US 20170299288A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2017/0299288 A1**

(43) **Pub. Date: Oct. 19, 2017**

**Bry et al.**

(54) **HEAT EXCHANGER, ESPECIALLY FOR MOTOR VEHICLE, AND METHOD FOR PRODUCING SUCH A HEAT EXCHANGER**

(71) Applicant: **Valeo Systemes Thermiques**, Le Mesnil Saint Denis (FR)

(72) Inventors: **Samuel Bry**, Parne Sur Roc (FR); **Patrick Boisselle**, Laval (FR); **Philippe Lemercier**, L'huisserie (FR)

(73) Assignee: **Valeo Systemes Thermiques**, Le Mesnil Saint Denis (FR)

(21) Appl. No.: **15/513,702**

(22) PCT Filed: **Sep. 23, 2015**

(86) PCT No.: **PCT/EP2015/071922**

§ 371 (c)(1),
(2) Date: **Mar. 23, 2017**

(30) **Foreign Application Priority Data**

Sep. 24, 2014 (FR) ..... 1459037

**Publication Classification**

(51) **Int. Cl.**

| | |
|---|---|
| ***F28F 21/06*** | (2006.01) |
| ***F28F 9/14*** | (2006.01) |
| ***F28F 9/013*** | (2006.01) |
| ***F28F 9/02*** | (2006.01) |
| ***F28F 19/00*** | (2006.01) |
| ***F28D 1/053*** | (2006.01) |
| *F28D 21/00* | (2006.01) |

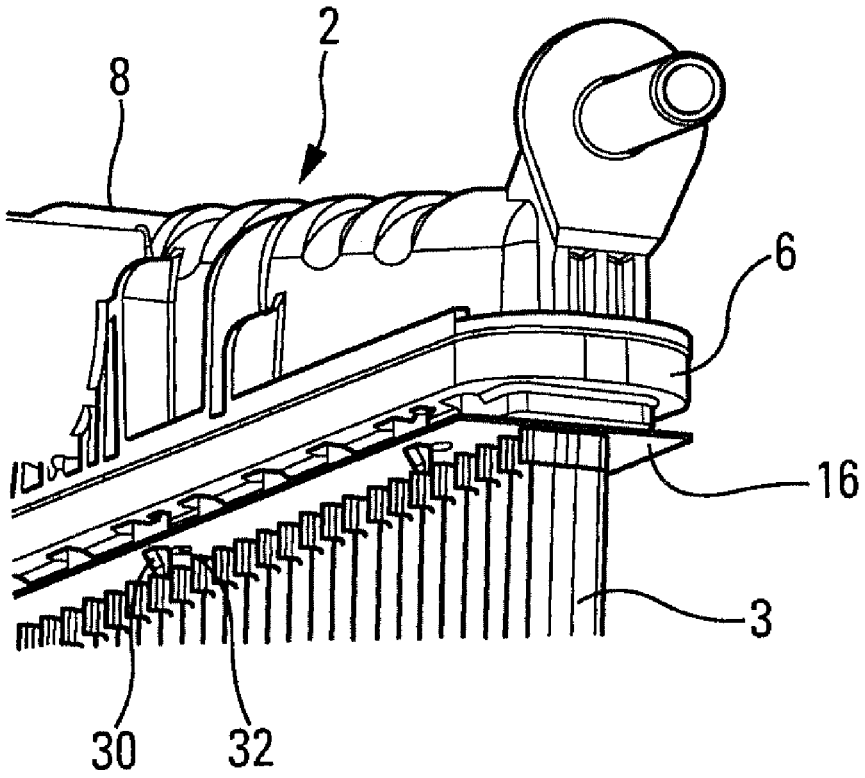
(52) **U.S. Cl.**

CPC ..... ***F28F 21/062*** (2013.01); ***F28F 19/00*** (2013.01); ***F28F 9/14*** (2013.01); ***F28D 1/05366*** (2013.01); ***F28F 9/0131*** (2013.01); ***F28F 9/0224*** (2013.01); *F28D 2021/0094* (2013.01)

(57) **ABSTRACT**

The invention relates to a heat exchanger, notably for a motor vehicle, said exchanger comprising a core bundle for the exchange of heat between a first and a second fluid, said core bundle comprising a plurality of tubes (**3**) and a header tank (**2**), said tubes (**3**) and said tank (**2**) allowing said first fluid to circulate between them, said exchanger further comprising a retaining plate (**16**) for holding said tubes (**3**), said plate (**16**) being fixed to said tank (**2**), said tank (**2**) comprising a collector plate (**6**) provided with orifices through which said tubes (**3**) pass, said collector plate (**6**) being made of plastic.

