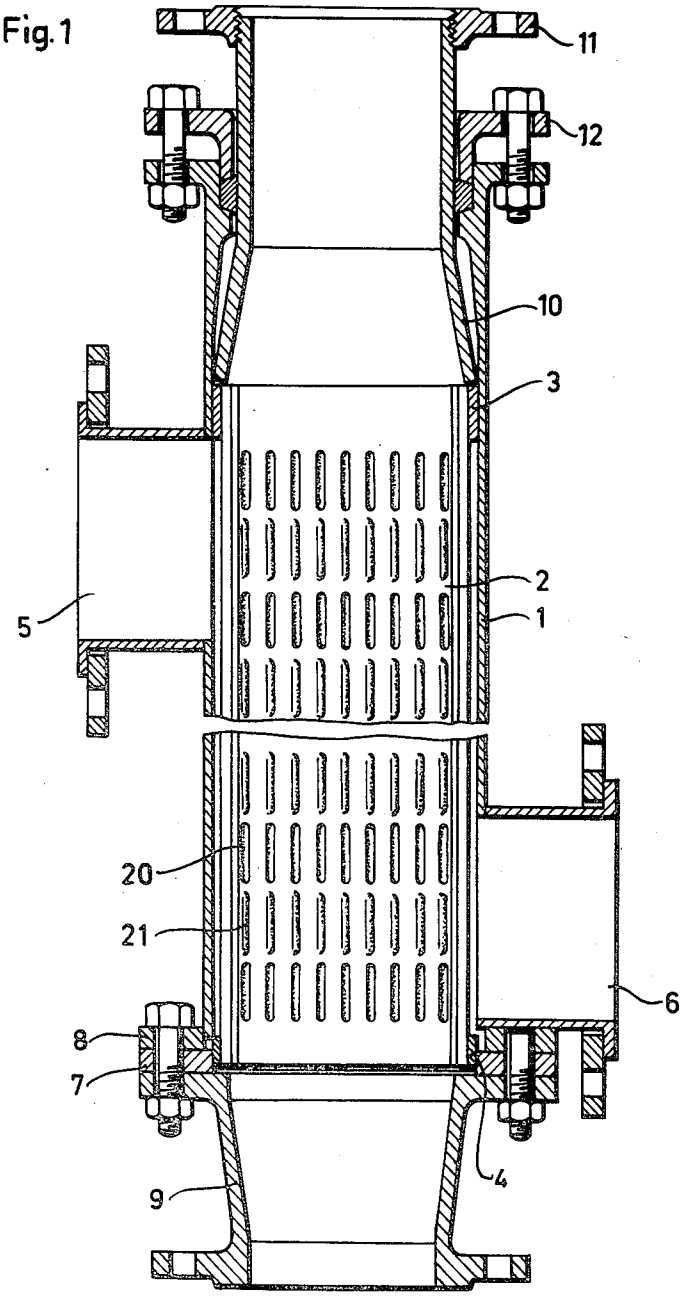
June 21, 1960 T. RAMÉN 2,941,787

APPARATUS FOR HEAT EXCHANGE

Filed Oct. 9, 1956

3 Sheets-Sheet 1

Fig. 1



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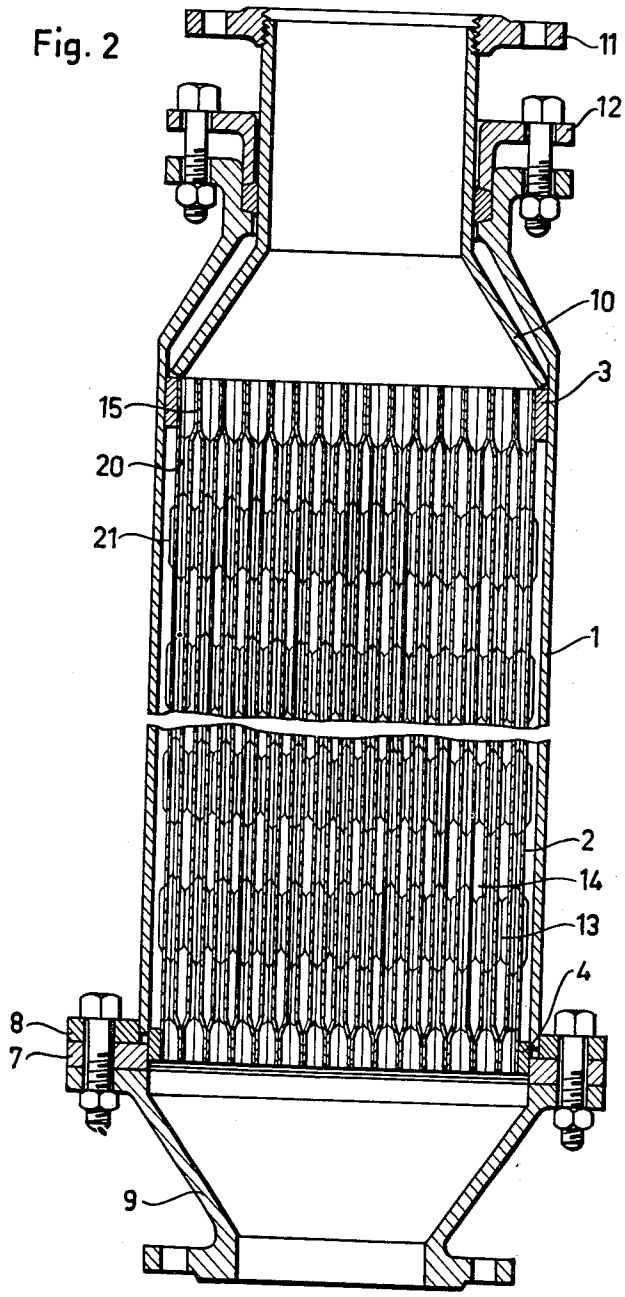
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APPARATUS FOR HEAT EXCHANGE

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3 Sheets-Sheet 2

Fig. 2



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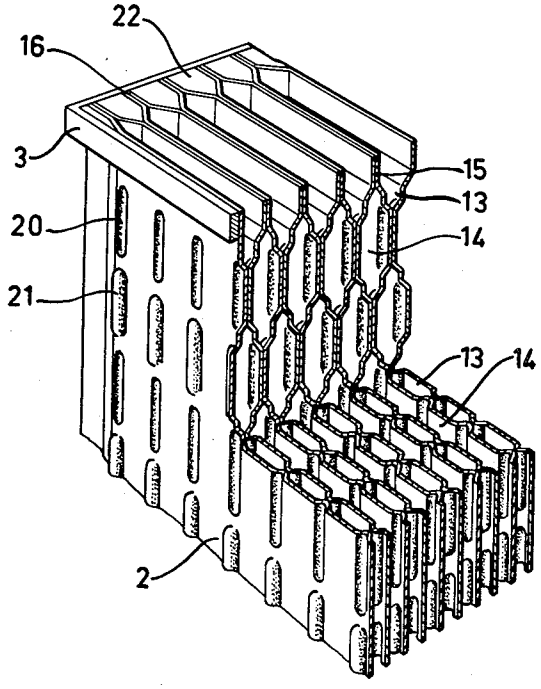
June 21, 1960 T. RAMÉN 2,941,787

APPARATUS FOR HEAT EXCHANGE

Filed Oct. 9, 1956

3 Sheets-Sheet 3

Fig. 3



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United States Patent Office 2,941,787 Patented June 21, 1960

2,941,787

APPARATUS FOR HEAT EXCHANGE

Torsten Ramén, Stockholm, Sweden, assignor, by mesne assignments, to Pedar Limited, Ottawa, Ontario, Canada, a body corporate and politic

Filed Oct. 9, 1956, Ser. No. 614,831
Claims priority, application Sweden Apr. 13, 1956
1 Claim. (Cl. 257—245)

The present invention relates to apparatus for heat exchange between two fluids (two gases, two liquids or a liquid and a gas), of the type comprising a plurality of sheets arranged in an enclosure and defining passages of flow for the two fluids.

The main object of this invention is to enable construction of large heat exchangers comprising large heat exchange surfaces. These can be subjected to considerable forces of pressure from one or the other side, and a more specific object of the invention, therefore, is to provide a construction which is simple but yet sufficiently resistant in both of these cases.

According to this invention, each sheet is provided with longitudinal depressions toward one side of the sheet and with similar longitudinal depressions toward the other side of the sheet, said depressions being arranged so that depressions toward one side are in alignment with and alternate with depressions directed toward the other side. The sheets are mounted in the heat exchanger so that depressions of each two adjacent sheets contact each other, whereby the sheets are stiffened against pressure acting on either side thereof.

