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Remarks:  
Amended claims in accordance with Rule 137(2) EPC.

(54) **Header plate and method of manufacture thereof**

(57) The invention relates to a header plate (10) which has a base plate formed with a series of tube receiving slots formed therein. The tube receiving slots each have a pair of lateral walls (3) cut and folded away from the base plate, and a pair of longitudinal walls folded away from the plane of the base plate. The combined effect of these folded out sections is a series of tube re-

ceiving slots which have a greater contact area to improve the resulting connection formed by subsequent solder/brazing. The resulting header plate also requires less packaging space. A method of manufacturing a header plate is also provided.

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## Description

**[0001]** The present invention relates to a header plate for a heat exchanger, particularly, but not exclusively a header plate for use in a heat exchanger of an automobile. A method of manufacturing the header plate is also provided.

**[0002]** Heat exchangers with flat sided tubes are widely used in various automotive applications. Typically, these tubes are inserted into pressed out slots S (see Fig. 1) on the header plate P of the heat exchanger. The tubes are then brazed or soldered to the header plate to provide a strong fluid tight connection there between.

**[0003]** Where the header tank is formed from metal, the tubes are often brazed or soldered to the header plate at the same time as the header plate is brazed or soldered to the header tank. Referring to Fig. 2, where the header tank T is formed from plastic, the tubes are typically brazed to the header plate first and then the plastic tank is subsequently crimped to the header plate. In either case, a significant depth component (indicated by D on Fig. 1 and Fig. 2) of the header plate P is needed to form the required connection. Therefore a problem with each of the presently available arrangements is that they occupy more space than is desired. Another problem is that, in the present system, the relatively small contact area between the tubes and header plates can result in weakness of the joint which can lead to premature malfunction of the heat exchanger.

**[0004]** According to a first aspect of the present invention there is provided a header plate for a heat exchanger, the header plate comprising a base plate having a plurality of tube receiving slots formed therein, wherein at least one tube receiving slot comprises at least a pair of flaps cut into and folded away from the base plate, and at least a pair of end walls folded toward said flaps.

**[0005]** According to a second aspect of the present invention there is provided a method of manufacturing a header plate for a heat exchanger, the method comprising providing a base plate, forming at least a pair of flaps in the base plate by making a plurality of cuts in the base plate, folding the flaps away from the base plate, folding at least a pair of end walls toward the flaps to thereby form a plurality of tube receiving slots.

**[0006]** Preferred features and advantages of the invention will be apparent from the following description and the claims.

**[0007]** Embodiments of the present invention will now be described, by way of example only, with reference to the following drawings, in which:-

Fig. 1 is a perspective view of a prior art header plate which has pressed out slots for connection to heat exchanger tubes;

Fig. 2 is a plan view of a prior art plastic header tank crimped to a prior art header plate;

Fig. 3 is a perspective view of a base plate of a header plate in a first stage of manufacture in accordance

with first and second aspects of the present invention;

Fig. 4 is a perspective view of a base plate of the header plate of Fig. 3 in a second stage of manufacture;

Fig. 5 is a perspective schematic view of a capped section of the header plate mounted over the ends of heat exchanger tubes;

Fig. 6 is a perspective view of the inside of an alternative embodiment of the header plate where the plate is formed with tall sided header tank walls; and Fig. 7 is a schematic planar view of a header plate of a further alternative embodiment, where the walls of the header plate are extended to allow them to be folded, closed upon one another and welded together to form an integrated header tank and header plate.

**[0008]** In the following it should be noted that the term tube receiving slots refers to those known in the art and those with which the present invention is concerned and may include a mixture of both. Furthermore, flaps could also consist of pair of end walls.

**[0009]** With reference to Figs. 3 and 4, header plate 10 comprises a base plate having a number of pairs of flaps 1 cut and folded out there from. The flaps are created by cutting laterally along the centre of the desired resultant slot and raising the pair of flaps 1 away from the header plate material. A pair of short longitudinal cuts may also be created at each end of flaps to allow them to be folded out more easily. At this stage the header plate 10 will be in the form illustrated by Fig. 3. The length of the flaps 1 is such that border portions of the base plate defined by dashed lines 2 remain on either side of the flaps 1.

