silicon may, in the melting depressant component, be represented by the boron and silicon in various boron and silicon compounds.

Obviously, the melting depressant composition is very different from conventional brazing substances since they have much more filling metal relative melting depressing substances like boron and silicon. Generally, brazing substances have less than 18 wt% boron and silicon.

The method is advantageous in that filler metal may be reduced or even excluded and in that it may be applied for metal plates that are made of different materials. Of course, the melting depressant composition may be applied on the second metal plate as well.

The boron may originate from any of elemental boron and boron of a boron compound selected from at least any of the following compounds: boron carbide, silicon boride, nickel boride and iron boride. The silicon may originate from any of elemental silicon and silicon of a silicon compound selected from at least any of the following compounds: silicon carbide, silicon boride and ferrosilicon.

The melting depressant component may comprise at least 40 wt% boron and silicon, or may even comprise at least 85 wt% boron and silicon. This means that if any filler metal is present it is present in amounts of less than 60 wt% respectively less than 15 wt%. The melting depressant component may even comprise at least 95 wt% boron and silicon.

Boron may constitute at least 10 wt% of the boron and silicon content of the melting depressant ~~compound~~ component. This means that, when the melting depressant component comprise at least 25 wt% boron and silicon, then the melting depressant component comprises at least at least 2.5 wt% boron. Silicon may constitute at least 55 wt% of the boron and silicon content of the melting depressant ~~compound~~ component.

The melting depressant component may comprise less than 50 wt% metallic elements, or less than 10 wt% metallic elements. Such metallic elements corresponds to the "metal filler" discussed above. Such small amounts of metallic elements or metal filler differentiates the melting depressant composition starkly from e.g. known brazing compositions since they comprise at least 60 wt% metallic elements. Here, "metallic elements" include e.g. all transition metals, which are the elements in the d-block of the periodic table, which includes groups 3 to 12 on the periodic table. This means that, for example, iron (Fe), nickel (Ni), cobalt (Co), chromium (Cr) and molybdenum (Mo) are "metallic elements. Elements that are not "metallic elements" are the noble gases, the halogens and the following elements: boron (B), carbon (C), silicon (Si), nitrogen (N),

plates 2 each have a first surface 16 having a convex shape and a second surface 17 having a concave shape.

The heat transfer area 10 comprises a corrugation of elevations 18 and depressions 19. Such depressions and elevations may e g be formed as ridges and grooves or as dimples.

The plates 2 may be made of of eg iron-, nickel and cobalt-based metallic alloys, as they typically have a solidus temperature above 1100 °C. The plates may not be made of pure copper, pure aluminum or aluminum-based alloys that do not have a solidus temperature above 1100 °C. For example the plates may typically be made of iron-, nickel- and cobalt-based alloys.

The metal in the plates 2 or even the plates 2 per se may be referred to as the "parent metal" or "parent material". In this context, an "iron-based" alloy is an alloy where iron has the largest weight percentage of all elements in the alloy (wt%). The corresponding situation also applies for e g nickel-, copper-, cobalt-, chromium- and aluminum-based alloys.

With reference to Fig. 4 a flow chart of a method for joining plates 2 for a plate heat exchanger 1 is illustrated. The plates 2 may be made of different materials as described above.

In a first step 201 a melting depressant composition ~~20~~ is applied on at least a part of the first convex surface 16 of the plates. The melting depressant composition ~~20~~ may be applied on only a part of the convex surface 16 or on substantially all of the convex surface 16. In an alternative embodiment the melting depressant composition ~~20~~ may also be applied on the second concave surface 17 of the plates 2 but then in an amount which is smaller than the amount of melting depressant composition applied on the first convex surface 16.

The application per se may be done by conventional techniques, e.g. by spraying, screen printing, rolling or painting in case the melting depressant composition comprises a binder component, by PVD or CVD or with only melting point depressants in case not binder component is used.

