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(54) **Thermal expansion feature for an exhaust gas cooler**

(57) An exhaust gas cooler and a method of manufacture an exhaust gas cooler comprising providing a shell, disposing within the shell a tube bundle/core

through which exhaust gas passes, and situating a seal or gasket assembly providing a liquid-tight seal between the shell and the tube bundle/core and between each tube of the tube/bundle core.

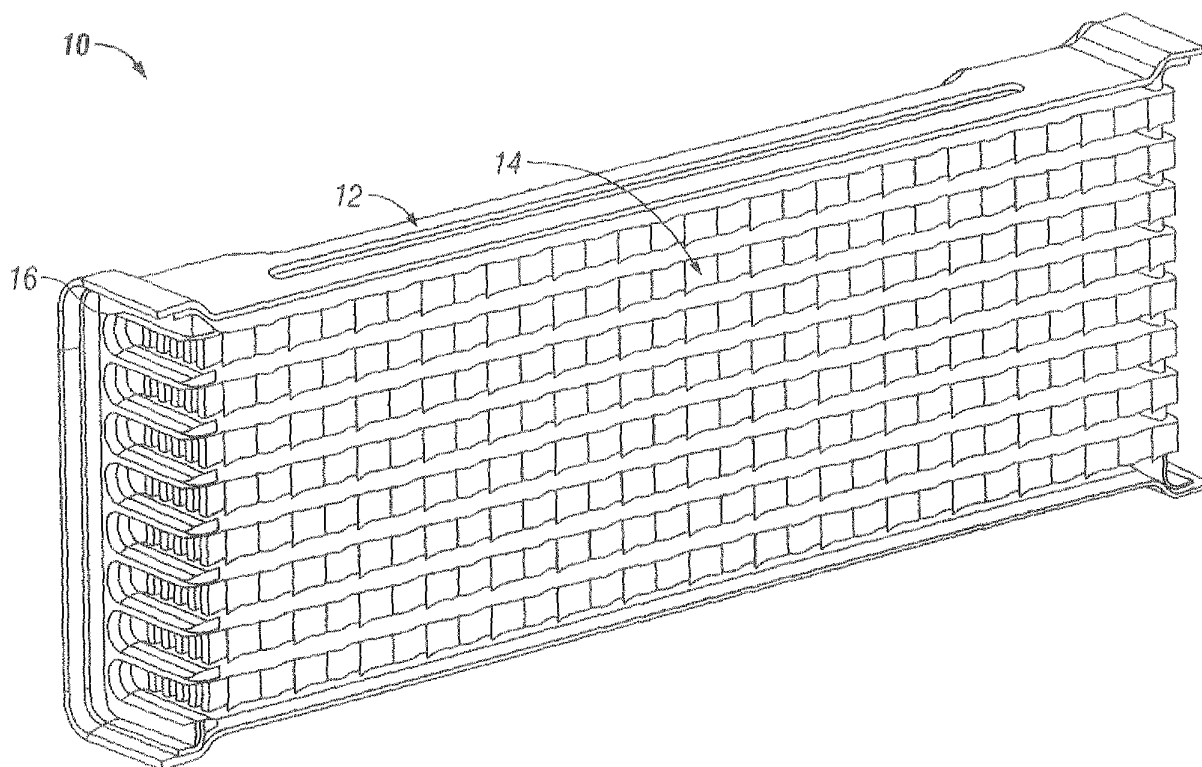


FIG. 1

Description

BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field):

[0001] The present invention relates to exhaust gas coolers and methods of making and using same.

Description of Related Art:

[0002] In some engine applications the high temperature of the exhaust gas that enters an exhaust gas cooler combined with the cyclic nature of the gas flow creates a thermal stress within the cooler core. This will lead to fatigue failure depending on the temperature and number of cycles. A way to reduce the stress in the core is required in order to prolong the life of the cooler.

[0003] One attempt for handling this issue is disclosed in U.S. Patent No. 7,044,116, entitled "Exhaust heat exchanger in particular for motor vehicles", relating to an exhaust cooler for motor vehicles with exhaust recycling. A sliding seating is arranged in the force flow, either in the housing sleeve or between a tube plate and the housing sleeve. The sliding fit is between two components which can slide in relation to one another, in what is referred to as a loose bearing, in contrast to a fixed bearing. Such a sliding fit compensates for the different degrees of expansion of the nest of pipes and housing, i.e., the abovementioned stresses are diminished.

