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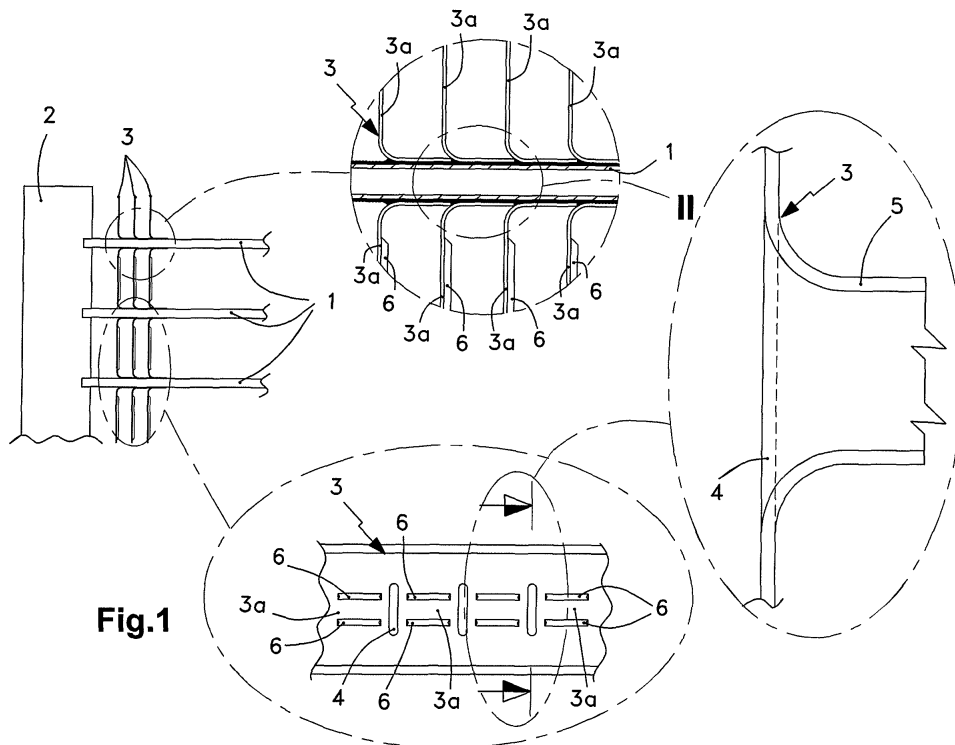
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(54) **Heat exchanger made of copper and brass alloys with a very high annealing temperature and high hardness factor able to withstand high internal pressures**

(57) Heat exchanger made of copper and brass alloys with a very high annealing temperature and high hardness factor able to withstand high internal pressures, characterized in that it consists of bundles of flattened tubes (1) which extend between respective end headers (2) and through radiating fins (3a) which are integrally incorporated in laminated plates (3) which form bundles perpendicular to those of the flattened tubes (1); the flat-

tened tubes (1), the headers (2) and the laminated plates (3) are made of copper and brass alloys which are resistant to annealing; the flattened tubes (1) are mounted through the laminated plates (3) via openings (4) in the latter which, along their edge and towards a same side of the same, these openings (4) extend so as to form a continuous flange (5) which embraces the entire contour of the flattened tube (1) which passes through it.



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Description

Field of the invention

[0001] This invention relates to a high-pressure heat exchanger which, owing to its high performance and limited volume and weight, is suitable for application to gas-fired, wall-mounted, instantaneous water heaters, as well as evaporators and condensers for refrigerating equipment which work with liquids and/or gases, and also pressurised-oil coolers.

Background art

[0002] In this sector it is known that the conventional copper alloy tubes with a flattened form are not suitable for operating directly exposed to combustion flames or fumes above 600°C.

[0003] By using a Cu, Cr alloy and the technology described in European Patent No. 1,306,626 also in the name of this same inventor it has been possible to manufacture flat-tube and zigzag fin (bellows) exchangers which are capable of withstanding the said temperature, but are unable to withstand pressures higher than 6 bar. Owing to the current assemblies used in this connection, above this pressure the tubes expand and their cross-section becomes rounder, this also resulting in deformation and warping of the cooling fins surrounding them.