The melting depressant composition ~~20~~ comprises at least one component, which is the melting depressant component. Optionally, the melting depressant composition comprises a binder component. All substances or parts of the melting depressant composition that contributes to decreasing a melting temperature of at least the first metal part is considered to be part of the melting depressant component. Parts of the melting depressant composition that are not involved in decreasing a melting

joining heat transfer plates or any suitable metal objects that otherwise are joined by e.g. welding or conventional brazing.

In another embodiment of the invention the melting depressant composition ~~20~~ is applied on a coil which subsequently is cut into plates 2.

In a following step 202 the second concave surface 17 of a second plate 22 is brought into contact with the melting depressant composition ~~20~~ at contact points 23 on the first convex surface 16 of the first plate 21. By stacking the first and second plates a plate package 3 is created. This can be done manually or automatically by employing conventional, automated manufacturing systems. Of course, the melting depressant composition ~~20~~ may be applied on the second concave surface 17 of the second plates 22 as well.

The boron may originate from any of elemental boron and boron of a boron compound selected from at least any of the following compounds: boron carbide, silicon boride, nickel boride and iron boride. The silicon may originate from any of elemental silicon and silicon of a silicon compound selected from at least any of the following compounds: silicon carbide, silicon boride and ferrosilicon.

The melting depressant component may comprise at least 40 wt% boron and silicon, or may even comprise at least 85 wt% boron and silicon. This means that if any filler metal is present it is present in amounts of less than 60 wt% respectively less than 15 wt%. The melting depressant component may even comprise at least 95 wt% boron and silicon.

Boron may constitute at least 10 wt% of the boron and silicon content of the melting depressant ~~compound~~ component. This means that, when the melting depressant component comprise at least 25 wt% boron and silicon, then the melting depressant component comprises at least at least 2.5 wt% boron. Silicon may constitute at least 55 wt% of the boron and silicon content of the melting depressant ~~compound~~ component.

The melting depressant component may comprise less than 50 wt% metallic elements, or less than 10 wt% metallic elements. Such metallic elements corresponds to the "metal filler" discussed above. Such small amounts of metallic elements or metal filler differentiates the melting depressant composition ~~20~~ from e.g. known brazing compositions since they comprise at least 60 wt% metallic elements. Here, "metallic elements" include e.g. all transition metals, which are the elements in the d-block of the periodic table, which includes groups 3 to 12 on the periodic table. This means that, for example, iron (Fe), nickel (Ni), cobalt (Co), chromium (Cr) and molybdenum (Mo) are "metallic elements. Elements that are not "metallic elements" are the noble gases, the

halogens and the following elements: boron (B), carbon (C), silicon (Si), nitrogen (N), phosphorus (P), arsenic (As), oxygen (O), sulfur (S), selenium (Se) and tellurium (Tu). It should be noted that, for example, if the boron comes from the compound nickel boride, then the nickel-part of this compound is a metallic element that is included in the metallic elements that in one embodiment should be less than 50wt% and in the other embodiment less than 10wt%.

The plates 2 may have a thickness of 0.3 - 0.6 mm and the applying 201 of the melting depressant composition ~~20~~ may then comprise applying an average of 0.02 - 0.12 mg boron and silicon per mm^2 on the first convex surface 16 of the first plate 21. The applying of an average of 0.02 - 0.12 mg boron and silicon per mm^2 on the surface of the first convex surface 16 includes any indirect application via e.g. the second concave surface 17, for example boron and silicon that is transferred from the second plate22 to the first plate 21. Thus, the boron and silicon referred to herein must not necessarily have been applied directly on the first plate 21, as long as it still contributes to the melting of the surface layer of the first convex surface 16 of the first plate 21.

The plates 2 may have a thickness of 0.6 - 1.0 mm and the applying of the melting depressant composition ~~20~~ may then comprise applying an average of 0.02 - 1.0 mg boron and silicon per mm^2 on the surface of the plates 2.

The plates 2 may have a thickness of more than 1.0 mm and the applying of the melting depressant composition may then comprise applying an average of 0.02 - 5.0 mg boron and silicon per mm^2 on the surface of the plates 2.