**[0010]** To form the desired tube receiving slots, the border portions are folded along the dashed lines 2 until metal to metal contact occurs at a point 4 between the ends of the flaps 1 and the newly created end walls 3. This ensures that the subsequent soldering or brazing process provides good metallurgical contact. The result is a strong and leak free joint. The completed header plate 10 is illustrated by Fig. 4.

**[0011]** The flaps 1 provide tube receiving slots having a large area for contacting the flat sides of typical rectangular section heat exchanger tubes. This increased contact area and support significantly strengthens the resulting connection between the tubes and slots once brazing / soldering has been completed.

**[0012]** Another advantage is that a packaging reduction is achieved since the header plate of the present invention projects no further than a single sheet thickness from the front of the header tank. Such a packaging reduction is important in the automotive industry.

**[0013]** The tank can be completed in a variety of different ways. For example, referring to Fig. 5, the end walls 3 of the header plate 10 can be formed to be high enough to allow a capping section 12 to be bent round

to seal off the top and ends of the tubes.

**[0014]** The side walls 3A can also be made tall enough to provide large depth tanks (Fig. 6) or indeed tall enough to allow them to be folded around and welded together at either end 14 to form the header tank itself (Fig. 7).

**[0015]** With such high walls, it may be necessary to provide bracing members (not shown) between the walls and / or strengthening ribs 16 pressed into the surface of the walls.

**[0016]** Modifications and improvement may be made to the foregoing, without departing from the scope of the invention, for example, rather than folding out the flaps 1 from the base plate first and then folding up the side walls 3, the sequence of these operations could be either performed simultaneously or could indeed be reversed.

**[0017]** Furthermore, although the invention has been described in relation to an automobile heat exchanger, it could equally be applied to any heat exchanger.

### Claims

1. A header plate for a heat exchanger, the header plate comprising a base plate having a plurality of tube receiving slots formed therein, wherein at least one tube receiving slot comprises at least a pair of flaps cut into and folded away from the base plate, and at least a pair of end walls folded toward said flaps. 25
2. A header plate according to claim 1, wherein the pair of flaps are substantially rectangular. 30
3. A header plate according to either of claims 1 or 2, wherein the pair of end walls have a lateral dimension large enough to allow them to form side walls of a heat exchanger header tank. 35
4. A header plate according to claim 3, wherein the edges of the pair of end walls are folded and joined to one another to form a heat exchanger header tank. 40
5. A header plate according to either of claims 3 or 4, wherein the pair of end walls are provided with at least one of bracing members and strengthening ribs. 45
6. A header plate according to any preceding claim, wherein the pair of end walls are adapted to allow a capping section to be formed by bending a portion thereof over the ends of the tubes of a heat exchanger. 50
7. A method of manufacturing a header plate for a heat exchanger, the method comprising providing a base plate, forming at least a pair of flaps in the base plate by making a plurality of cuts in the base plate, folding the flaps away from the base plate, folding at least a pair of end walls toward the flaps to thereby form 55

a plurality of tube receiving slots.

8. A method of manufacturing a header plate according to claim 7, further comprising attaching the header plate to a header tank. 5
9. A method of manufacturing a header plate according to claim 7, wherein the step of folding the pair of end walls also includes the step of forming heat exchanger tank walls therefrom. 10
10. A method of manufacturing a header plate according to claim 9, wherein the step of forming the tank walls also includes the step of joining the ends of the tank walls to form a header tank. 15
11. A method of manufacturing a header plate according to any of claims 7 to 10, further comprising the step of folding a portion of the header plate around tubes of a heat exchanger to form a capping section. 20
12. A method of manufacturing a header plate according to any of claims 9 to 12 further comprising forming at least one of bracing members and strengthening ribs in the pair of end walls. 25

### Amended claims in accordance with Rule 137(2) EPC.

1. A header plate for a heat exchanger, the header plate comprising a base plate having a plurality of tube receiving slots formed therein, wherein at least one tube receiving slot comprises at least a pair of flaps (1) cut into and folded away from the base plate, and at least a pair of end walls folded toward said flaps (1) **characterised in that** the end walls have a lateral dimension large enough to form side walls (3) of a heat exchanger when folded into contact with the flaps (1) and wherein the contact between the side walls (3) and the flaps (1) allows brazing of the side walls (3) to the flaps (1).
2. A header plate according to claim 1, wherein the pair of flaps (1) are substantially rectangular.
3. A header plate according to claim 2, wherein the edges of the pair of end walls (3) are folded and joined to one another.
4. A header plate according to any preceding claim, wherein the pair of end walls (3) are provided with at least one of bracing members and strengthening ribs.
5. A header plate according to any preceding claim, wherein the pair of end walls (3) are adapted to allow a capping section (12) to be formed by bending a

portion thereof over the ends of the tubes of a heat exchanger.