[0004] When these assemblies are used for gas-fired, wall-mounted, instantaneous water heaters, in an average-size city where large differences in height must be negotiated (high buildings or buildings on hillsides or mountain slopes), in order to ensure that water arrives in the correct state to the highest user point, frequently the water supply network provides an inlet pressure of up to twelve bars; consequently, the service provider, in order to avoid complaints from users situated highest up, supplies the water to the users situated at low levels at an excessively high inlet pressure, this being dangerous for correct operation of the heater and also endangering the physical integrity of the latter or the internal supply network of the user.

Description of the invention and its advantages

[0005] In view of this situation, the heat exchanger forming the subject of this invention has the special feature that it consists of bundles of flattened tubes which extend between respective end headers and through radiating fins which are integrally incorporated in laminated plates which form bundles perpendicular to those of the flattened tubes; the flattened tubes, the headers and the laminated plates are made of copper and brass alloys which are resistant to annealing; the flattened tubes are mounted so as to pass through the laminated plates via openings in the latter which, along their edge and towards a same side of the same, these openings extend so as to form a continuous flange which embraces the entire

contour of the flattened tube which passes through it; the flanges are brazed to the flattened tubes using a brazing paste consisting of a copper combined with fluxing agents, this also being used to braze the associated flattened tubes to the headers; between each pair of consecutive openings of the radiating fins, and transversely with respect thereto, there are ribs which are obtained by means of deformation of the associated laminated body of these radiating fins; by way of a preferred embodiment it is envisaged that each flange and its opening are interconnected by means of a curved fold which, between it and the wall of the flattened tube which passes through it, forms a gap which is able to receive the edge of the flange of the adjacent parallel radiating fin, while it remains situated inside the gap corresponding to the other adjacent parallel radiating fin on the other side of the said opening of the first flange. The brazing operations mentioned are performed using the known method registered under the name "Cuprobraze" which uses a brazing paste consisting of copper combined with fluxing agents (or "binders"). Both the special copper alloy used as a paste and the process of European Patent No. 1,306,626 result in a metallographic structure which is resistant to annealing and mechanical properties which are such that the exchangers thus manufactured are perfectly resistant to very high temperatures (exposure to combustion gas flames having a temperature of 1100°C at a distance of 60 mm).

[0006] Furthermore, this structure results in an assembly in which overlapping of the flanges acts in the manner of a clamping collar which covers the whole outer surface of the flattened tubes, forming a strong part which enables operation at pressures in the region of 25 bar (with fluids in the liquid and/or gaseous state) and even higher than this value, without the flattened tubes being deformed, as occurs hitherto. This new design of exchanger, together with the material used for its construction, allows it to operate at the same time with gases up to a temperature of 1100°C outside of the tubes and 85°C inside the said tubes; it is also possible to operate with gases and/or liquids at a temperature as low as -40°C inside the flattened tubes. Said ribs formed by means of deformation of the material in the radiating fins increase the resistance of the latter to warping.

[0007] Regarding the proposed structure it should be pointed out that, together with the effectiveness of the aim for which it has been designed, it has a simple design, with a very limited volume and weight, and, owing to the materials and construction technology used, it has been shown to have a very high efficiency in energy terms.

Drawings and references

[0008] In order to understand more fully the nature of the invention, in the accompanying drawings an industrial embodiment is shown purely by way of a nonlimiting example.

[0009] Figure 1 shows a main view in which an ex-

changer according to the invention can be partially seen; in said figure the flattened tubes (1) are viewed edgewise with a corresponding end joined to one of the headers (2). Two enlarged details are obtained from this main view, i.e. a top detail, relating to the assembly of the radiating fins (3a) and the flattened tube (1), and another bottom detail, relating to a front view of a laminated plate (3); from this latter detail, in turn, an enlarged cross-section of a flattened tube (1) along its larger axis is obtained.

[0010] Figure 2 is an enlargement of the detail II encircled in the top detail of Figure 1.

[0011] Figure 3 is a schematic view, similar to the bottom detail of Figure 1 and shows a possible arrangement of the exchanger with various bundles of flattened tubes (1).

[0012] Figure 4 is the same as Figure 3, but relates to another arrangement of various bundles of flattened tubes.

[0013] In these figures the reference numbers refer to the following parts:

1. Flattened tube
2. Header
3. Laminated plate
- 3a. Radiating fins in laminated plate (3)
4. Openings in laminated plate (3)
5. Flange of openings (4)
6. Ribs in radiating fins (3a)
7. Curved fold of flanges (5)
8. Brazing paste

Description of a preferred embodiment

[0014] with reference to the figures and the reference numbers listed above, the accompanying drawings illustrate a preferred embodiment of the subject of the present invention, relating to a heat exchanger which has been especially designed for operating at high pressure with fluids in the liquid and/or gaseous state.