The melting depressant composition may be applied on a surface having an area that is larger than an area defined by the contact points 23 , such that metal in the melted metal layer flows to the contact point when allowing the joint to form. Such flow is typically caused by capillary action.

The area of the melting component surface may be at least 10 times larger than the area defined by the contact points 23. The area of the surface may be even larger (or the contact point relatively smaller), such as at least 20 or 30 times larger than the area defined by the contact point. The area of the surface refers to the area of the surface from where melted metal flows to form the joint. Of course the melting depressant composition may be applied on all of the first convex surface 16 of the first plate 21.

The area of the surface may be at least 3 times larger than a cross-sectional area of the joint. The area of the surface may be even bigger (or the cross-sectional

area of the joint relatively smaller), such as it is at least 6 or 10 times larger than the area defined by the contact point. The cross-sectional area of the joint may be defined as the cross-sectional area that the joint has across a plane that is parallel to the surface where the contact point is located, at a location where the joint has its smallest extension (cross sectional area).

The joints may comprise at least 50 wt% or at least 85 wt% or even 100 wt% metal (metallic element) that, before the heating, was part of any of the plates 2. This is accomplished by allowing metal of the plates to flow to the contact points 23 and form the joint. A joint that is formed in this way is very different from joints that are formed by brazing, since such joints generally comprises at least 90 wt% metal that, before the brazing, was part of a filler metal of the a brazing substance that was used to form the joint.

The first plates 2 may comprise any of:

i) >50 wt% Fe, <13 wt% Cr, <1 wt% Mo, <1 wt% Ni and <3 wt% Mn;

ii) >90 wt% Fe;

iii) >65 wt% Fe and >13wt% Cr;

iv) >50 wt% Fe, >15.5 wt% Cr and >6 wt% Ni;

v) >50 wt% Fe, >15.5 wt% Cr, 1-10 wt% Mo and >8 wt% Ni;

vi) >97 wt% Ni;

vii) >10 wt% Cr and >60 wt% Ni;

viii) >15 wt% Cr, >10 wt% Mo and >50 wt% Ni;

ix) >70 wt% Co; and

x) >10 wt% Fe, 0.1-30wt% Mo, 0.1-30 wt% Ni and >50 wt% Co.

The above means that the plates 2 may be made of a large number of different alloys. Obviously, the examples above are balanced with other metals or elements, as common within the industry.

In a next step 203 the plate package 3 is heated to a temperature which is above 1100 °C. The exact temperature can be found in the following examples. During the heating the first convex surface 16 of the first plate 21 melt and forms a surface layer ~~24~~ and, together with the melting depressant component, forms a melted metal layer ~~25~~ that is in contact with the second concave surface 17 of the second plate 22 at the contact points 23 between the first plate 21 and the second plate 22. When this happen, metal of the melted metal layer flows towards the contact point 23.

In a final step 204 the melted metal layer ~~25~~ is allowed to solidify, such that a joint ~~26~~ is obtained at the contact points 23 between the plates in the plate package 3

and such that the bent edges 15 form a tight fit between the bent edges 15 of the plates 2 in the plate package 3. i.e. the metal that has flown to the contact points 23 solidifies. By applying 201 the melting depressant composition ~~20~~ on only the convex surface 16 of the plates 2 it was surprisingly found that a change in shape of the plates 2 occur such that the convex shape of the plates 2 becomes even more convex, i e the bent edges 15 create a very tight and snug fit to each other in the plate package 3, which becomes more tight than is the case in known brazing techniques Actually, also more tight than the original distance was between the bent edges 15. In comparison, if applying the melting depressant composition ~~20~~ only on the concave surface 17 the gap increases between the bent edges15. The change in shape occurs when the blends alloys with the surface, also meaning that there will be a compressive stress in the surface due to the alloying. If both the melting depressant composition is applied on both the convex surface 16 and the concave surface 17 there will be compressive stresses present in both surfaces, resulting in an increase of the fatigue strength of the plates 2 and the plate package 3.