**6.** A method of manufacturing a header plate for a heat exchanger, the method comprising providing a base plate, forming at least a pair of flaps (1) in the base plate by making a plurality of cuts in the base plate, folding the flaps (1) away from the base plate, folding at least a pair of end walls (3) toward the flaps (1) to thereby form a plurality of tube receiving slots **characterised in that** the method further includes the steps of folding the end walls (3) into contact with the flaps (1) and brazing the side walls (3) to the flaps (1).

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**7.** A method of manufacturing a header plate according to claim 6, further comprising attaching the header plate to a header tank.

**8.** A method of manufacturing a header plate according to claim 6, wherein the step of folding the pair of end walls (3A) also includes the step of folding the end walls (3A) and joining them to one another..

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**9.** A method of manufacturing a header plate according to any of claims 6 to 8, further comprising the step of folding a portion of the header plate around tubes of a heat exchanger to form a capping section (12).

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**10.** A method of manufacturing a header plate according to any of claims 8 to 9 further comprising forming at least one of bracing members and strengthening ribs in the pair of end walls (3).

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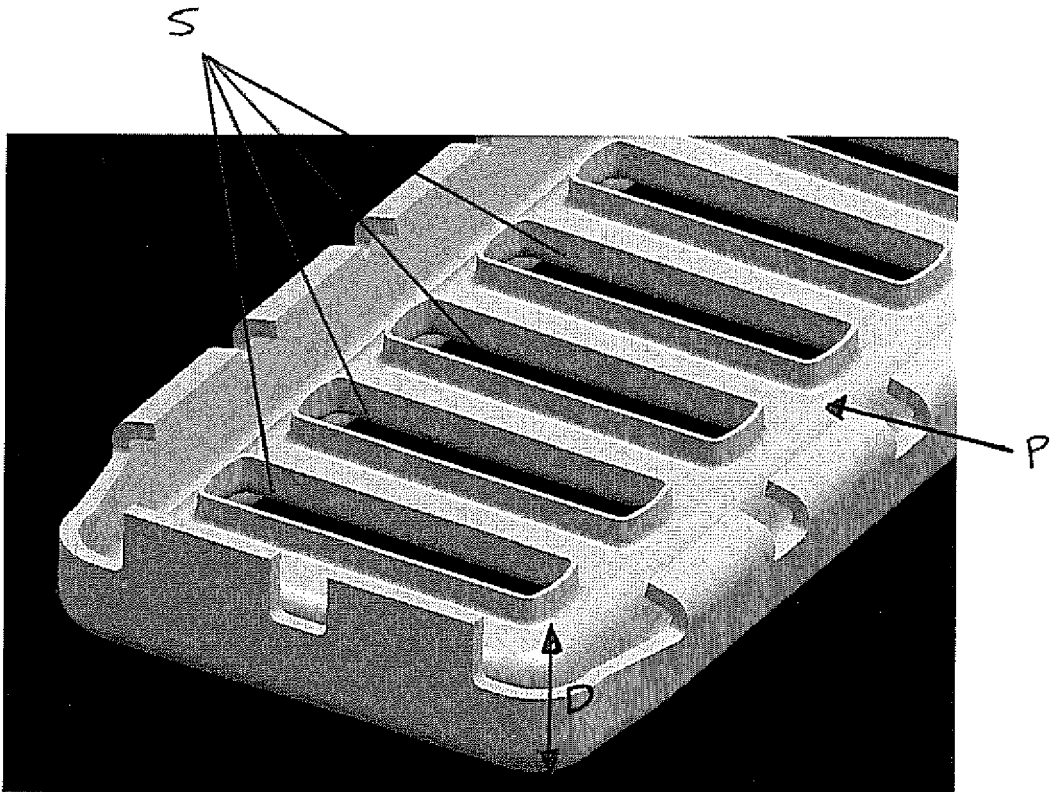