The invention also relates to a method of manufacturing such an exchanger.



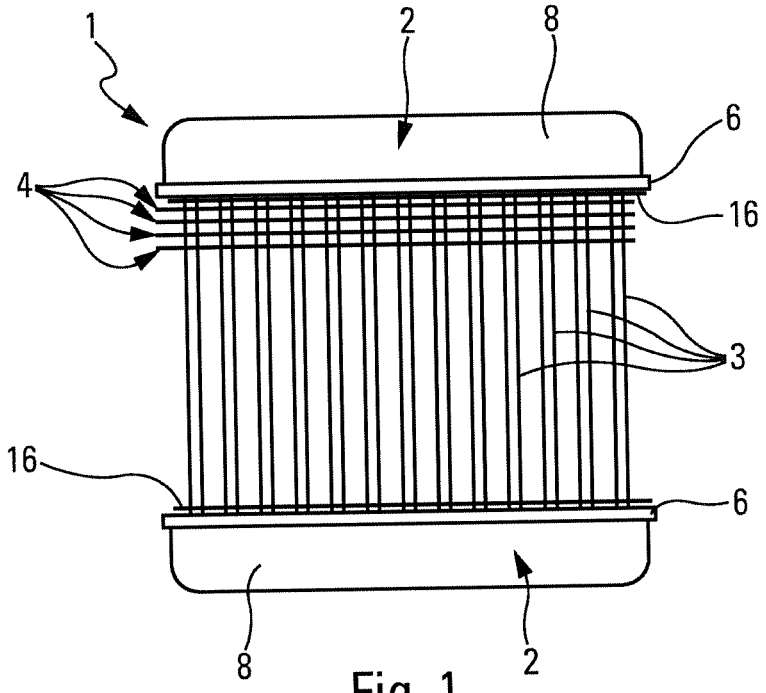



Fig. 1

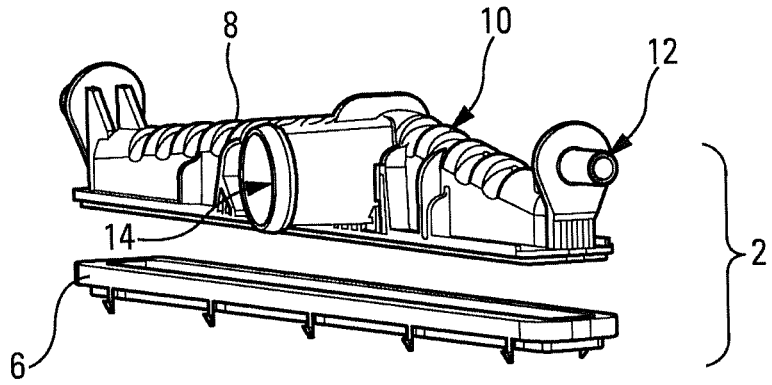



Fig. 2

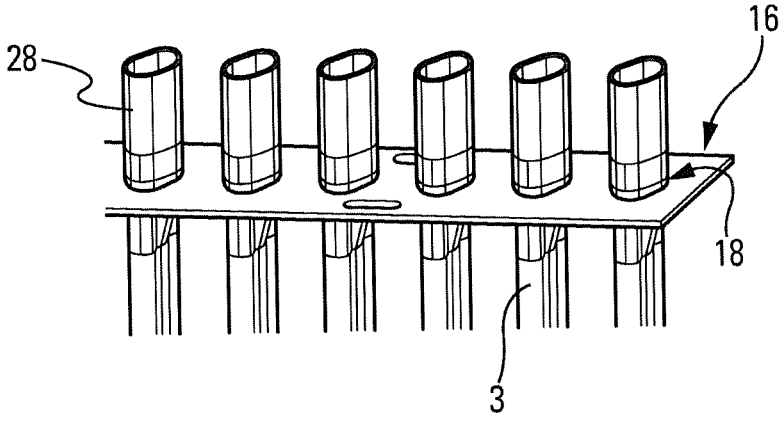



Fig. 3

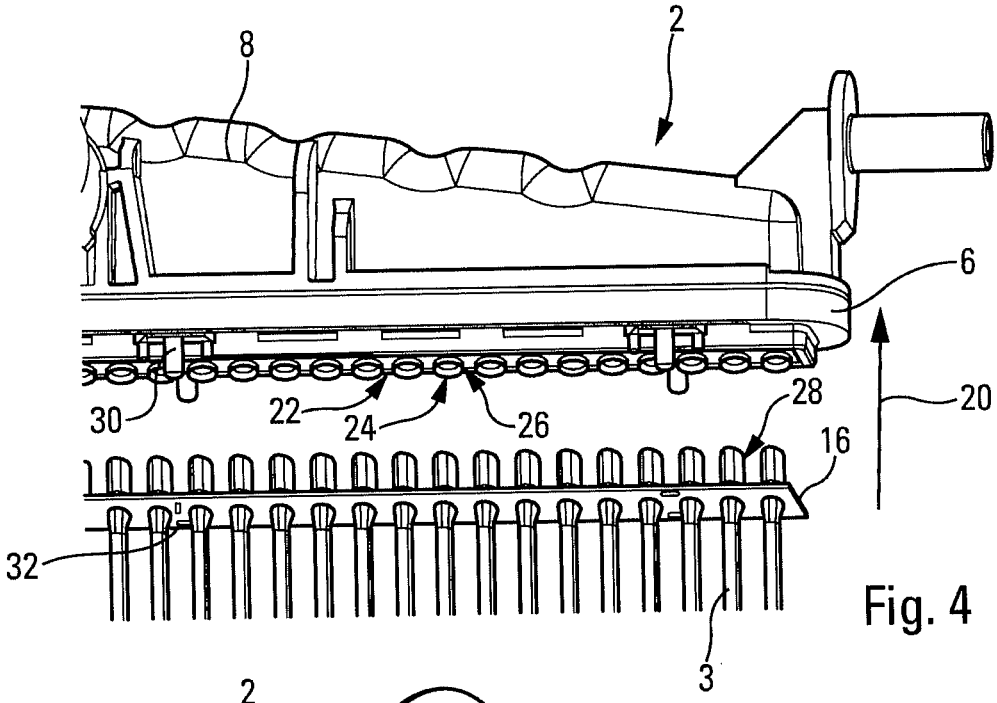



Fig. 4

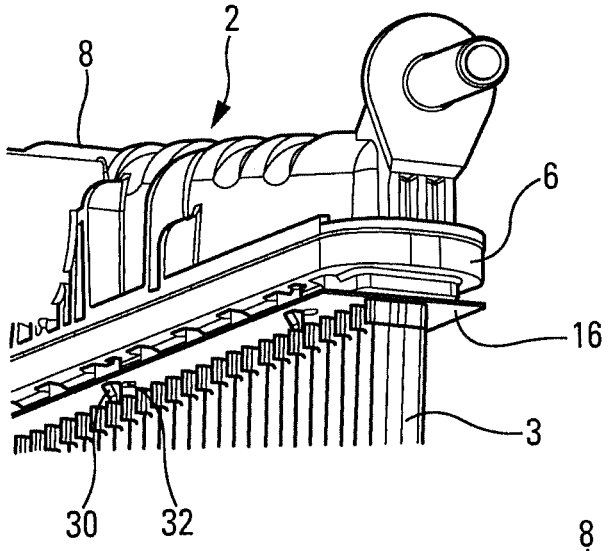



Fig. 5

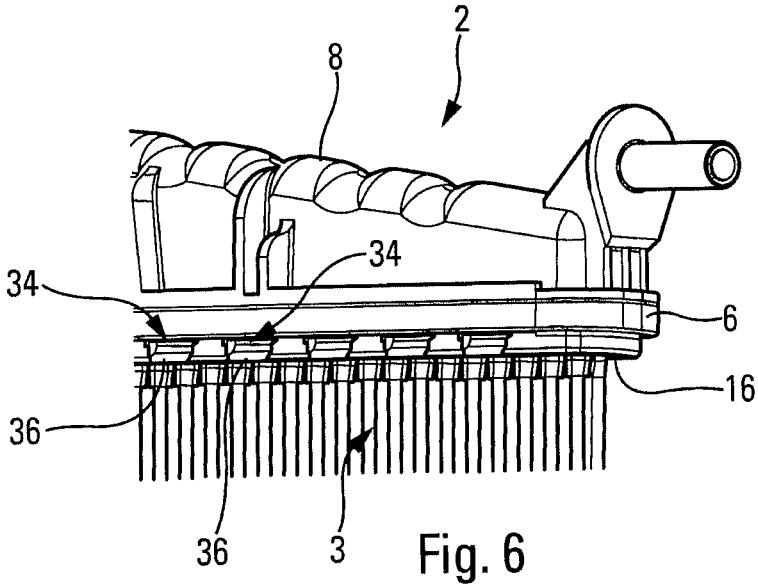



Fig. 6

# HEAT EXCHANGER, ESPECIALLY FOR MOTOR VEHICLE, AND METHOD FOR PRODUCING SUCH A HEAT EXCHANGER

**[0001]** The present invention relates to a heat exchanger and to a method of manufacturing such an exchanger. It is particularly aimed at applications in the automotive vehicle field, notably as a radiator for cooling the heat-transfer fluid used to cool the engine of the vehicles.

**[0002]** In automotive applications there are two known main types of heat exchanger: a first type, referred to as mechanical, corresponding to exchangers which are obtained by assembling their components by the deformation of material, and exchangers referred to as brazed exchangers, corresponding to exchangers obtained by assembling their components using brazing.