The solidification typically includes decreasing temperature to normal room temperature. However, solidification also occurs during the physical process of redistribution of components (boron and silicon) in the joint area, before a temperature is decreased.

From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims. Various melting depressant compositions can also be combined with various metals for the metal parts. For example, melting depressant composition (blend) A3.3 may be combined with metal parts made of 316 steel.

Examples

A number of experiments and examples are now presented for describing suitable materials for the plates, the composition of the melting depressant composition 23, which amounts of melting depressant composition should be used, suitable temperatures for the heating, for how long heating shall be done etc. Thus, the results of these experiments and examples are used for previously described entities like the first plate, the second plate, the melting depressant composition, the contact point, the joint etc., i.e. all previously described entities may incorporate the respectively related features described in connection with the experiments and examples below. In the

CLAIMS

1. A method for producing a permanently joined plate heat exchanger (1) comprising a plurality of metal heat exchanger plates (2) having a solidus temperature above 1100 °C, provided beside each other and forming a plate package (3) with first plate interspaces (4) for a first medium and second plate interspaces (5) for a second medium, wherein the first and second plate interspaces (4,5) are provided in an alternating order in the plate package (3),

wherein each heat exchanger plate (2) comprises a heat transfer area (10) and an edge area (11) comprising bent edges (15) which extend around the heat transfer area (10),

wherein a first surface (16) of the plates (2) forms a convex shape and a second surface (17) of the plates forms a concave shape

wherein the heat transfer area (10) comprises a corrugation of elevations (18) and depressions (19),

wherein said corrugation of the plates and the bent edges (15) are provided by pressing the plates (2)

the method comprising

applying (201) a melting depressant composition (20) on at least a part of the first convex surface (16) of a first plate (21), the melting depressant composition (20) comprising

- a melting depressant component that comprises at least 25 wt% boron and silicon for decreasing a melting temperature of the first plate (21), and
- optionally, a binder component for facilitating the applying (201) of the melting depressant composition (20) on the first convex surface (16),

bringing (202) a second concave surface (17) of a second plate (22) into contact with the melting depressant composition (20) on said first convex surface (16) of the first plate (21) by stacking the plates (21, 22) into a plate package (3),

heating (203) the first and second plates (21, 22) to a temperature above 1100 °C, said first convex surface (16) of the first plate (21) thereby melting such that a surface layer (24) of the first plate (21) melts and, together with the melting depressant component (20), forms a molten metal layer (25) that is in contact with the second plate (22) at contact points (23) between the first plate (21) and the second plate (22), and

allowing the molten metal layer (25) to solidify, such that a joint (26) is obtained at the contact points (23) between the plates (2) in the plate package (3) and such that the bent edges (15) form a tight fit between the bent edges (15) of the plates (2) in the plate package (3).

2. Method according to claim 1, wherein the boron originates from any of elemental boron and boron of a boron compound selected from any of the following compounds: boron carbide, silicon boride, nickel boride and iron boride.

3. A method according to claim 1 or 2, wherein the silicon originates from any of elemental silicon and silicon of a silicon compound selected from any of the following compounds: silicon carbide, silicon boride and ferrosilicon.

4. A method according to any one of claims 1 - 3, wherein the melting depressant component comprises at least 40 wt% boron and silicon.

5. A method according to any one of claims 1 - 4, wherein the melting depressant component comprises at least 85 wt% boron and silicon.

6. A method according to any one of claims 1 - 5, wherein boron constitutes at least 10 wt% of the boron and silicon content of the melting depressant compound.

7. A method according to any one of claims 1 - 6, wherein boron constitutes at least 55 wt% of the boron and silicon content of the melting depressant compound.

8. A method according to any one of claims 1 - 7, wherein the melting depressant component comprises less than 50 wt% metallic elements.

9. A method according to any one of claims 1 - 8, wherein the melting depressant component comprises less than 10wt% metallic elements.

