

[54] HEAT EXCHANGER

[75] Inventor: Edmond Soudron, Ans, Belgium
[73] Assignee: Etablissements Thomas Defawes,
Rocour-Lez-Liege, Belgium
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[51] Int. Cl.F28a 3/12
[58] Field of Search.....165/144, 150, 130,
165/167-170; 29/157.3 D

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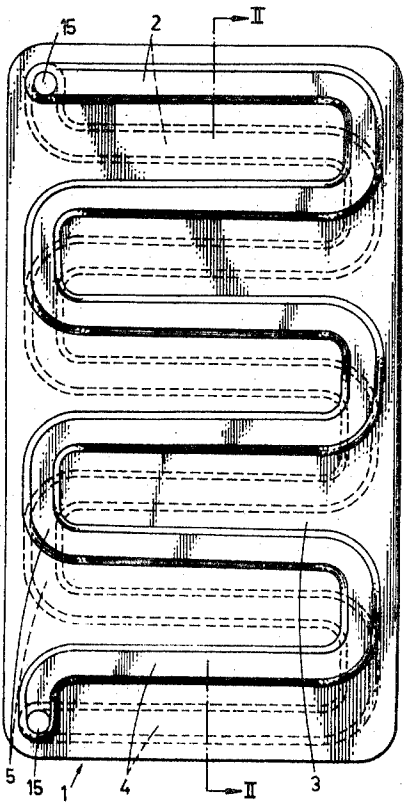
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Primary Examiner—Charles J. Myhre
Assistant Examiner—Theophil W. Streule, Jr.
Attorney—Cushman, Darby & Cushman

[57] ABSTRACT

A heat exchanger, such as a boiler, comprising a nest of tubes travelled by a heat-bearing fluid, said tubes being branched on a starting header and on a return header of fluid, as well as a heat source for heating said fluid, this nest of tubes comprising ribbed elements, the ribs of which form communicating channels for the fluid and comprised of panels applied the one against the other and each presenting a ribbed profile, wherein the ribs of the panels forming each of the elements extend as serpentine, the ribs of one panel being offset with respect to the ribs of the other panel.

4 Claims, 9 Drawing Figures



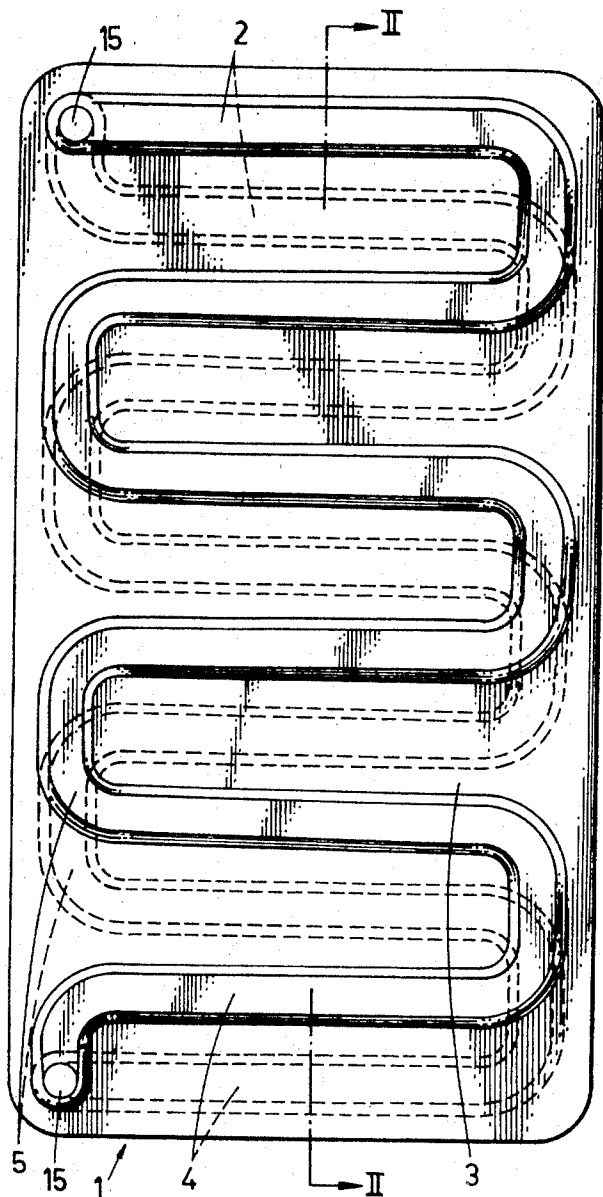


FIG. 1.

