

(19)



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(11)

EP 0 690 281 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
08.12.1999 Bulletin 1999/49

(51) Int Cl.⁶: **F28F 7/02**, B22D 19/00,
F24H 1/38

(21) Application number: **95201661.6**

(22) Date of filing: **19.06.1995**

(54) Method for construction of a heat exchanger and a heat exchanger

Verfahren zum Herstellen eines Wärmetauschers und ein Wärmetauscher

Procédé pour fabriquer un échangeur de chaleur et un échangeur de chaleur

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI NL

(30) Priority: **27.06.1994 NL 9401061**

(43) Date of publication of application:
03.01.1996 Bulletin 1996/01

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(56) References cited:
EP-A- 0 495 762 **WO-A-85/01101**
US-A- 4 865 112 **US-A- 5 305 818**

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Description

[0001] Existing heat exchangers for use in a heating boiler for heating water of a central heating system and/or tap water, are usually cast round a sand core. Using the sand core a duct can be left free in the casting which can form for instance the duct for water of a central heating system or tap water. A drawback of this method is that it is relatively labour-intensive to first manufacture and then remove a sand core from the casting. Another drawback to this method is that the duct wall is formed by the casting. The material properties of the wall of the duct are thus determined by the choice of material from the casting material. This causes problems in practice. An aluminum duct wall is thus undesirable in the case of a liquid for transporting which has a pH greater than 8.5; this can occur with water in a closed central heating circuit, while aluminum is very suitable as casting material.

[0002] From the international patent application, published under number WO 85/01101, a heat exchanger according to the preamble of claim 1 is known, comprising at least one straight liquid pipe incorporated in a casting, which casting is provided in at least one side with a profiled heat exchanging surface. By placing at least a part of the liquid pipe in the mould the sand core has become superfluous.

[0003] EP-A-0 495 762 discloses a heat exchanger element, comprising three parallel tubes, which are cast into a body. The portion of the tubes enclosed by the body are externally provided with helical ribs, before the casting operation.

[0004] It is an object of the present invention to provide a heat exchanger suitable for domestic purposes, such as a central heating system and/or tap water.

[0005] The present invention provides a heat exchanger with at least one liquid pipe incorporated in a casting, said casting being provided on at least one side with a profiled heat exchanging surface, characterized in that said liquid pipe is spirally wound or arranged in a zig zag form prior to pouring of the casting material, said profiled heat exchanging surface and said bent pipe being incorporated in a single casting body.

[0006] Different materials can be chosen for the duct wall and the casting material. It thus becomes possible to optimize these materials, and further allows great freedom in respect of the form and the position of the duct in the casting. The heat exchanger thus has at least one profiled side without the direction of the duct, i.e. the position of the liquid pipe, being hereby determined. It is moreover possible to embody the heat exchanger very compactly.

[0007] A preferred embodiment of the heat exchanger is characterized in that the profiled surface comprises a substantially lengthwise oriented profile and the liquid pipe is arranged in the casting substantially perpendicularly of the lengthwise oriented profile. With this construction it is possible to realize greater efficiency using

the counterflow principle. By supplying a heating gas in lengthwise direction along the lengthwise oriented profile and supplying a counterflow liquid through the liquid pipe a high efficiency can be realized due in part to the comparatively large heat-exchanging surfaces.

[0008] Another preferred embodiment of the heat exchanger is characterized in that at least two liquid pipes are arranged in the casting. This heat exchanger can be applied for combined heating of a plurality of liquids, wherein can be envisaged use in a so-called combi-boiler for heating tap water and water of a central heating system. Both pipes are encased with casting material and mutually separated by casting material, whereby the danger of leakages is very small.

[0009] Yet another preferred embodiment of the heat exchanger is characterized in that the liquid pipes are arranged practically parallel to each other in the casting. This step enables arrangement of relatively long pipes in the casting, which will enhance the efficiency of the heat exchanger.

[0010] The casting is preferably manufactured from aluminum. The liquid pipe preferably manufactured from copper or stainless steel. Aluminum has the advantage that it has good heat-exchanging properties with a relatively small specific mass. Copper and stainless steel have the advantage that they are not rapidly affected by aggressive liquids.