**[0003]** Mechanical exchangers are made up mainly of a core bundle of tubes through which a heat-transfer fluid circulates and of a plurality of fins arranged perpendicular to the tubes and provided with orifices through which said tubes pass. The purpose of the fins is to increase the surface area for exchange with the air passing through the exchanger. An exchange of heat between the fluid circulating through the tubes and the air passing between the fins is thus obtained.

**[0004]** The fins are held on the tubes and the tubes are held on the collector plates by expanding the tubes. More specifically, an expansion olive is passed along the tubes, inside same. It has the effect of deforming the material of the tubes thereby increasing their cross section and thus allows the tubes to be kept pressed against the fins.

**[0005]** One benefit of mechanical exchangers over brazed exchangers is their great ease of assembly. Specifically, brazed exchangers require brazing ovens which involve significant investment, whereas mechanical exchangers can be produced with installations that require far lower investment.

**[0006]** Nevertheless, in mechanical exchangers, the collector plate and the tubes are made of metal and therefore subject to corrosion. Such a phenomenon is further amplified by a galvanic effect between the collector plate and the tubes. Corrosion weakens the tubes and/or the collector plate and introduces a risk as to the fluidtightness of the exchanger.

**[0007]** To alleviate this disadvantage, header tanks made of plastic have already been proposed. These are tubular in shape and provided with orifices for the passage of the tubes. However, with such a solution it is difficult to expand the tubes given the amount of space available inside the tank. Immobilizing the tubes with respect to the tanks therefore presents problems.

**[0008]** The present invention seeks to overcome these disadvantages and relates first of all to a heat exchanger, notably for a motor vehicle, said exchanger comprising a core bundle for the exchange of heat between a first and a second fluid, said core bundle comprising a plurality of tubes and a header tank, said tubes and said tank allowing said first fluid to circulate between them, said exchanger further comprising a retaining plate for holding said tubes, said plate being fixed to said tank, said tank comprising a collector plate provided with orifices through which said tubes pass, said collector plate being made of plastic.

**[0009]** Because the collector plate is made of plastic, the corrosion phenomena encountered with the metal collector plates of the prior art are avoided. In addition, by attaching the tubes to the tank via the retaining plate, the problem of immobilizing the tubes relative to the tanks is solved.

