

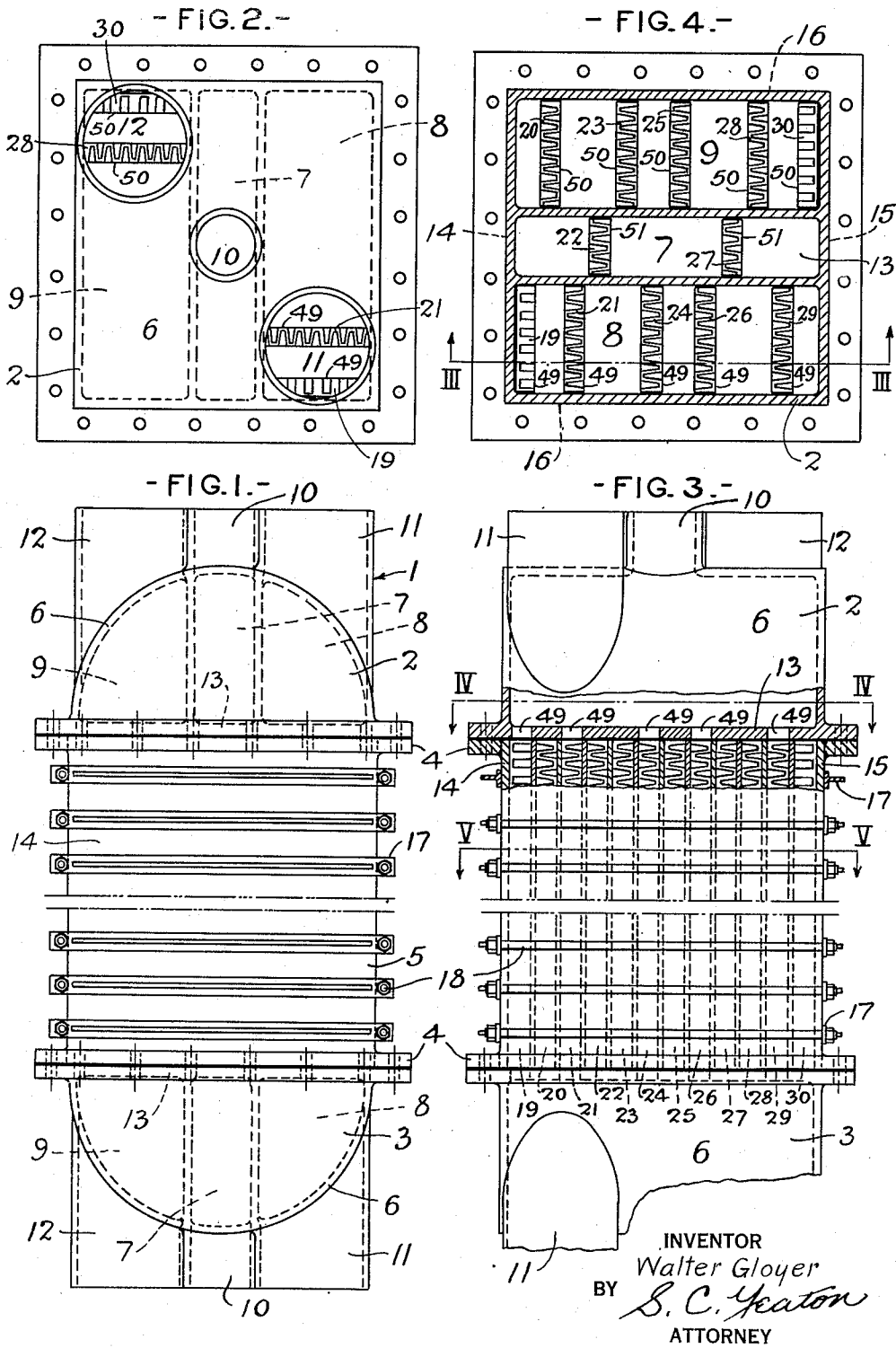
**Nov. 7, 1950**

**W. GLOYER**  
**HEAT EXCHANGER**

**2,529,013**

Filed May 10, 1945

2 Sheets-Sheet 1



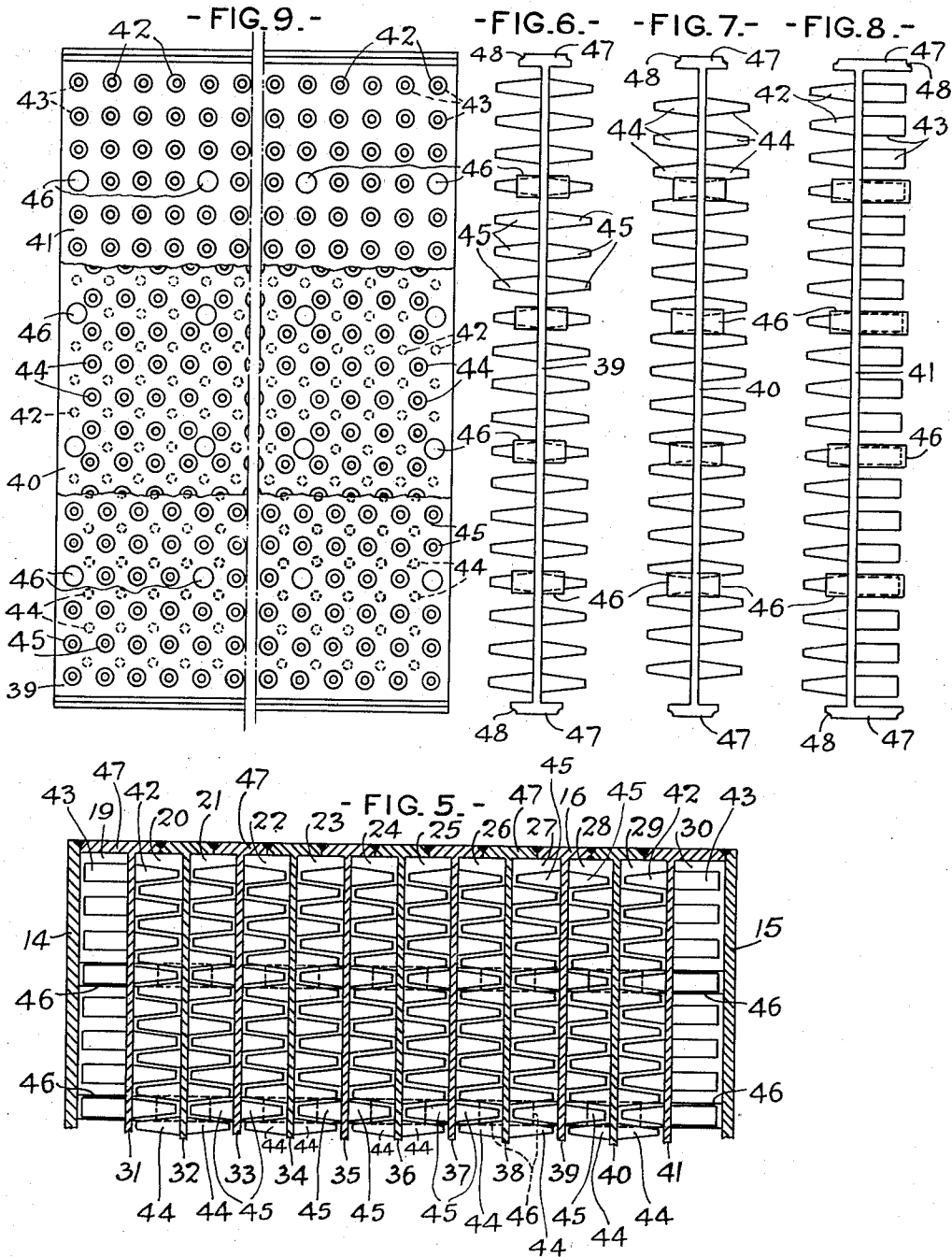
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## UNITED STATES PATENT OFFICE

2,529,013

## HEAT EXCHANGER

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1 Claim. (Cl. 257—245)

1

This invention relates to heat exchangers.

An object of the present invention is to provide a plate-type heat exchanger for heat exchange of one fluid with two other fluids, the heat exchange surfaces of the plates being extended by pin fins.

Other and further objects of this invention will appear from the following description, the accompanying drawings and the appended claim.