[0011] Further the present invention provides a method for manufacturing a heat exchanger, comprising the following successive steps:

- shaping at least one liquid pipe;
- placing at least a part of the liquid pipe into a mould;
- pouring casting material into the mould;
- causing the casting material to pass into a solid state;
- removing from the mould the casting with liquid pipe incorporated therein, characterized in that said liquid pipe is spirally wound or arranged in a zig zag form before placing into said mould and in that said mould is provided with at least one profiled wall so that the casting is provided on at least one side with a profiled surface.

[0012] The present invention will be further elucidated with reference to the non-limitative embodiments shown in the following figures. Herein:

fig. 1 shows a partly cut away perspective view of a burner with a round heat exchanger according to the invention;

fig. 2 shows a partly cut away perspective view of a flat heat exchanger according to the invention; and

fig. 3 shows a perspective view of a mould for manufacturing the heat exchanger of fig. 2.

[0013] Fig. 1 shows a round heat exchanger 1 according to the invention in which is placed a burner 2. The

burner 2 is connected to a mixing chamber 3 to which air and flammable gas are supplied via an air inlet 4 and a flammable gas inlet 5. The inner surface of heat exchanger 1 is provided with ribs 6 which enlarge the heat-exchanging surface. The ribs 6 form part of casting 7 in which two liquid pipes 8, 9 are arranged. Liquid pipe 8 herein forms the conduit through which water of a central heating system is carried, while liquid pipe 9 forms the conduit through which flows tap water for heating. The liquid in liquid pipes 8, 9 flows spirally upward from below as according to arrows S_1 , S_2 . The combustion gases flow downward from above as according to arrow S_3 , whereby the heating medium and the media for heating flow in opposing directions. The cooled combustion gases are further discharged via an outlet 10. Due to the high efficiency it is probable that condensation occurs on the underside of heat exchanger 1 and in outlet 10. Condensed liquid is drained via a condensation drain 11.

[0014] Fig. 2 shows a flat heat exchanger 12 comprising a casting 13 of which ribs 14 form part and two liquid pipes 15, 16 incorporated in a casting 13. Liquid pipes 15, 16 are incorporated in casting 13 such that the heat-exchanging surface is large. To this end liquid pipes 15, 16 are incorporated in casting 13 in zigzag form. The flow direction of the liquid in the liquid pipes is indicated with arrows S_4 , S_5 , while arrow S_6 indicates the flow direction of the combustion gas. Use is also made in this situation of the counterflow principle to optimize the efficiency of heat exchanger 12. The heat exchanger 12 shown in this figure can for instance be incorporated into a so-called combi-boiler for household use.

[0015] Fig. 3 shows a mould 17 with which the heat exchanger 12 shown in fig. 2 can be manufactured. The liquid pipes 15, 16 are already arranged in the mould 17. Casting material will subsequently be poured into mould 17 via an opening 18. A profiled mould wall 19 comprises a main profile 20 whereby the ribs 14 are formed. After the casting material introduced into the mould 17 has hardened a top plate 21 is removed, whereafter the casting 13 with the pipes 15, 16 arranged therein is removed together with side walls 22, 23 from the mould 17. Finally, the side walls 22, 23 are taken from the casting. Such a method is also known as investment casting method.

Claims

1. Heat exchanger with at least one liquid pipe incorporated in a casting, said casting being provided on at least one side with a profiled heat exchanging surface, **characterized in that** said liquid pipe is spirally wound or arranged in a zig zag form prior to pouring of the casting material, said profiled heat exchanging surface and said bent pipe being incorporated in a single casting body.

2. Heat exchanger according to claim 1 with at least two liquid pipes incorporated in a casting material, **characterized in that** the liquid pipes in the heat exchanger form at least two separate conduits for heat exchange to/from different fluids.
3. Heat exchanger according to claim 1 or 2, **characterized in that** the heat exchanger has a central opening, and the inner surface of the heat exchanger is provided with the profiled heat exchanging surface.
4. Heat exchanger according to claim 3, **characterized in that** a burner is mounted in the central opening of the heat exchanger.
5. Heat exchanger according to one of claims 2-4, **characterized in that** the distance from one to the conduits to the heat exchanging surface of the heat exchanger is larger than the distance of another circuit to the heat exchanging surface of the heat exchanger.
6. Heat exchanger according to any of claims 1-5, wherein said liquid pipe is of copper and said casting material comprises aluminum.
7. A method for manufacturing a heat exchanger, comprising the following successive steps:
 - shaping at least one liquid pipe;
 - placing at least a part of the liquid pipe into a mould;
 - pouring casting material into the mould;
 - causing the casting material to pass into a solid state;
 - removing from the mould the casting with liquid pipe incorporated therein, **characterized in that** said liquid pipe is spirally wound or arranged in a zig zag form before placing into said mould and in that said mould is provided with at least one profiled wall so that the casting is provided on at least one side with a profiled surface.