10. A method according to any one of claims 1 - 9, wherein the first plate has a thickness of 0,3 - 0,6 mm and the applying (201) of the melting depressant

composition () comprises applying an average of 0,02 - 0,12 mg boron and silicon per mm^2 on the first convex surface (16) of the first plate (21).

11. A method according to any one of claims 1 - 9, wherein the first metal part comprises a thickness of 0,6 - 1,0 mm and the applying (201) of the melting depressant composition () comprises applying an average of 0,02 - 1,0 mg boron and silicon per mm^2 on the first convex surface (16) of the first plate (21).

12. A method according to any one of claims 1 - 11, wherein the applying (201) of the melting depressant composition (20) comprises

- heating (203) the plates (2) until the melting depressant composition binds to the first convex surface (16) of the first plate (21), and
- decreasing the temperature of the plates (2), before all boron and silicon in the melting depressant composition () have formed a compound with the metal in the first plate ().

13. A method according to any one of claims 1 - 12, wherein the applying (201) of the melting depressant composition (20) is made before the pressing of the plates.

14. A method according to any one of claims 1 - 11, wherein the applying (201) of the melting depressant composition (20) is made after the pressing of the plates.

15. A method according to any one of claims 1 - 11, wherein the applying (201) of the melting depressant composition (20) is made after stacking the plates into a plate package (3) by flushing a suspension containing the melting depressant composition through the plate package.

16. A method according to any one of claims 1 - 11, wherein the applying (201) of the melting depressant composition (20) is made by means of screen-printing.

17. A method according to any one of claims 1 - 11, wherein the applying (201) of the melting depressant composition (20) is made by means of sputtering onto a coil which is cut into plates (2).

18. A method according to any one of claims 1 - 17, wherein the first surface (16) has an area (A1) that is larger than an area (A2) defined by the contact points (23) on said surface (16), such that metal in the melted metal layer (25) flows to the contact point (23) when allowing (204) the joint (26) to form.

19. A method according to claim 18, wherein the area (A1) of the convex surface (16) is at least 10 times larger than the area (A2) defined by the contact point (26).

20. A method according to claim 18 or 19, wherein the area (A1) of the surface (16) is at least 3 times larger than a cross-sectional area (A3) of the joint (26).

21. A method according to any one of claims 1 - 20, wherein the joint (26) comprises at least 50 wt% metal that, before the heating (203), was part of any of the plates (2).

22. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >50 wt% Fe, <13 wt% Cr, <1 wt% Mo, <1 wt% Ni and <3 wt% Mn.

23. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >90 wt% Fe.

24. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >65 wt% Fe and >13wt% Cr.

25. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >50 wt% Fe, >15.5 wt% Cr and >6 wt% Ni.

26. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >50 wt% Fe, >15.5 wt% Cr, 1-10 wt% Mo and >8 wt% Ni.

27. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >97 wt% Ni.

28. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >10 wt% Cr and >60 wt% Ni.

29. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >15 wt% Cr, >10 wt% Mo and >50 wt% Ni.

30. A method according to any one of claims 1 - 21, wherein the plates (2) comprises >70 wt% Co.

31. A method according to any one of claims 1 - 21, wherein the first plate comprises >10 wt% Fe, 0.1-30wt% Mo, 0.1-30 wt% Ni and >50 wt% Co.

32. A permanently joined plate heat exchanger (1) comprising a plurality of metal heat exchanger plates (2) having a solidus temperature above 1100 °C, provided beside each other and forming a plate package (3) with first plate interspaces (4) for a first medium and second plate interspaces (5) for a second medium, wherein the first and second plate interspaces (4,5) are provided in an alternating order in the plate package (3),

wherein each heat exchanger plate (2) comprises a heat transfer area (10) and an edge area (11) comprising bent edges (15) which extend around the heat transfer area (10),

wherein a first surface (16) of the plates (2) forms a convex shape and a second surface (17) of the plates forms a concave shape

wherein the heat transfer area (10) comprises a corrugation of elevations (18) and depressions (19),

wherein said corrugation of the plates and the bent edges (15) are provided by pressing the plates (2),

wherein the plate heat exchanger is produced by the method according to any one of claims 1-31