[0015] As shown clearly in Figure 1, the exchanger consists of bundles of flattened tubes (1) which extend between respective end headers (2) and through radiating fins (3a) which are integrally incorporated in laminated plates (3) which form bundles perpendicular to those of the flattened tubes (1); the flattened tubes (1), the headers (2) and the laminated plates (3) are made of copper and brass alloys which are resistant to annealing; the flattened tubes (1) are mounted through the laminated plates (3) via openings (4) in the latter which, along their edge and towards a same side of the same, these openings (4) extend so as to form a continuous flange (5) which embraces the entire contour of the flattened tube (1) which passes through it; the flanges (5) are brazed to the flattened tubes (1) using a brazing paste (8) consisting of copper combined with fluxing agents, this also being used to braze the associated flattened tubes (1) to the headers (2); between each pair of consecutive openings (4) of the radiating fins (3a), and trans-

versely with respect thereto, there are ribs (6) which are obtained by means of deformation of the associated laminated body of these radiating fins (3a). The bottom detail of Figure 1 shows a laminated plate (3) prepared in this case for a single bundle of flattened tubes (1) which will pass through the openings (4), between which the radiating fins (3a) extend, there being formed in the latter a pair of ribs (6) which ensure a better form rigidity.

[0016] In the enlargement of the cross-section shown in this bottom detail it is possible to see clearly the formation of one of the flanges (5) of one of the openings (4).

[0017] The enlarged constructional detail in Figure 2 shows a preferred embodiment and assembly of the flanges (5), which consists in each flange (5) and its opening (4) being interconnected by means of a curved fold (7) which, between it and the wall of the flattened tube (1) which passes through it, forms a gap which is able to receive the edge of the flange (5) of the adjacent parallel radiating fin (3a), while it remains situated in the gap corresponding to the other adjacent parallel radiating fin (3a) on the opposite side of said opening (4) of the first flange, (5). The result of this is that the flattened tube (1) is totally lined by the overlapping succession of flanges (5) which act in the manner of a clamping collar which strengthens it so that it is able to operate with high-pressure fluids (liquids and/or gases), something which hitherto has not been achieved in flattened tubes although similar materials may have been used.

[0018] This invention may be applied in general to any other arrangement of the flattened tubes. By way of example, it is possible to envisage the presence of various bundles of flattened tubes (1) which, when the exchanger rests horizontally, form tiers of flattened tubes (1) which are aligned vertically. Another alternative is the presence of various bundles of flattened tubes (1) which, when the exchanger rests horizontally, form tiers of flattened tubes (1) in which the flattened tubes (1) of the superimposed bundles alternate vertically. Figures 3 and 4 show respective examples of these alternatives which relate in both cases to a number of bundles of flattened tubes (1) equal to three.

Claims

1. Heat exchanger made of copper and brass alloys with a very high annealing temperature and high hardness factor able to withstand high internal pressures, **characterized in that** it consists of bundles of flattened tubes (1) which extend between respective end headers (2) and through radiating fins (3a) which are integrally incorporated in laminated plates (3) which form bundles perpendicular to those of the flattened tubes (1); the flattened tubes (1), the headers (2) and the laminated plates (3) are made of copper and brass alloys which are resistant to annealing; the flattened tubes (1) are mounted through the laminated plates (3) via openings (4) in the latter which,

along their edge and towards a same side of these same openings (4), extend so as to form a continuous flange (5) which embraces the entire contour of the flattened tube (1) which passes through it; the flanges (5) are brazed to the flattened tubes (1) using a brazing paste (8) consisting of copper combined with fluxing agents, this also being used to braze the associated flattened tubes (1) to the headers (2); between each pair of consecutive openings (4) of the radiating fins (3a), and transversely with respect thereto, there are ribs (6) which are obtained by means of deformation of the associated laminated body of these radiating fins (3a).