Patentansprüche

1. Wärmetauscher mit zumindest einem Flüssigkeitsrohr, das in ein Gußstück einbezogen ist, wobei das Gußstück an zumindest einer Seite mit einer profilierten Wärmetauschfläche versehen ist, **dadurch gekennzeichnet**, daß das Flüssigkeitsrohr vor dem Vergießen des Gußmaterials spiralförmig gewunden ist und in einer Zickzack-Form angeordnet ist, wobei die profilierte Wärmetauschfläche und das gebogene Rohr in einem einzigen Gußkörper einbezogen sind.

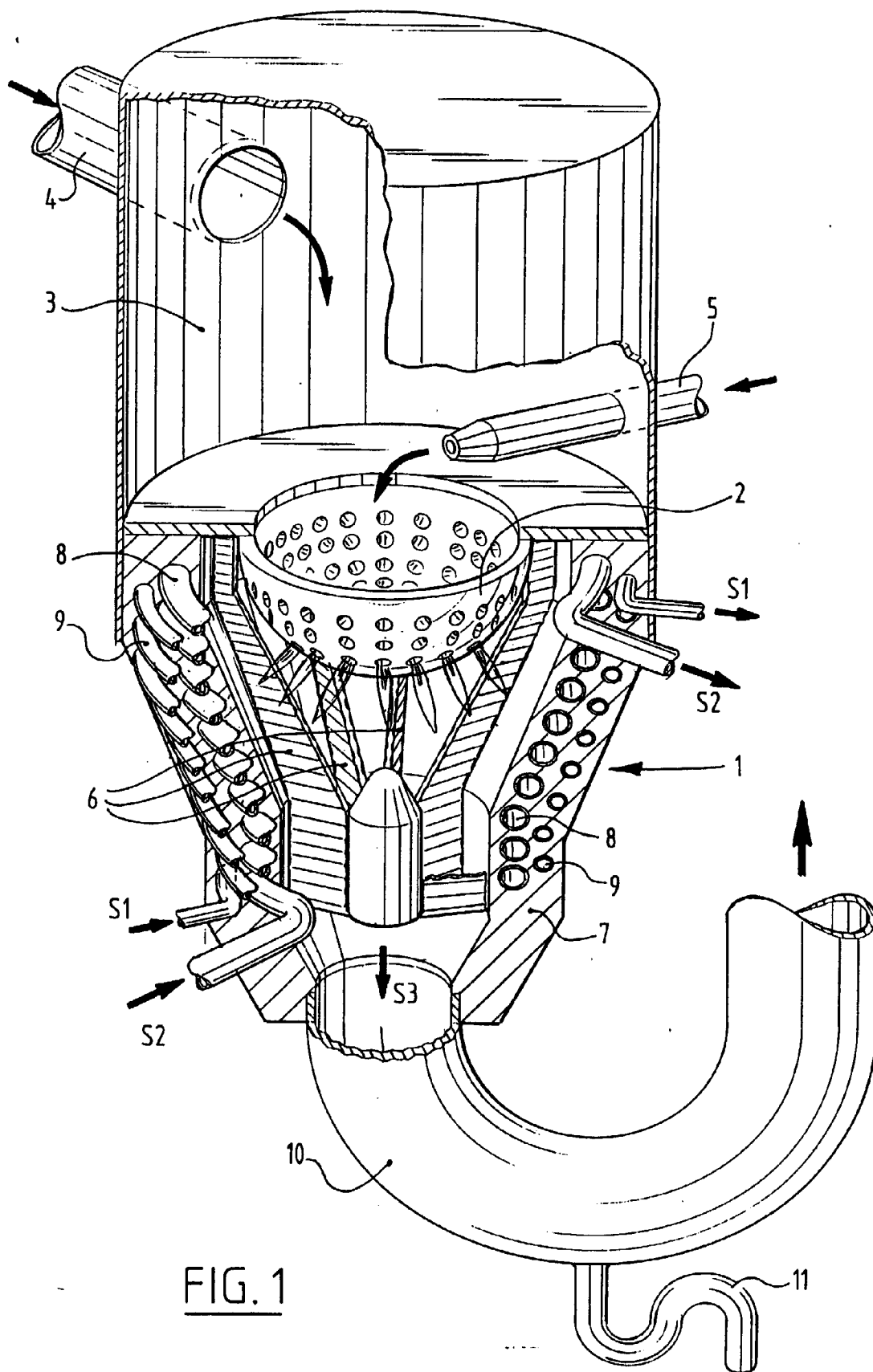
2. Wärmetauscher nach Anspruch 1, mit zumindest zwei Flüssigkeitsrohren, die in einem Gußmaterial einbezogen sind, **dadurch gekennzeichnet**, daß die Flüssigkeitsrohre in dem Wärmetauscher zumindest zwei voneinander getrennte Kanäle für den Wärmeaustausch zu/von verschiedenen Flüssigkeiten bilden.
3. Wärmetauscher nach Anspruch 1 oder 2, **dadurch gekennzeichnet**, daß der Wärmetauscher eine zentrale Öffnung aufweist und die Innenfläche des Wärmetauschers mit der profilierten Wärmetauschfläche versehen ist.
4. Wärmetauscher nach Anspruch 3, **dadurch gekennzeichnet**, daß ein Brenner in der zentralen Öffnung des Wärmetauschers montiert ist.
5. Wärmetauscher nach einem der Ansprüche 2-4, **dadurch gekennzeichnet**, daß der Abstand des einen der Kanäle von der Wärmetauschfläche des Wärmetauschers größer als der Abstand des anderen Kanals von der Wärmetauschfläche des Wärmetauschers ist.
6. Wärmetauscher nach einem der Ansprüche 1-5, wobei das Flüssigkeitsrohr aus Kupfer ist und das Gußmaterial Aluminium aufweist.
7. Verfahren zum Herstellen eines Wärmetauschers, mit den folgenden aufeinanderfolgenden Schritten:
- Formen zumindest eines Flüssigkeitsrohres;
 - Plazieren zumindest eines Teils des Flüssigkeitsrohres in eine Gießform;
 - Vergießen von Gußmaterial in die Gießform;
 - Veranlassen des Gußmaterials zum Übergehen in einen festen Zustand;
 - Entfernen des Gußstücks mit dem darin einbezogenen Flüssigkeitsrohr aus der Gießform, **dadurch gekennzeichnet**, daß das Flüssigkeitsrohr vor dem Plazieren in die Gießform spiralförmig gewunden wird und in Zickzack-Form angeordnet wird, und daß die Gießform mit zumindest einer profilierten Wand versehen ist, so daß das Gußstück an zumindest einer Seite mit einer profilierten Fläche versehen ist.