Fig. 1 (PRIOR ART)

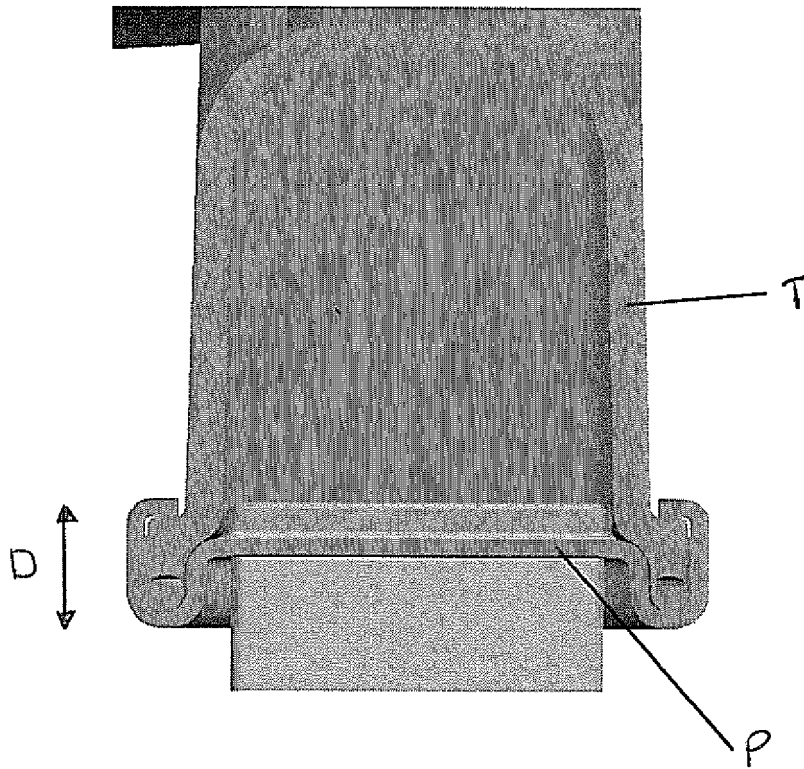


Fig. 2 (PRIOR ART)