The invention will be described in detail with reference to the accompanying drawings which show by way of example an embodiment thereof.

Figures 1 and 2 show two longitudinal sections of the apparatus taken at right angles to each other, the section of Figure 1 being taken between two sheets.

Figure 3 shows a fragment of the sheet pack in perspective view.

Referring to the drawings, the heat exchanger shown therein comprises a rectangular elongate casing **1** in which there are mounted a plurality of sheets or plates **2**, which define passages for the two media, e.g. steam or another gas on one hand and a liquid on the other hand or two gases or liquids. The construction of the sheets **2** will be described more in detail later on.

The sheets are carried at their ends by two frames **3**, **4**. The casing **1** is, at two opposed sides and adjacent its ends, provided with inlet or outlet ports **5** and **6** for one medium, said ports having flanges for connection to suitable fluid conduits. To the frame **4** is welded a flange **7**, which is held between a flange **8** on the casing and an outlet or inlet port member **9** through which the other medium enters or leaves. The other frame **3** is welded to a port member **10** on the opposite end of which is screwed a flange **11** for connection to a conduit. The end of the casing **1** surrounds this member **10** and forms together with a displaceable gland **12** a packing box which seals against the member **10**.

The sheets **2**, the arrangement of which is best seen from Figure 3, are provided with longitudinal depressions **20** toward one side thereof and, longitudinally aligned with and alternating with them, depressions **21** toward the opposite side, the sheets being mounted so that depressions of each pair of sheets contact each other. Thereby, longitudinal passages are formed, some of which, such as **13**, serve to admit the medium entering through one end port, **9** or **10**, and leaving through the other of them, while the other passages, such as **14**, serve to permit flow of the second medium entering through one lateral port **5** or **6** and leaving through the other lateral port. To this purpose, the sheets are at the ends of the sheet pack bent and welded together in pairs, as shown at **15**, so that the passages **13** are open toward the sheet ends and the passages **14** closed. Similarly, the sheets are bent along the sides of the sheet pack and welded together as seen at **16**, but in this case so that the passages **13** are closed toward the sheet sides, and the passages **14** open. Thus, one medium which enters e.g. through **10** may pass into the passages **13** to flow along them to the opposite end of the pack and leave through port **9** without entering the passages **14**, and the other medium entering e.g. through port **6** may pass into the passages **14** to flow along them to the other end of the sheet pack and leave through port **5** without entering passages **13**. Small filling plates **22** are arranged to fill the spaces between the bent parts **16** of the sheets **2** and the frames **3** and **4**.

The invention is not limited to the embodiment shown on the drawing, such embodiment being given merely as an example. Thus, for example, the sheets need not be welded together at their ends, but instead, the frames **3** and **4** may be replaced by box-shaped elements the bottoms of which have apertures in alignment with passages **13**, but close passages **14**. Furthermore, it is not necessary that depressions toward one side be at the same level, as shown, but the depressions may be arranged so that depressions toward one side in each longitudinal line are at the same level with depressions towards the opposite side in each adjacent longitudinal line, i.e. so that the depressions are staggered. Furthermore, the depressions toward opposite sides need not be of equal length, but, for example, the depressions directed toward passages **13** may be of greater length than the other depressions. Finally, it may be suitable, when high pressures are encountered in the heat exchanger, to make the sheet portions between the lines of depressions slightly curved instead of flat as shown on the drawing.

I claim:

Apparatus for heat exchange between two fluids, comprising, in combination: a casing, a set of flat, substantially rectangular sheets within said casing subject to high pressures exerted by said fluids, said sheets being disposed in parallel relationship and spaced apart from each other to define non-communicating passages for the respective fluids, one fluid passing through every other passage between the sheets and the second fluid passing through the remaining passages between the sheets, each of said sheets being stiffened by longitudinal rows of depressions extending along the whole length of each sheet for resisting said high pressures, each row comprising a plurality of first longitudinal depressions directed toward one side of the sheet and a plurality of second longitudinal depressions directed toward the opposite side thereof, said first depressions being in longitudinal alignment with said second depressions and alternating with them, the ends of each depression in each row being close to the adjacent ends of the adjacent depressions in the same row and said sheets being mounted so that each sheet has its first depressions in contact with the second depressions of one adjacent sheet, and its second depressions in contact with the first depressions of the other adjacent sheet.

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