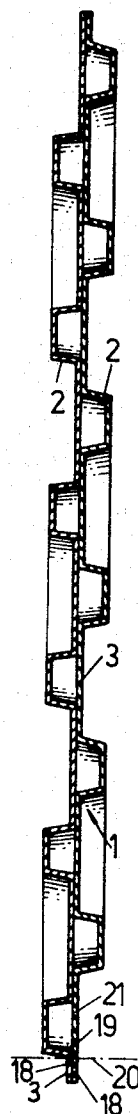


FIG. 2.



FIG. 7.

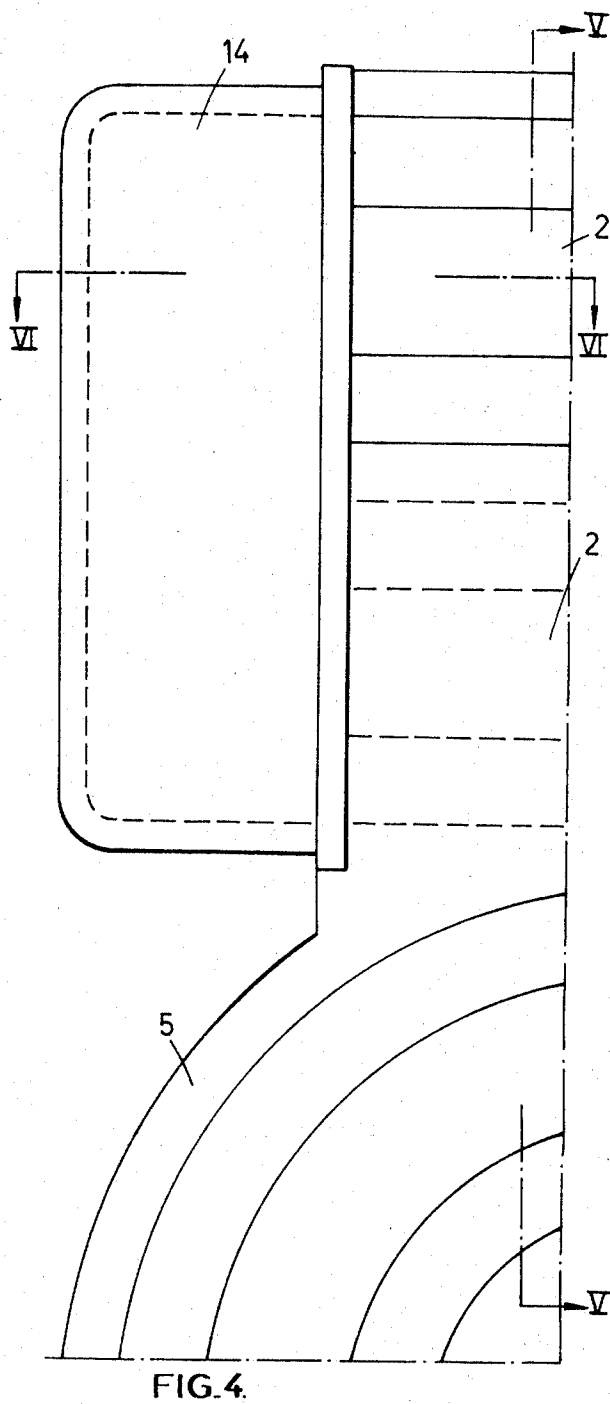
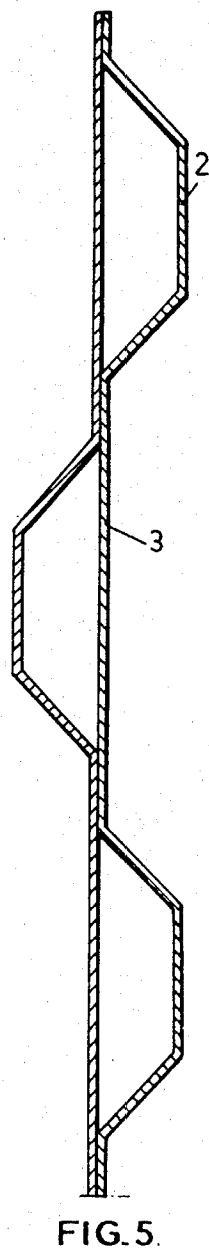
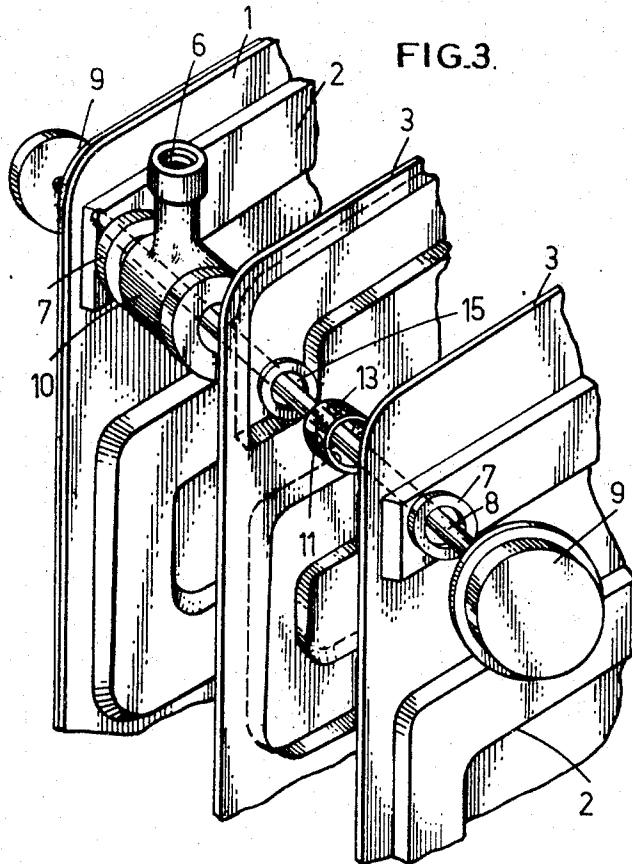
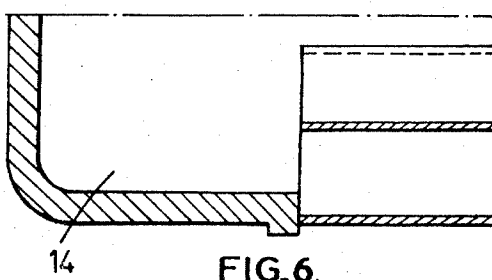
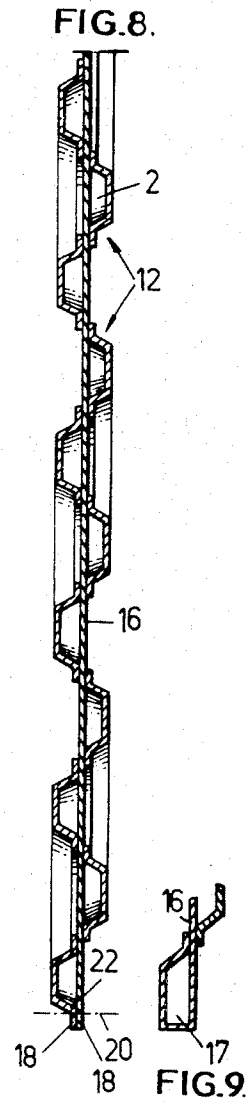