[0004] The present invention provides a solution that is much less complicated and does not require the sliding arrangement of the prior art, as well as providing additional benefits, namely an intermediate seal or gasket between the header plate and the individual tubes of the exhaust gas cooler. While other heat exchangers are known to have a gasket between the tubes and header to form a seal, the gasket on these units is to allow a unit to be assembled without brazing. Like gaskets are used at both ends of the tubes. The present invention is still brazed, but the seal allows for thermal expansion of non-brazed tube ends. The cooled medium of the invention is exhaust gas through the tubes cooled by coolant over the tubes,

BRIEF SUMMARY OF THE INVENTION

[0005] The present invention is of an exhaust gas cooler and a method of manufacturing an exhaust gas cooler, comprising: providing a shell; disposing within the shell a tube bundle/core through which exhaust gas passes; and situating a seal or gasket assembly providing a liquid-tight seal between the shell and the tube bundle/core and between each tube of the tube/bundle core, in the preferred embodiment, the seal or gasket assembly is situated proximate an end of the tube bundle/core, most preferably proximate the cold end of the tube bundle/core. The seal or gasket assembly preferably comprises a seal

or gasket comprising one or more of rubber, silicone, and a polymer, and the assembly preferably comprises a header between the shell and the seal or gasket. The seal or gasket preferably comprises a notch accepting the header and has a rounded interior profile. The tube bundle/core preferably comprises tubes with unbrazed ends. The tubes are preferably flared and have fins recessed to accommodate the flared ends,

[0006] Objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] The accompanying drawings, which are incorporated into and form a part of the specification, illustrate one or more embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating one or more preferred embodiments of the invention and are not to be construed as limiting the invention in the drawings:

[0008] Fig. 1 is a front perspective view of an exhaust gas cooler according to the invention; and

[0009] Fig. 2 is a front perspective detail of the invention shown in Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The present invention allows the tubes of an exhaust gas cooler to expand and contract without restraining them within the core bundle. This is achieved by the use of an intermediate seal or gasket between the header plate and the individual tubes. The seal prevents coolant from leaking out of the cooler and lets the tube length increase and decrease with the variation of the exhaust gas temperature. The seal is applied to the cold end of the core, where the temperatures are low enough on the tube wall to allow a polymer to be used without degradation over time. The geometry of the arrangement also encourages corrosive condensate to run away from the seal.

[0011] The cooler core is preferably brazed before assembly of the gasket seal onto the tubes. The gasket is preferably pushed over the tube ends and through the header. After assembling the gasket onto the tubes and header plate the tube ends are preferably expanded (flared) to resist the tendency of the pressurized coolant to force the gasket off the ends of the tubes. In a cooler with a secondary surface within the tubes the fins are pref-

erably recessed within the tube to allow passage for the expansion punch.

[0012] Referring to the Figures, the exhaust gas cooler **10** of the invention comprises shell **12**, tube bundle/core and seal or gasket **16**. The seal preferably comprises rubber, silicone, or polymer able to withstand the temperature ranges expected to be encountered by the particular exhaust gas cooler at issue. Inset **18** of Fig. 1 is shown in detail in Fig. 2. Header **20** is placed within the shell and fits into a corresponding notch in the seal or gasket, forming a seal or gasket assembly. It fins **24** are employed within one or more tubes of the tube bundle/core, then the fins are preferably recessed to allow for flaring **22** of the tubes at the ends with the seal or gasket. The seal or gasket preferably has a rounded profile on its interior, as shown in Fig. 2, to ease insertion onto the tube bundle/core.

[0013] Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover in the appended claims all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above are hereby incorporated by reference.