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33. A plate heat exchanger (1) according to claim 32 comprising a first plate (21) that is joined with a second plate (22) by a joint (26), the plates (2) having a solidus temperature above 1100 °C, wherein the joint (26) comprises at least 50 wt% metallic elements that have been drawn from an area (A1) that surrounds the joint (269 and was part of any of the first plate (1) and the second plate (2).

CLAIMS

1. A method for producing a permanently joined plate heat exchanger comprising a plurality of metal heat exchanger plates having a solidus temperature above 1100 °C, provided beside each other and forming a plate package with first plate interspaces for a first medium and second plate interspaces for a second medium, wherein the first and second plate interspaces are provided in an alternating order in the plate package,

wherein each heat exchanger plate comprises a heat transfer area and an edge area comprising bent edges which extend around the heat transfer area,

wherein a first surface of the plates forms a convex shape and a second surface of the plates forms a concave shape

wherein the heat transfer area comprises a corrugation of elevations and depressions,

wherein said corrugation of the plates and the bent edges are provided by pressing the plates,

the method comprising

applying a melting depressant composition on at least a part of the first convex surface of a first plate, the melting depressant composition comprising a melting depressant component that comprises at least 25 wt% boron and silicon for decreasing a melting temperature of the first plate,

bringing a second concave surface of a second plate into contact with the melting depressant composition on said first convex surface of the first plate by stacking the plates into a plate package,

heating the first and second plates to a temperature above 1100 °C, said first convex surface of the first plate thereby melting such that a surface layer of the first plate melts and, together with the melting depressant component, forms a molten metal layer that is in contact with the second plate at contact points between the first plate and the second plate, and

allowing the molten metal layer to solidify, such that a joint is obtained at the contact points between the plates in the plate package and such that the bent edges form a tight fit between the bent edges of the plates in the plate package.

2. The method of claim 1, wherein the melting depressant composition further comprises a binder component for facilitating the applying of the melting depressant composition on the first convex surface .

3. The method according to claim 1, wherein the boron originates from any of elemental boron and boron of a boron compound selected from any of the following compounds: boron carbide, silicon boride, nickel boride and iron boride.

4. The method according to any one of claims 1 - 3, wherein the silicon originates from any of elemental silicon and silicon of a silicon compound selected from any of the following compounds: silicon carbide, silicon boride and ferrosilicon.

5. The method according to any one of claims 1 - 4, wherein the melting depressant component comprises at least 40 wt% boron and silicon.

6. The method according to any one of claims 1 - 5, wherein the melting depressant component comprises at least 85 wt% boron and silicon.

7. The method according to any one of claims 1 - 6, wherein boron constitutes at least 10 wt% of the boron and silicon content of the melting depressant component.

8. The method according to any one of claims 1 - 7, wherein boron constitutes at least 55 wt% of the boron and silicon content of the melting depressant component.

9. The method according to any one of claims 1 - 8, wherein the melting depressant component comprises less than 50 wt% metallic elements.

10. The method according to any one of claims 1 - 9, wherein the melting depressant component comprises less than 10 wt% metallic elements.

11. The method according to any one of claims 1 - 10, wherein the first plate has a thickness of 0.3 – 0.6 mm and the applying of the melting depressant composition comprises applying an average of 0.02 - 0.12 mg boron and silicon per mm^2 on the first convex surface of the first plate.

12. The method according to any one of claims 1 - 10, wherein the first metal part comprises a thickness of 0.6 – 1.0 mm and the applying of the melting

depressant composition comprises applying an average of 0.02 - 1.0 mg boron and silicon per mm^2 on the first convex surface of the first plate.