**[0010]** According to various embodiments which may be considered together or separately:

- **[0011]** said retaining plate is attached externally to said tank,
- **[0012]** said retaining plate is attached to said collector plate,
- **[0013]** said tank comprises a cover, attached to said collector plate,
- **[0014]** said cover is made of plastic,
- **[0015]** said cover and said collector plate are fixed by welding,
- **[0016]** said tubes are made of metal,
- **[0017]** said tubes are made of aluminum alloy,
- **[0018]** said exchanger further comprises a gasket through which said tubes pass,
- **[0019]** said gasket is situated outside said header tank,
- **[0020]** said gasket is compressed between said tubes and said collector plate at an outline of said orifices provided in said collector plate for the passage of said tubes,
- **[0021]** said tubes are flared at their ends,
- **[0022]** said flare extends at least facing said retaining plate and/or said collector plate, or even facing said gasket,
- **[0023]** said retaining plate is removable with respect to said header tank.

**[0024]** The invention also relates to a method of manufacturing such an exchanger, said method comprising:

- **[0025]** a step of fixing said tubes to said retaining plate,
- **[0026]** a step of attaching said retaining plate to said header tank.

**[0027]** According to various embodiments of the invention which may be considered together or separately:

- **[0028]** said step of fixing the tubes in the retaining plate involves a step of flaring said tubes in said retaining plate,
- **[0029]** said method comprises a step of introducing said tubes into said collector plate,
- **[0030]** said step of introducing the tubes into said collector plate is after the step of fixing said tubes to said retaining plate and/or before the step of attaching said retaining plate to said header tank,
- **[0031]** said step of introducing said tubes into said collector plate comprises a step of force-fitting said tubes into said collector plate and/or said gasket.

**[0032]** The attached figures will make it easy to understand how the invention may be embodied. In these figures, references that are identical denote elements that are similar.

**[0033]** FIG. **1** is an elevation schematically illustrating an exchanger according to the invention.

**[0034]** FIG. **2** is an exploded perspective view of a header tank of a heat exchanger according to the invention.

**[0035]** FIG. **3** is a partial perspective view of a core bundle of a heat exchanger according to the invention.

**[0036]** FIG. **4** is a perspective view showing the mounting of the core bundle of FIG. **3** on the header tank of FIG. **2**.

**[0037]** FIG. **5** is a perspective view showing one example of a heat exchanger according to the invention, after assembly.

**[0038]** FIG. **6** is a perspective view showing an alternative form of embodiment, according to the invention, of the exchanger of FIG. **5**.

**[0039]** As illustrated in FIG. **1**, the invention relates to a heat exchanger **1** exchanging heat between a first and a second fluid. This is an exchanger of the mechanical type. It comprises a core bundle of tubes **3** through which the first fluid, in this instance a heat-transfer fluid, circulates. Said heat-transfer fluid is, for example, glycol water, in particular when the exchanger **1** acts as a radiator for cooling a combustion engine.

**[0040]** Said tubes **3** are, for example of circular, oval or oblong cross section. In this last instance, their cross section could exhibit concave zones to give the tubes a reduced bore section in their middle zone. Said tubes **3** are, for example, made of a metal alloy such as an aluminum alloy. They are notably obtained by electric arc welding.

**[0041]** Said core bundle may further comprise cooling or heat sink fins **4**, through which the tubes **3** pass. These tubes are, for example, aligned in parallel in one or more banks and the fins **4**, which are provided parallel to one another, are arranged transversely, particularly perpendicularly, to said tubes **3**. To simplify the drawing, only a limited number of fins of the core bundle have been depicted.

**[0042]** The fins **4** are provided with tube passage orifices of a shape corresponding to the cross section of said tubes. They may also have louvers to disrupt the flow of the second fluid, namely in this instance an incident air stream. This then encourages the exchange of heat between said air stream, flowing between the fins **4**, and the heat-transfer fluid circulating through the tubes **3**. Said fins **4** are separated from one another by a spacing which is advantageously constant.

**[0043]** Said exchanger additionally comprises two end header tanks **2** spaced apart parallel to one another and connected by the tubes **3**. Said tubes **3** and said tanks **2** allow said first fluid to circulate between them. For preference, the dimensions of the fins **4**, in plan, correspond substantially to those of the header tanks **2**, for the sake of the compactness of the heat exchanger **1**.