FIG. 5



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HEAT EXCHANGER

This invention relates to a heat exchanger, such as a boiler, comprising a nest of tubes travelled by a heat-bearing fluid, said tubes being branched on a starting header and on a return header of fluid, as well as a heat source for heating said fluid, this nest of tubes comprising ribbed elements, the ribs of which form communicating channels for the fluid and comprised of panels applied the one against the other and each presenting a ribbed profile.

Heat exchangers, such as boilers, were already been proposed, which are formed with ribbed elements by means of which nests of ducts which are substantially identical to nests of tubes assembled one by one and generally used in said exchangers are obtained. If the use of said ribbed elements makes much easier the construction of heat exchangers of non-standard sizes, due to the possibility to rapidly stack and assemble the desired number of elements which are prefabricated, it improves in no way the heat efficiency of the exchangers with ribbed elements with respect to the efficiency of exchangers made of conventional tube nests, because practically the ducts of the elements are arranged in an identical manner to that of the conventional tubes.

The invention has for its object to provide ribbed elements allowing to increase the heat efficiency of a heat exchanger for a same space occupied as that of the known tubes or ribbed elements.

To this end, according to the invention, the ribs of the panels forming each of the elements extend as serpentine, the ribs of one panel being offset with respect to the ribs of the other panel.

According to an advantageous embodiment of the invention, the ribs of each panel comprise right, parallel and equidistant portions, connected two by two through a curved portion.

According to a particularly advantageous embodiment of the invention, the right portions of the ribs of one panel are offset, by a distance substantially equal to half the distance separating the axes of the right portions of two successive ribs, with respect to the corresponding right portions of the ribs of the other panel, so as to form separate channels.