Referring to the drawings forming a part of this application, Figure 1 is a foreshortened front elevation of a heat exchanger constructed in accordance with this invention; Fig. 2 is a plan view of the heat exchanger; Fig. 3 is a foreshortened side view of the heat exchanger, taken from the right side of Fig. 1, partly in side elevation and partly in section on the line III—III of Fig. 4, parts being broken away; Fig. 4 is a section on the line IV—IV of Fig. 3; Fig. 5 is an enlarged sectional view on the line V—V of Fig. 3 of a portion of the exchanger; Fig. 6 is an enlarged plan view of one plate of the exchanger; Fig. 7 is an enlarged plan view of another plate of the exchanger, adapted to be disposed adjacent the plate of Fig. 6; Fig. 8 is an enlarged plan view of an outer plate of the exchanger, adapted to be disposed adjacent the plate of Fig. 7; and Fig. 9 is a foreshortened view looking at the three plates of Figs. 6–8 from the left side thereof, parts being broken away to show the lower third of the plate of Fig. 6, the middle third of the plate of Fig. 7 and the upper third of the plate of Fig. 8.

The heat exchanger 1 is of the plate-type having pin fins. It includes a top header 2 and a bottom header 3, the headers being similar and being bolted respectively to top and bottom flanges 4 of a shell 5.

Each header includes a semi-cylindrical dome 6 partitioned into a central chamber 7 and side chambers 8 and 9 on opposite sides thereof. Chamber 7 is provided with a small cylindrical nozzle 10 and chambers 8 and 9 are provided respectively with large cylindrical nozzles 11 and 12. The chambers are closed at their inner ends by a wall 13 in which are ports later to be described for communicating with the shell.

The shell 5 is rectangular in cross section and includes two walls 14 and 15 each formed of a long solid plate of metal. Wall 14 will be considered the shell front wall for the purpose of clarity in the following description. The side walls 16 or the shell are built-up welded constructions as will presently appear, these walls 16 being welded to the walls 14 and 15. The

2

shell is very long (high) relative to its cross-sectional dimensions and is braced externally by rows of spaced T-irons 17 extending across the walls 14 and 15, and secured together by tie bolts 18 extending across the walls 16.

The shell is partitioned into twelve longitudinal compartments or chambers 19–30 inclusive by eleven longitudinal plates 31–41 inclusive provided with pin fins. The chambers are numbered in order from the front of the shell rearward and the plates are similarly numbered in order, plate 31 being adjacent chamber 19 (Fig. 5). Plates 31 and 41 are similar but oppositely disposed. Plates 31 and 41 each has rows of conical pin fins 42, arranged in square pitch, integral with its inner side, and cylindrical pin fins 43 in line with the fins 42 on its outer side. The pin fins are spaced and they extend substantially the full depth of the chamber in which they are disposed, the depth being the distance, for example, between adjacent plates.

Plates 32, 34, 36, 38 and 40 similar. Each has conical pin fins 44 extending in alignment from its opposite sides. These fins are similar to fins 42. Plates 32 and 40 are disposed so that their fins 44 on the outer sides fit in the spaces between the adjacent fins 42. Plates 33, 35, 37 and 39 are similar. Each has conical pin fins 45 extending in alignment from its opposite sides. These fins are similar to fins 44 and are disposed in the spaces between these fins 44. The clearance in the inner chambers between the pin fins is very small, but is shown enlarged somewhat in the drawings for clarity. The clearance between the cylindrical pin fins 43 is also shown enlarged in the drawings for clarity. The fins greatly reduce the net free flow area of the chambers.

Each plate also has extending from its opposite sides rows of cylindrical bosses 46. The bosses extend outwardly from the plates 31 and 41 abut the walls 14 and 15 respectively and the other bosses extend half the depth of the adjacent chambers and abut each other, thus forming segmental bracing rods extending between walls 14 and 15 for bracing the plates against bending due to pressure differentials.