Revendications

1. Echangeur de chaleur avec au moins un tuyau pour liquide incorporé dans une pièce moulée, ladite pièce moulée étant pourvue sur au moins un côté d'une surface d'échange de chaleur profilée, caractérisé en ce que ledit tuyau pour liquide est enroulé en spirale ou agencé selon une forme en zigzag avant de verser le matériau de moulage, ladite surface

d'échange de chaleur profilée et ledit tuyau cintré étant incorporés dans un corps formant pièce moulée unique.

2. Echangeur de chaleur selon la revendication 1, avec au moins deux tuyaux pour liquide incorporés dans un matériau de moulage, caractérisé en ce que les tuyaux pour liquide dans l'échangeur de chaleur forment au moins deux conduits séparés pour assurer l'échange de chaleur vers/depuis différents fluides.
3. Echangeur de chaleur selon la revendication 1 ou 2, caractérisé en ce que l'échangeur de chaleur présente une ouverture centrale, et la surface intérieure de l'échangeur de chaleur est munie de la surface d'échange de chaleur profilée.
4. Echangeur de chaleur selon la revendication 3, caractérisé en ce qu'un brûleur est monté dans l'ouverture centrale de l'échangeur de chaleur.
5. Echangeur de chaleur selon l'une des revendications 2 à 4, caractérisé en ce que la distance de l'un des conduits jusqu'à la surface d'échange de chaleur de l'échangeur de chaleur est supérieure à la distance d'un autre circuit jusqu'à la surface d'échange de chaleur de l'échangeur de chaleur.
6. Echangeur de chaleur selon l'une quelconque des revendications 1 à 5, dans lequel ledit tuyau pour liquide est fabriqué en cuivre et ledit matériau de moulage comprend de l'aluminium.
7. Procédé pour fabriquer un échangeur de chaleur, comprenant les étapes successives consistant à :
- façonner au moins un tuyau pour liquide ;
 - placer au moins une partie du tuyau pour liquide dans un moule ;
 - verser le matériau de moulage dans le moule ;
 - faire passer le matériau de moulage à l'état solide ;
 - extraire du moule la pièce moulée avec le tuyau pour liquide incorporé dans celle-ci, caractérisé en ce que ledit tuyau pour liquide est enroulé en spirale ou agencé selon une forme en zigzag avant d'être placé dans ledit moule et en ce que ledit moule est muni d'au moins une paroi profilée, de telle sorte que la pièce moulée soit pourvue sur au moins un côté d'une surface profilée.