2. Heat exchanger made of copper and brass alloys with a very high annealing temperature and high hardness factor able to withstand high internal pressures, according to Claim 1, **characterized in that** each flange (5) and its opening (4) are interconnected by means of a curved fold (7) which, between it and the wall of the flattened tube (1) which passes through it, forms a gap which is able to receive the edge of the flange (5) of the adjacent parallel radiating fin (3a), while it remains situated inside the gap corresponding to the other adjacent parallel radiating fin (3a) on the opposite side of said opening (4) of the first flange (5).
3. Heat exchanger made of copper and brass alloys with a very high annealing temperature and high hardness factor able to withstand high internal pressures, according to the preceding claims, **characterized in that** there are various bundles of flattened tubes (1) which, when the exchanger rests horizontally, form tiers of flattened tubes (1) which are aligned vertically.
4. Heat exchanger made of copper and brass alloys with a very high annealing temperature and high hardness factor able to withstand high internal pressures, according to Claims 1 and 2, **characterized in that** there are various bundles of flattened tubes (1) which, when the exchanger rests horizontally, form tiers of flattened tubes (1) in which the flattened tubes (1) of the superimposed bundles alternate vertically.

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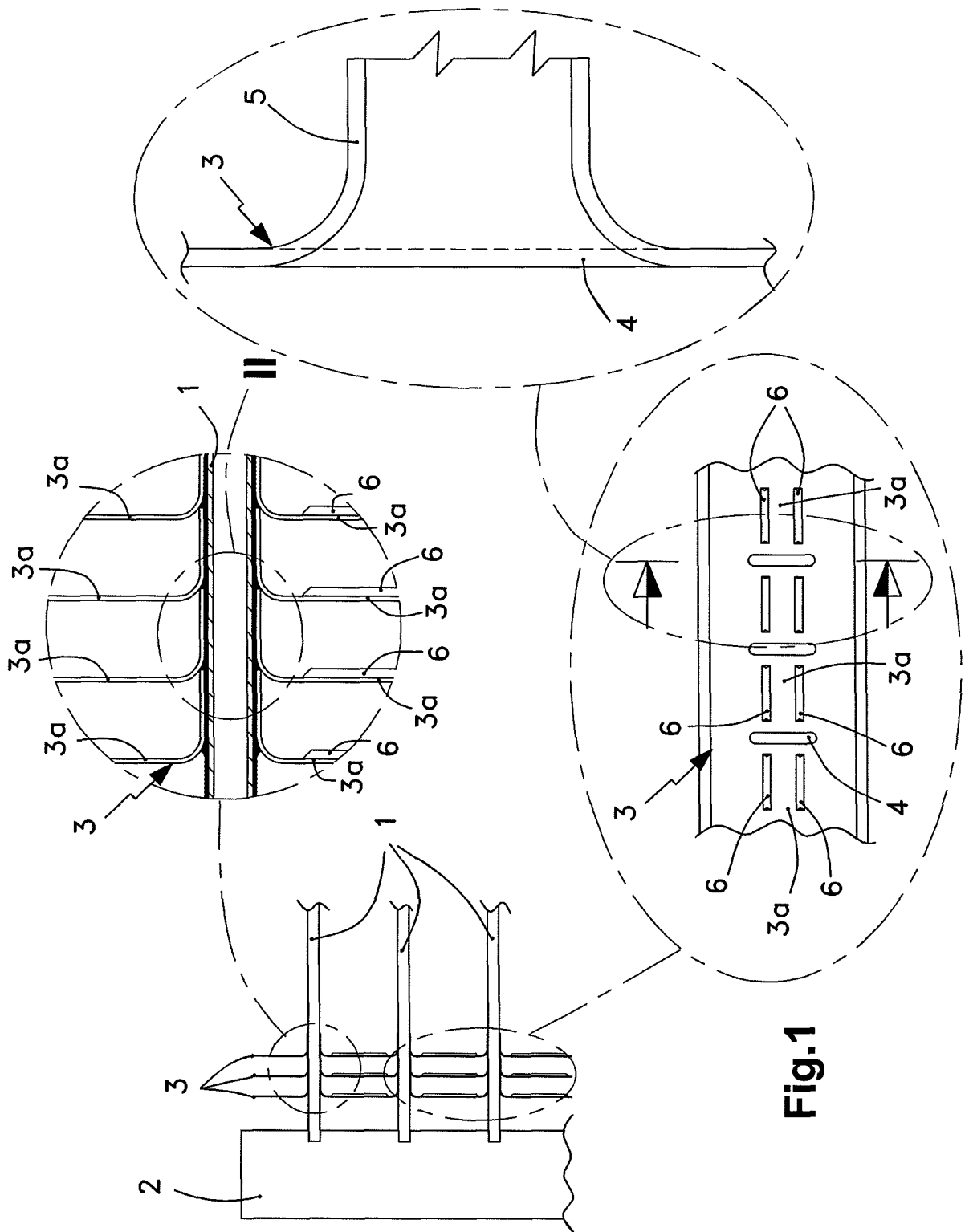