13. The method according to any one of claims 1 - 12, wherein the applying of the melting depressant composition comprises

- heating the plates until the melting depressant composition binds to the first convex surface of the first plate, and
- decreasing the temperature of the plates, before all boron and silicon in the melting depressant composition have formed a compound with the metal in the first plate.

14. The method according to any one of claims 1 - 13, wherein the applying of the melting depressant composition is made before the pressing of the plates.

15. The method according to any one of claims 1 - 12, wherein the applying of the melting depressant composition is made after the pressing of the plates.

16. The method according to any one of claims 1 - 12, wherein the applying of the melting depressant composition is made after stacking the plates into a plate package by flushing a suspension containing the melting depressant composition through the plate package.

17. The method according to any one of claims 1 - 12, wherein the applying of the melting depressant composition is made by means of screen-printing.

18. The method according to any one of claims 1 - 12, wherein the applying of the melting depressant composition is made by means of sputtering onto a coil which is cut into plates.

19. The method according to any one of claims 1 - 18, wherein the first convex surface has an area (A1) that is larger than an area (A2) defined by the contact points on said surface, such that metal in the melted metal layer flows to the contact point when allowing the joint to form.

20. The method according to claim 19, wherein the area (A1) of the first

convex surface is at least 10 times larger than the area (A2) defined by the contact point.

21. The method according to claim 19 or claim 20, wherein the area (A1) of the first convex surface is at least 3 times larger than a cross-sectional area (A3) of the joint.

22. The method according to any one of claims 1 - 21, wherein the joint comprises at least 50 wt% metal that, before the heating, was part of any of the plates.

23. The method according to any one of claims 1 - 22, wherein the plates comprises >50 wt% Fe, <13 wt% Cr, <1 wt% Mo, <1 wt% Ni and <3 wt% Mn.

24. The method according to any one of claims 1 - 22, wherein the plates comprises >90 wt% Fe.

25. The method according to any one of claims 1 - 22, wherein the plates comprises >65 wt% Fe and >13wt% Cr.

26. The method according to any one of claims 1 - 22, wherein the plates comprises >50 wt% Fe, >15.5 wt% Cr and >6 wt% Ni.

27. The method according to any one of claims 1 - 22, wherein the plates comprises >50 wt% Fe, >15.5 wt% Cr, 1-10 wt% Mo and >8 wt% Ni.

28. The method according to any one of claims 1 - 22, wherein the plates comprises >97 wt% Ni.

29. The method according to any one of claims 1 - 22, wherein the plates comprises >10 wt% Cr and >60 wt% Ni.

30. The method according to any one of claims 1 - 22, wherein the plates comprises >15 wt% Cr, >10 wt% Mo and >50 wt% Ni.

31. The method according to any one of claims 1 - 22, wherein the plates comprises >70 wt% Co.

32. The method according to any one of claims 1 - 22, wherein the first plate comprises >10 wt% Fe, 0.1-30wt% Mo, 0.1-30 wt% Ni and >50 wt% Co.

33. A permanently joined plate heat exchanger comprising a plurality of metal heat exchanger plates having a solidus temperature above 1100 °C, provided beside each other and forming a plate package with first plate interspaces for a first medium and second plate interspaces for a second medium, wherein the first and second plate interspaces are provided in an alternating order in the plate package,

wherein each heat exchanger plate comprises a heat transfer area and an edge area comprising bent edges which extend around the heat transfer area,

wherein a first surface of the plates forms a convex shape and a second surface of the plates forms a concave shape,

wherein the heat transfer area comprises a corrugation of elevations and depressions,

wherein said corrugation of the plates and the bent edges are provided by pressing the plates,

wherein the plate heat exchanger is produced by the method according to any one of claims 1-32.

34. The plate heat exchanger according to claim 33, comprising a first plate that is joined with a second plate by a joint, the plates having a solidus temperature above 1100 °C, wherein the joint comprises at least 50 wt% metallic elements that have been drawn from an area (A1) that surrounds the joint and was part of any of the first plate and the second plate.