**[0044]** In the case of an application as a cooling radiator cooling a motor vehicle engine, the heat-transfer fluid coming from the tubes and passing through one of the header tanks is conveyed, by a feed pipe, to the various hot parts of the engine (the engine block, cylinder head, etc.) that need cooling before being returned, now heated, by a return pipe to the other header tank of the radiator to circulate once again through the tubes. The exchange of heat between the hot heat-transfer fluid circulating through the tubes of the exchanger and the stream of air passing between said tubes in order to lower the temperature of the heat-transfer fluid, is encouraged by the presence of the fins of which the shape, number and material are chosen to optimize the removal of a significant amount of heat with a view to gradually bringing the heat-transfer fluid passing through the exchanger down to a range of temperatures that is acceptable and effective for cooling the engine. The fluid feed and return couplings provided in the respective tanks leading to the engine and returning therefrom have not been depicted.

**[0045]** Said tanks **2** comprise a collector plate **6** equipped with orifices for the passage of said tubes **3**. Said tanks **2** further comprise here a cover **8**, attached to said collector plate **6**. Said cover **8** is, for example, made of plastic. This is notably polyamide, particularly PA-6,6.

**[0046]** As is best visible in FIG. **2**, said cover **8** may have reinforcing ribs **10**. It may also incorporate one or more flanges **12** for the fixing of the exchanger, these here being situated at its longitudinal ends, and/or one or more inlet and/or outlet manifolds **14** for the first fluid, in this instance situated between its longitudinal ends.

**[0047]** According to the invention, said collector plate is made of plastic, notably polyamide, particularly PA-6,6. Such a choice of material makes it possible to limit the effects of corrosion.

**[0048]** FIG. **2** depicts the cover **8** and the collector plate **6** separately. Said cover **8** and said collector plate **6** may advantageously be fixed together by welding, notably using vibration, ultrasound, infrared, laser welding, hot fusion bonding or the like.

**[0049]** As illustrated in FIG. **3**, said exchanger further comprises a retaining plate **16** for holding said tubes **3**. Here it is provided with such a retaining plate **16** near each longitudinal end of said tubes **3**. Said plate **16** is, for example, pierced with through-orifices **18** in which the tubes **3** are held. In other words, said tubes **3** and said retaining plate **16** are secured to one another, preferably indissociably. Said plate **16** is, for example, made of metal. Here it is of substantially rectangular shape.

**[0050]** It should particularly be noted that said retaining plate **16** is different from the fins **4**. In particular, it is stronger than these latter, notably through the choice of a different material and/or a different thickness of material.

**[0051]** FIG. **4** depicts the assembly of the exchanger core bundle with the tank **2**, in the direction of the arrow referenced **20**.

**[0052]** As illustrated in the next figures, on completion of this assembly each retaining plate **16** is fixed to one of the tanks **2**. That immobilizes the tubes **3** with respect to the tanks **2**. In this instance, said retaining plates **16** are attached externally to said tanks **2** and, more particularly, to said collector plates **6**.

**[0053]** In order to ensure a good seal between the tanks **2** and the tubes **3**, the latter are advantageously force-fitted into said collector plate **6**. To improve this result still further and as is more visible in FIG. **4**, said exchanger may comprise a gasket **22**, notably an elastomeric gasket, through which said tubes **3** pass.

**[0054]** Said gasket **22** for that reason advantageously has tube passage orifices **24**. Said gasket **22** here has a flat part connecting annular parts, which are substantially projecting, forming cuffs or nipples **26** at which said orifices **24** for the passage of the tubes through the gasket **22** are defined. In other words, each of said tubes **3** passes through one of said cuffs **26**. Said gasket **22** in this instance is situated outside said header tank **2**.

**[0055]** Said gasket **22** is compressed between said tubes **3** and said collector plate **6**, at a contour of said orifices **24** provided in said collector plate **6** for the passage of said tubes **3**. In other words, the cuffs **26** are compressed here, in line with said collector plate **6**, between the tubes **3** and a contour of the orifices for the passage of said tubes **3** which are formed in said collector plate **6**. Put in yet another way, a part of the cuffs **26** is inserted into said orifices for the passage of the tubes **3** which are formed in the collector plate **6**, or even extends axially as far as the inside of the header tank **2**.