Each plate has integral therewith at its longitudinal edges, flanges 47. These flanges, when welded together, form the side walls 16, as is clearly shown in Fig. 5. The shapes of the flanges in cross section are best shown in Figs. 7 and 8. The flanges of all the inner plates are similar to the flange of Fig. 7, extending equal distances on opposite sides of the plate and having welding shoulders 48 formed in the outer longitudinal

3

edges. The flanges of the outer plates are similar except that on the outer sides of these plates they extend beyond the cylindrical fins. Thus each flange 47 of plate 31 abuts plate 14, and each flange 47 of plate 41 abuts plate 15. Plates 14 and 15 are formed with welding shoulders which mate with the adjacent shoulders 48 of the adjacent flanges 47. Mating shoulders 48 form outwardly opening U-grooves for welding.

Nozzle 11 communicates, through chamber 8, with chambers 19, 21, 24, 26 and 29, wall 13 being provided with ports 49 opening into these chambers at the right side (Fig. 1) thereof. Nozzle 12 communicates, through chamber 9, with chambers 20, 23, 25, 28 and 30, wall 13 being provided with ports 50 opening into these chambers at the left side (Fig. 1) thereof. Nozzle 10 communicates, through chamber 7, with chambers 22 and 27, wall 13 being provided with ports 51 opening into these chambers at the center thereof. While ports 49 and 50 open into their respective chambers only at one end thereof, the fluid entering the chambers through these ports will disperse through the spaces between the pin fins and entirely fill these chambers. The same is true of the center ports 51, the dispersion here being in opposite directions on each side of the ports 51.

Referring to Fig. 4, it will be seen that the arrangement of chambers 19, 21, 24, 26 and 29, taking them in this order, is similar to the arrangement of chambers 30, 28, 25, 23 and 20, taking them in this order. It is contemplated that three different fluids will enter the heat exchanger through nozzles 10, 11 and 12. For instance oxygen may enter the exchanger through nozzle 10, nitrogen may enter the exchanger through nozzle 12, and atmospheric air may enter the exchanger through nozzle 11. This would be one example of a three-fluid heat exchange operation carried out in the heat exchanger.

If the atmospheric air is cooled by the oxygen and nitrogen, the chambers 19, 21, 24, 26 and 29 will become frosted due to the moisture in the air. In order to defrost these chambers it is only necessary to transfer, by means of valves (not shown), the flow of air to nozzle 12 and the flow of nitrogen to nozzle 11, so that air will then flow through chambers 20, 23, 25, 28 and 30, and nitrogen will flow through chambers 19, 21, 24, 26 and 29. The nitrogen will then defrost the frosted chambers and frost will begin to accumulate in the chambers 20, 23, 25, 28 and 30, these chambers eventually being defrosted by a reversal of the above procedure.

It may be seen from Fig. 4 that transferring the air and nitrogen streams as aforementioned does not change the arrangement of the streams of fluid through the heat exchanger. That is to say, when the air is admitted through nozzle 11, the fluid flows through the twelve chambers 19 to 30 are in the following order: air, nitrogen, air, oxygen, nitrogen, air, nitrogen, air, oxygen, nitrogen, air, nitrogen, and when the air is admitted to the exchanger through nozzle 12, the same ar-

4

rangement is obtained but in the order from chamber 30 to chamber 19. No two adjacent chambers of the chambers 19 to 30 open to the same nozzle.

While there has been hereinbefore described an approved embodiment of this invention, it will be understood that many and various changes and modifications in form, arrangement of parts and details of construction thereof may be made without departing from the spirit of the invention and that all such changes and modifications as fall within the scope of the appended claim are contemplated as a part of this invention.

The invention claimed and desired to be secured by Letters Patent is:

A heat exchanger comprising a shell; a row of adjacent plates extending completely across and lengthwise through and partitioning said shell into a plurality of compartments; a single header at each end of said shell, each header having three chambers, each extending crosswise of said compartments, a nozzle for each chamber, and a single wall covering the adjacent ends of said compartments, said wall having ports in each chamber, each of said compartments communicating at one end with only one of said ports of the adjacent header and communicating at its other end with only one of said ports of the other of said headers, no two adjacent compartments communicating with the same chamber; and rows of closely spaced pin fins extending from opposite sides of each of said plates, the fins of adjacent plates interfitting, the interfitting fins being conical, each with its base adjacent its plate and the fins on the outer sides of the outer plates being cylindrical, said fins filling the major portion of said compartments, greatly reducing the net free flow area thereof.

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