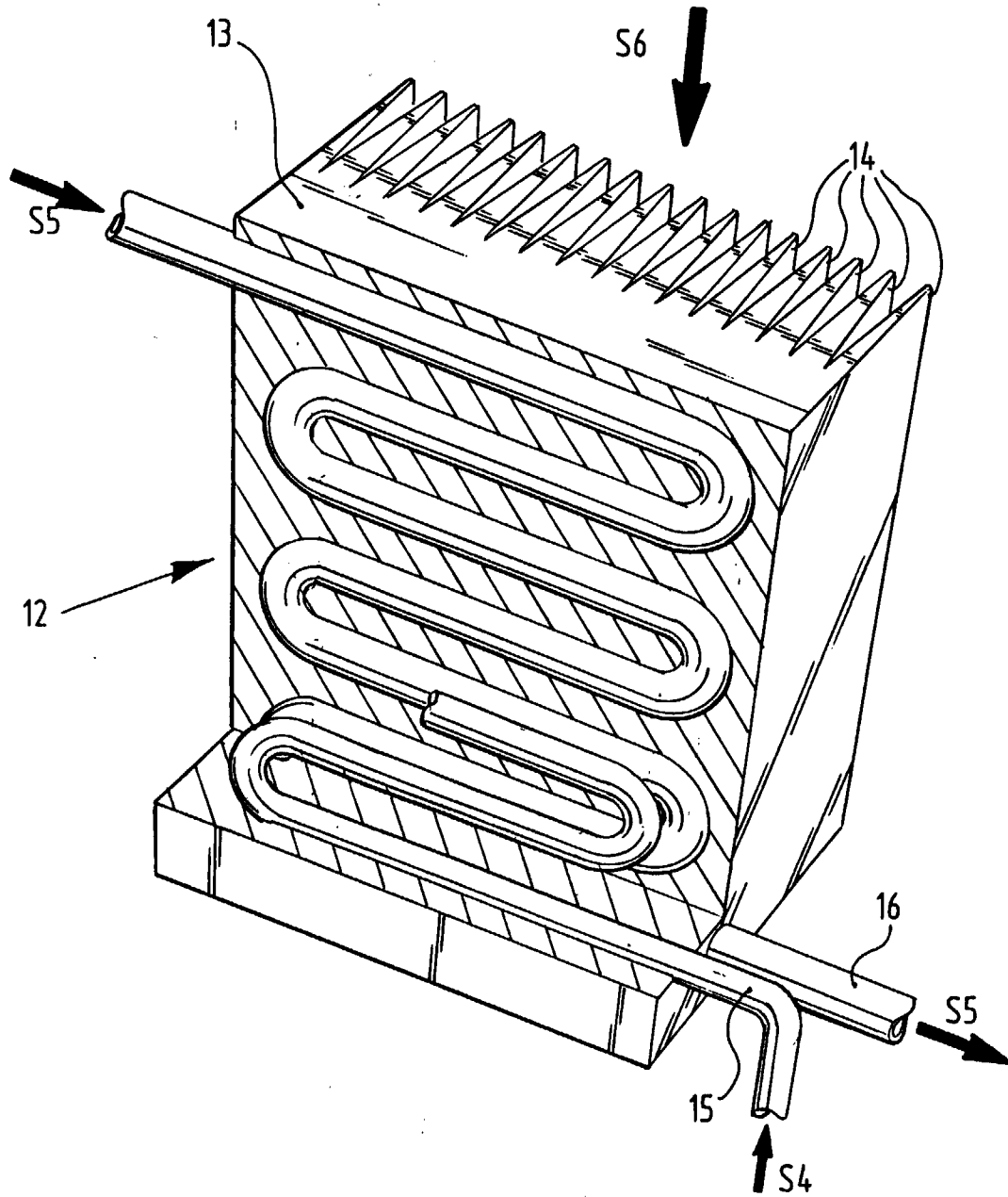


FIG. 2