Claims

1. An exhaust gas cooler comprising:
 - a shell;
 - a tube bundle/core through which exhaust gas passes; and
 - a seal or gasket assembly providing a liquid-tight seal between said shell and said tube bundle/core and between each tube of said tube/bundle core.
2. The exhaust gas cooler of claim 1 wherein said seal or gasket assembly is located proximate an end of said tube bundle/core.
3. The exhaust gas cooler of claim 2 wherein said seal or gasket assembly is located proximate the cold end of said tube bundle/core.
4. The exhaust gas cooler of claim 1 wherein said seal or gasket assembly comprises a seal or gasket comprising one or more of the group consisting of rubber, silicone, and a polymer.
5. The exhaust gas cooler of claim 4 wherein said seal or gasket assembly comprises a header between said shell and said seal or gasket
6. The exhaust gas cooler of claim 5 wherein said seal or gasket comprises a notch accepting said header.
7. The exhaust gas cooler of claim 4 wherein said seal or gasket comprises a rounded interior profile.
8. The exhaust cooler of claim 1 wherein said tube bundle/core comprises tubes with unbrazed ends.
9. The exhaust gas cooler of claim 1 wherein said tube bundle/core comprises tubes with flared ends.
10. The exhaust gas cooler of claim 9 wherein tube comprises one or more tubes with fins recessed to accommodate said flared ends,
11. A method of manufacturing an exhaust gas cooler, the method the steps of:
 - providing a shell;
 - disposing within the shell a tube bundle/core through which exhaust gas passes; and
 - situating a seal or gasket assembly providing a liquid-tight seal between the shell and the tube bundle/core and between each tube of the tube/bundle core.
12. The method of claim 11 wherein in the situating step the seal or gasket assembly is situated proximate an end of the tube bundle/core.
13. The method of claim 12 wherein in the situating step the seal or gasket assembly is situated proximate the cold end of the tube bundle/core.
14. The method of claim 11 wherein in the situating step the seal or gasket assembly comprises a seal or gasket comprising one or more of the group consisting of rubber, silicone, and a polymer.
15. The method of claim 14 wherein in the situating step the seal or gasket assembly comprises a header between the shell and the seal or gasket.
16. The method of claim 15 wherein in the situating step the seal or gasket comprises a notch accepting the header.
17. The method of claim 14 wherein in the situating step the seal or gasket comprises a rounded interior profile.
18. The method of claim 11 wherein in the disposing step the tube bundle/core comprises tubes with unbrazed ends.
19. The method of claim 11 wherein in the disposing step the tube bundle/core comprises tubes with ends.

20. The method of claim 19 wherein in the disposing step the tube bundle/core comprises one or more tubes with fins recessed to accommodate the flared ends.

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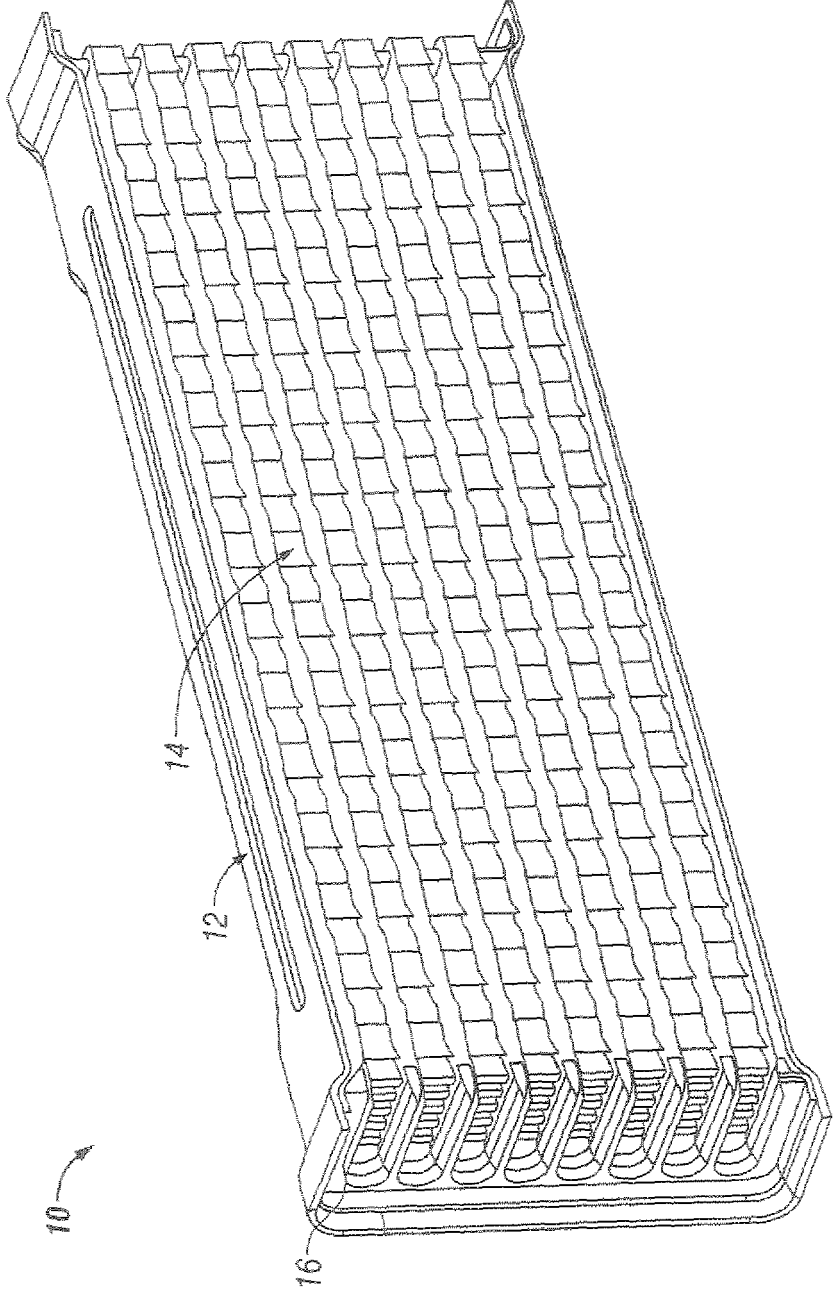