Other details and features of the invention will become apparent from the description of a heat exchanger according to the invention, this description being given hereinafter by way of non-limitative example and with reference to the annexed drawings.

FIG. 1 is an elevation view of an element of heat exchanger according to the invention.

FIG. 2 is a cross-section along line II—II of FIG. 1.

FIG. 3 is a perspective, partially broken away view of two elements shown in FIG. 1, before assembling thereof.

FIG. 4 is a view analogous to FIG. 1, at a larger scale, showing a variant of the element shown in FIG. 1.

FIGS. 5 and 6 are cross-sections along lines V—V and VI—VI of FIG. 4.

FIGS. 7, 8 and 9 are cross-sections, similar to FIGS. 2 and 5 and showing various embodiments of a ribbed element, which are different from those illustrated by said FIGS. 2 and 5.

In the various Figures, same reference notations relate to similar or identical elements.

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The elements 1 shown in the drawings are provided for forming in a heat exchanger such as a boiler, a stacking where the heat-bearing fluid is heated. This stacking of elements 1 is as usually mounted above a burner, such as a natural gas burner, not shown by the drawings, the sizes and the number of the elements depending from the capacity of the boiler. Each of elements 1 presents on each face hollow ribs 2 as serpentine which limit communicating channels intended to be travelled by a heat-bearing fluid. Said elements 1 are, for example and as shown by FIGS. 1 and 3, each made of two panels 3 applied the one against the other and fixed the one to the other. FIG. 3 illustrates the assembling system of panels 3 and elements 1, two of said panels 3 being shown by said FIG. 3 in an unassembled state. Panels 3, which present a ribbed profile, are advantageously made of steel sheets by swaging and the ribs thereof comprise right, parallel and equidistant portions 4, connected two by two through curved portions 5.

To improve the heat exchange by radiation and convection between the burner, the hot gases and the heat-bearing fluid, two panels 3 are assembled to form an element 1, so that the right portions 4 of the ribs 2 of one panel are offset, by a distance which is substantially equal to half the distance between the axes of two successive ribs, with respect to corresponding portions of ribs 2 of the other panel. In this way, the right portions 4 of ribs 2 of each panel form separate channels. It is only at the level of the curved portions 5 that the channels of one face of the element communicate with the channels presented by the other face of the latter. This arrangement of the ribs 2 having a form of serpentine allows to direct the flow of the heat-bearing fluid so that in each of the elements there remains no stagnant fluid zone which could create overheating points where the elements would lose their strength and would render the exchanger noisy. Furthermore, the offset existing between the ribs provided on the large opposing faces of the elements allows to provide between two successive elements, baffles which create a turbulence of the hot gases and accordingly improve the heat exchange between said hot gases and the fluid, which is not the case with the existing elements which present a substantially plane surface and which require for promoting this exchange, the mounting of directing blades for gases between the elements, which results in a complication of the manufacture and stacking of said elements and a substantial increase of the costs of the heat exchangers provided with such blades. The elements according to the invention present, which respect to known elements, the advantage, while creating baffles due to their design, to allow that a gas passageway with a constant cross-section subsists between two next elements, which allows to improve the heat exchange by convection by eliminating the unnecessary pressure losses.

As shown in FIG. 3, an unit formed of two elements is represented before the assembly of said two elements. The channels of said elements communicate through holes 15 with a connection 10 provided between said two elements. A ring 11 having apertures 13 and arranged between both panels of each elements extends along the contour of opposing holes 15 and forms a cylindrical passageway wherein the channels of said elements open through apertures 13. The cylindrical passageways and the connection 10 form a duct which

is for example branched on the starting header through a piping, not shown, connected to the nozzle 6 forming part of the connection 10.

Blind nuts 9 threaded on the ends of a rod 8 passing through the cylindrical passageways and the connection 10 are used as plugs for the holes 15 of the extreme panels. Said rod 8 and the blind nuts 9 form a tie-bar by means of which the two elements and the connection 10 are pressed the ones against the others. The rings 11 reinforce the elements at the location where said elements and the connection 10 are contiguous.

In the same way as that hereinbefore described, the channels of said elements are branched on the return header. Said branching is carried out by means of a second series of cylindrical passageway, a second connection and a second tie-bar, which are situated at the other end of the channels, which is not shown by FIG. 3. Seals 7 are provided between the connection 10 and the elements 1, as well as between the nuts 9 and the elements 1, so as to ensure tightness.