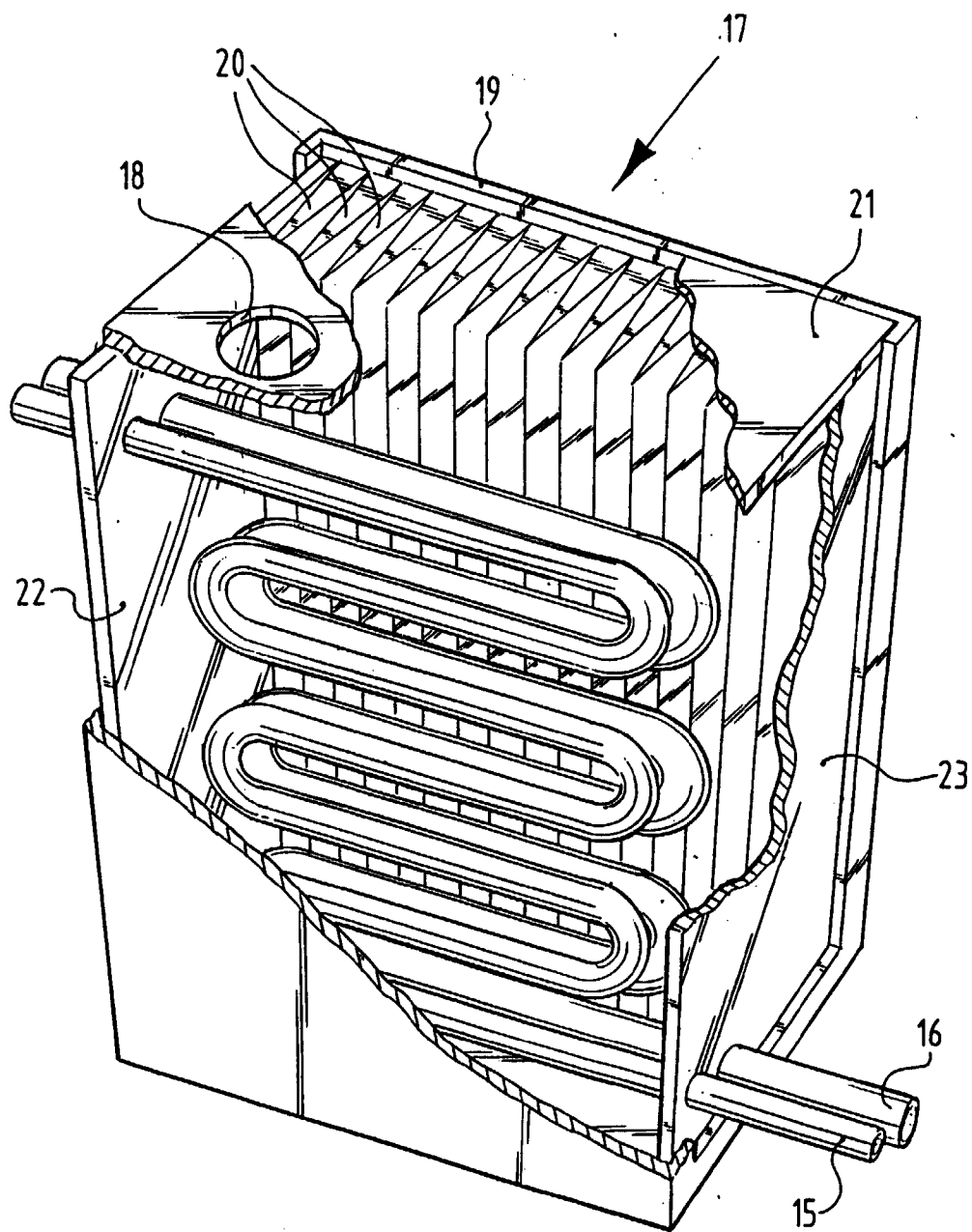


FIG. 3