Fig.1

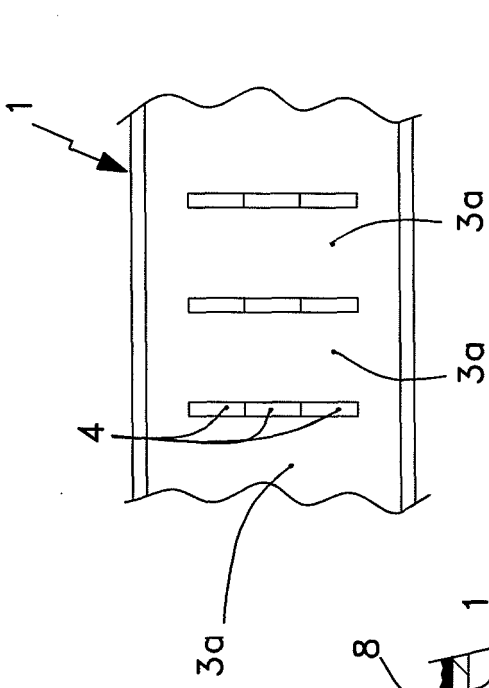


Fig.3

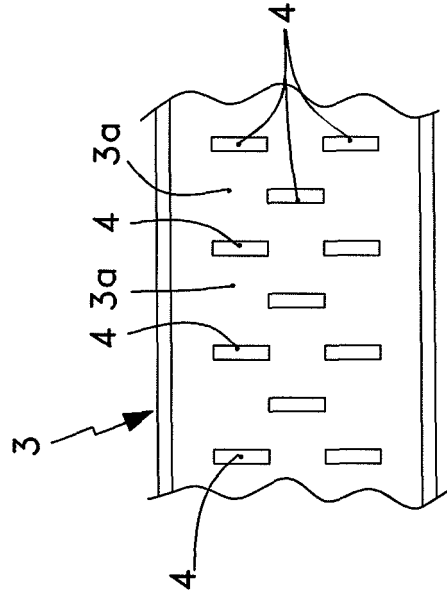


Fig.4

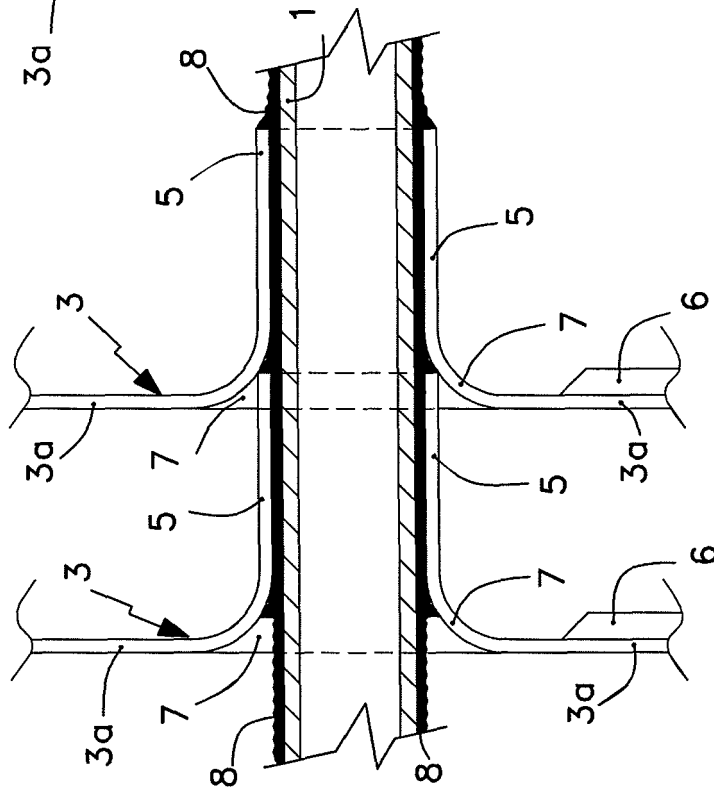


Fig.2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1306626 A [0003] [0005]