so the sweet water passes through the space between plates Nos. 8 and 9. Since neither lower corner of plate No. 9 has a port formed therein, the sweet water then flows upwardly across the heat exchange surface of plate No. 9 to the only port communicating with said surface, port A in the upper right hand corner. Port A in the upper right hand corner of plate No. 10 is enclosed by a gasket so the sweet water flows through plate No. 10 to the space between plates 10 and 11, passing downwardly over the heat exchange surfaces thereof and through the port in the lower left-hand corner of plate 11. The sweet water then flows out through the sweet water outlet 28 in the end member 24.

Milk is introduced into the plate assembly through the milk inlet 29 in the fixed end member 23. The milk then passes in the conventional manner through a flow path that carries it through alternate heat exchange spaces, that is on a flow path between plates Nos. 1 and 2, then between Nos. 3 and 4, then between Nos. 5 and 6, then between Nos. 7 and 8, and then between Nos. 9 and 10 from which space it passes through the ports in the lower right corners of plates Nos. 10 and 11 to the milk outlet 30 through which it is discharged from the plate assembly.

It should be understood that the arrangement of plates and ports described herein and as shown in Fig. 4 are merely illustrative of the various types of flow patterns and plate arrangements which are made possible by my invention, and while I have shown and described my invention in this illustrative form it may be practiced in a variety of ways and with a variety of products and heat exchange media without departing from the spirit of my invention, the scope of which is to be determined by the appended claims.

I claim:

1. In a plate-type heat exchange apparatus of the class described, the combination of plate supporting means, end members movable relative to each other and having fluid inlets and outlets therein, and at least ten substantially rectangular corner ported heat exchange plates mounted in stacked relationship on said supporting means and adapted to be engaged between said end members, two of said heat exchange plates positioned in the series next adjacent one of the end members having primary and secondary ports located in one corner, and two additional heat exchange plates positioned in the series and spaced one plate from the other end member having primary and secondary ports located in one corner, said ten plates being arranged in series to form three separate flow paths, the first flow path being through an inlet in one of said end members, through a port in one corner of the first plate in said series, through the space defined by surfaces of the first and second plates in the series, through aligned corner ports in the second and third plates in the series, through the space defined by surfaces of the third and fourth plates in the series, through aligned corner ports in the fourth and fifth plates, through the space defined by the surfaces of the fifth and sixth plates in the series, through aligned corner ports in the sixth and seventh plates, through the space defined by surfaces of the seventh and eighth plates in the series, through aligned corner ports in the eighth and ninth plates, through the space defined by surfaces of the ninth and tenth plates in the series, through a corner port in the tenth plate, and through an outlet in one of said end members, the second flow path being through an inlet in one of said end members, through the space defined by surfaces of said end member and said first plate, through aligned secondary ports in corners of said first and second plates, through the space defined by the surfaces of sec-

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ond and third plates, through aligned corner ports of said third and fourth plates, through the space defined by surfaces of said fourth and fifth plates, returning through aligned ports in corners of said first five plates, including the primary ports of said first, second and third plates, and through an outlet in one of said end members, the third flow path being through an inlet in one of said end members, through aligned corner ports of the tenth, ninth, eighth and seventh plates, including the primary ports of the tenth and ninth plates, through the space defined by surfaces of the sixth and seventh plates, through aligned corner ports in the seventh and eighth plates, returning through the space defined by surfaces of the eighth and ninth plates, through aligned secondary ports in corners of said ninth and tenth plates, and through an outlet in one of said end members.

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2. The plate-type heat exchange apparatus of claim 1 in which said primary ports are generally triangular in shape and said secondary ports are elongated in shape and located adjacent one side of said triangular-shaped primary port.

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