FIG. 1

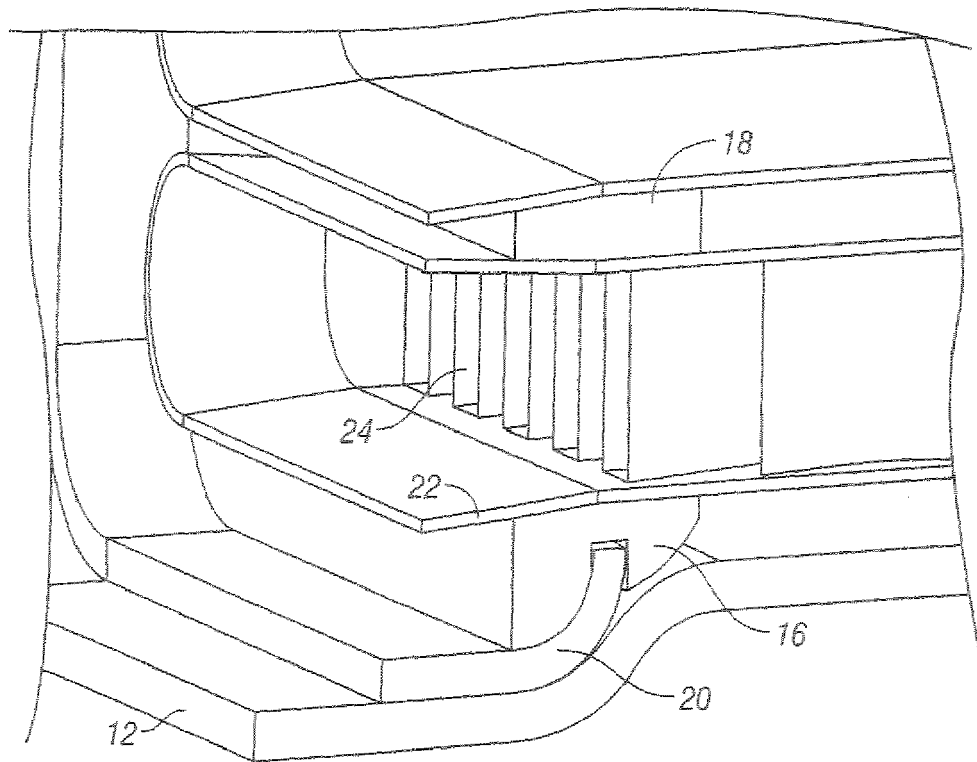


FIG. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 5770

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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			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
Munich		4 February 2008	Bain, David
CATEGORY OF CITED DOCUMENTS 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 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			

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EPO FORM 1503 03.82 (P04/C01)

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

EP 07 11 5770

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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