What is explained hereinbefore for a unit comprised of two elements is obviously also true for a unit comprising more than two elements. It is only the number of connection which increases and the length of rods 8 which must be adapted. In general, only one connection of each series is provided with a nozzle. The length of the connections between two successive elements corresponds to the desired distance between said elements.

FIGS. 4 to 6 show a variant of the element represented by FIGS. 1 to 3, only the portions of the embodiment of FIGS. 4 to 6 which are different from those according to FIGS. 1 to 3 having been represented and being described hereinafter.

FIG. 4 retakes from FIG. 1 only the modified portion which is at the above and left part of the Figure. A analogous modification, not shown, concerns the lower and left part of FIG. 1.

According to the embodiment, represented by FIGS. 4 to 6, the channels of the various elements are branched on a starting header 14 and on a return header, not shown. Said headers extend along a direction perpendicular to the elements. The header 14 is mounted on a portion of the element edge and has a rectangular form in cross-section. In said header, two hollow ribs open, said ribs being situated on different sides of the element to which they appertain. It results from FIG. 4 that the elements have a less important length at the level of the header 14.

The elements represented by FIGS. 4 to 6 need no longer necessarily to be assembled the ones to the others by means of tie-bars 8 but may be directly welded on the headers 14 to carry out the stacking of the elements.

As shown by FIG. 7, each of elements 1 may advantageously be formed by only one panel folded in its median portion, in a parallel direction to the ribs of the panel, the two halves of the panel being folded back the one on the other and fixed the one to the other, as hereinbefore described, so as to obtain a lower channel 17 which does not present any zone not cooled by the heat-bearing fluid in the zone of the elements subjected to the high temperatures, so as to prevent any risk of damage to the latter.

In order to prevent this risk of damage to the ele-

ments, the latter represented by FIGS. 1 2 and 8 can advantageously be carried out by cutting in 20 the edges 18 of the panel forming the element and intended to be situated in the high temperature zone, the panels being then fixed in this location by welding either of the edge 19 of the rib of one of the panels to the plane portion 21 of the other panel, or of the edge 22 of the trough to the central plate 16.

FIG. 8 shows an embodiment according to which the elements are made of only one plate 16. To the two faces of said plate troughs 12 are fixed, which form said channels 2. Said troughs are preferably welded to the plate 16 and extend as serpentines. They constitute, along the two faces of the plate, channels which communicate only by the two cylindrical passageways provided in the element, the connection of the elements according to FIG. 8 being carried out in the same way as the connection of the elements shown in FIGS. 1 to 3.

To prevent a damage to the welds of the element in the lower zone subjected to high temperatures, the lower edge of the plate 16 is as shown in FIG. 9 folded back so as to form the channel 17, this way to proceed allowing the fluid to cool the element portion subjected to high temperatures.

It is to be understood that the invention is in no way limited to the embodiments hereinbefore described and that many changes can be made without departing from the scope of this patent.

Thus, for example, a heat exchanger, such as a boiler, a radiator and the like can comprise several groups of elements constituted as explained hereinbefore.

I claim

1. A heat exchanger, such as a boiler, comprising a nest of tubes for conducting a heat-exchange fluid, said tubes being branched on a starting header and on a return header of fluid, said nest of tubes being formed by elements having hollow ribs which form communicating channels for the fluid, said elements comprising ribbed panel placed the one against the other, the ribs of each panel including straight, parallel and equidistant portions, connected two by two through a curved portion so that the ribs are serpentine in shape, the straight portions of the ribs of one panel being offset, by a distance substantially equal to half the distance separating the axes of the straight portions of two successive ribs, with respect to the corresponding straight portions of the ribs of the other panel, so as to form separate channels, the channels of one of the panels communicating with the channels of the other panel only at the location of said curved portions.

2. A heat exchanger as in claim 1, wherein each of said ribbed elements is formed from only one panel folded in its median portion in a parallel direction to one of its edges, the two halves of the panel being folded back the one on the other and fixed the one to the other so as to form said channels.

3. A heat exchanger as in claim 1, wherein each of said ribbed elements is formed of a central plate and troughs fixed on both sides of said plate.

4. A heat exchanger as claimed in claim 3, wherein the edge of said central plate is bent and folded back on the plate so as to form a channel.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,734,178 Dated May 22, 1973

Inventor(s) Edmond Soudron

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, line 30 was omitted and should appear as follows:

[30] Foreign Application Priority Data

May 27, 1970

Belgium

751.028

Signed and sealed this 27th day of November 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGMEYER
Acting Commissioner of Patents