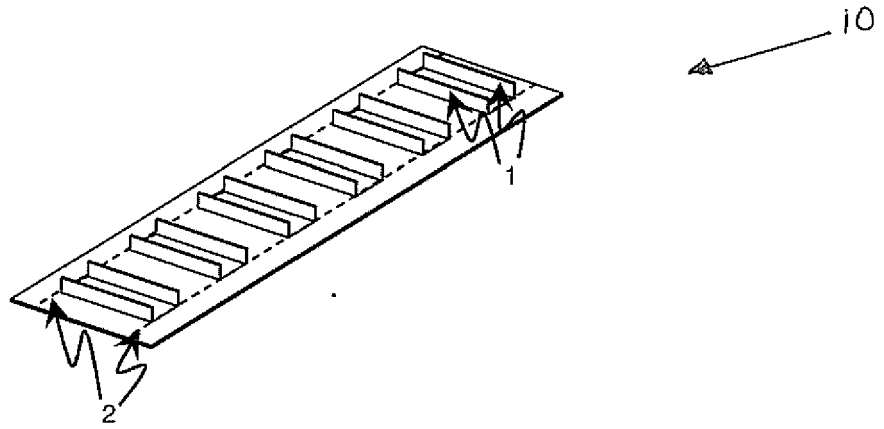


Fig. 3

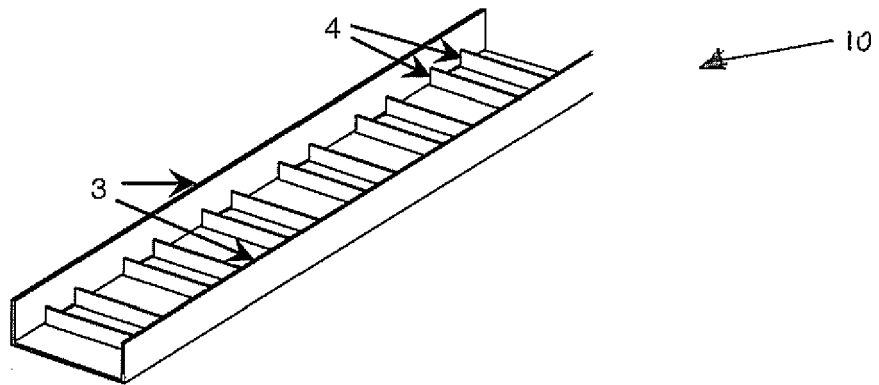


Fig. 4

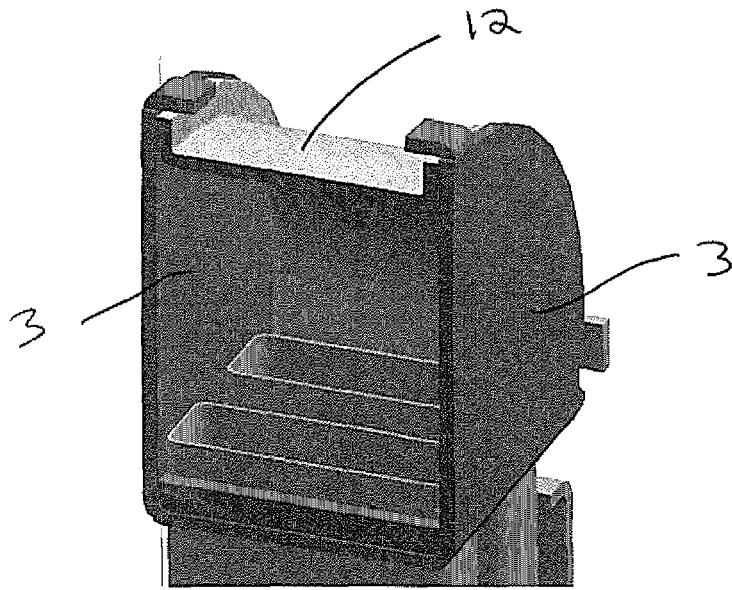


Fig. 5

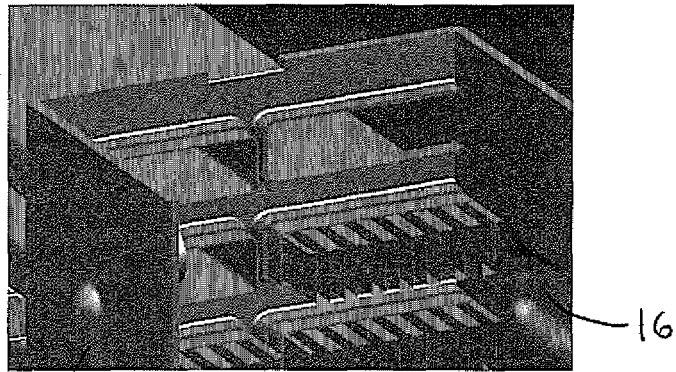


Fig. 6

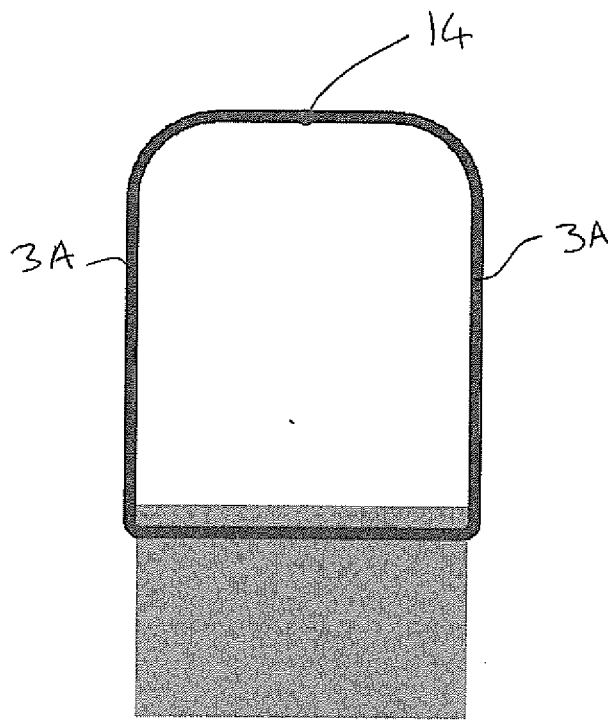


Fig. 7



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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		18 January 2008	Martínez Rico, Celia
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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18-01-2008

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