**[0056]** Said tubes **3** are advantageously flared **28** at their longitudinal ends. Said flare **28** extends at least facing said retaining plate **16**, said gasket **22** and said collector plate **6**. Such a flare **28** encourages retention of the tubes **3** in said

retaining plate **16**, forcible fitting thereof into the collector plate **6** and compression of the gasket **22** between said tubes **3** and the collector plate **6**.

**[0057]** As illustrated in FIGS. **5** and **6**, said retaining plate **16** is removable in relation to said header tank **2**.

**[0058]** In FIG. **5**, said retaining plate **16** is secured to the collector plate **6** by lugs **30** provided on said collector plate **6** and slots **32** provided on said retaining plate **16**, said lugs **30** clipping into said slots **32**.

**[0059]** In FIG. **6**, said retaining plate **16** is secured to the collector plate **6** by crimping. For that, said collector plate **6** is provided with housings **34**, in this instance uniformly distributed along its periphery, at the level of which crimping teeth **36** of the retaining plate **16** are situated.

**[0060]** A method of manufacturing an exchanger as described above is described hereinafter.

**[0061]** According to the invention, said tubes **3** are fixed on said retaining plate **16**, for example by flaring the end of said tubes.

**[0062]** A prior step of fixing the fins **4** may take place, likewise by flaring. To do that, an expansion olive may be passed along, deforming the tubes to a diameter slightly greater than that of the orifices provided in the fins **4** for passage of said tubes. The flaring of the end of the tubes then takes place in a second stage, to an even greater diameter.

**[0063]** Furthermore, said header tank **2** is assembled, notably by welding the collector plate **6** and the cover **8**.

**[0064]** In a later step, said retaining plate **16** and, therefore, the heat exchange core bundle, is attached to said header tank **2**, notably using said lugs **30** and/or by crimping.

**[0065]** Before that, said tubes **3** will advantageously have been introduced into said collector plate **6**, notably by force-fitting said tubes **3** into said collector plate **6**, thereby compressing the gasket **22**.

**1**. A heat exchanger, notably for a motor vehicle, said exchanger comprising:

a core bundle for the exchange of heat between a first and a second fluid, said core bundle comprising a plurality of tubes and a header tank, said tubes and said tank allowing said first fluid to circulate between them; and

a retaining plate for holding said plurality of tubes, said retaining plate being fixed to said tank,

said tank comprising a collector plate provided with orifices through which said tubes pass, and

said collector plate being made of plastic.

**2**. The exchanger as claimed in claim **1**, wherein said retaining plate is attached externally to said tank.

**3**. The exchanger as claimed in claim **1**, wherein said retaining plate is attached to said collector plate.

**4**. The exchanger as claimed in claim **1**, wherein said tank comprises a cover, attached to said collector plate.

**5**. The exchanger as claimed in claim **4**, wherein said cover is made of plastic.

**6**. The exchanger as claimed in claim **4**, wherein said cover and said collector plate are fixed by welding.

**7**. The exchanger as claimed in claim **1**, further comprising a gasket through which said tubes pass.

**8**. The exchanger as claimed in claim **7**, wherein said gasket is situated outside said header tank.

**9**. The exchanger as claimed in claim **7**, wherein said gasket is compressed between said tubes and said collector plate (**6**) at an outline of said orifices provided in said collector plate for the passage of said tubes.

**10**. The exchanger as claimed in claim **1**, wherein said tubes are flared at their ends, said flare extending at least facing said retaining plate and/or said collector plate.

**11**. The exchanger as claimed in claim **1**, wherein said retaining plate is removable with respect to said header tank.

**12**. A method of manufacturing an exchanger as claimed in claim **1**, said method comprising:

fixing said tubes to said retaining plate; and

attaching said retaining plate to said header tank.

**13**. The method as claimed in claim **12**, wherein fixing the tubes in the retaining plate comprises flaring said tubes in said retaining plate.

**14**. The method as claimed in claim **12**, further comprising: introducing said tubes into said collector plate, after fixing said tubes to said retaining plate and/or before attaching said retaining plate to said header tank.

**15**. The method as claimed in claim **14**, wherein introducing said tubes into said collector plate comprises force-fitting said tubes into said collector plate.

* * * * *