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(54) **Heat exchanger for an EGR system with an integrated by-pass duct.**

(57) A heat exchanger (1) for an EGR system with an integrated by-pass duct (9). A heat exchanger for recirculated exhaust gases of an internal combustion engine is proposed with an integrated by-pass duct (9) through which the exhaust gases can recirculate during the engine starting and/or in low temperature or load conditions.

The exchanger is formed by a cylindrical casing (2) inside of which the typical refrigeration chamber (3) in

this type of devices is assembled, as well as the by-pass duct (9). As a coupling means to the gas intake device of the EGR system, a flange (15,16) is used with a housing for the refrigerating tubes of the refrigeration chamber and another housing (22) for the by-pass duct; with a separation area (23) between said housings.

The by-pass duct can be a double-walled duct with an intermediate air chamber to prevent the cooling of the gases circulating through it.

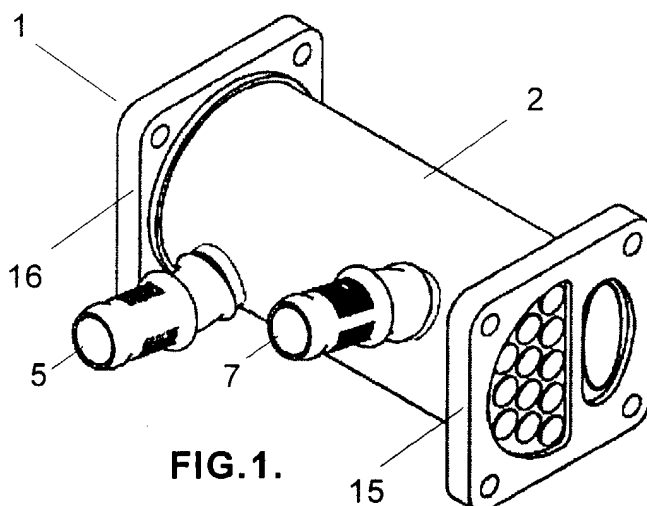


FIG.1.

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Description

FIELD OF THE INVENTION

[0001] The present invention refers to a heat exchanger for an exhaust gas recirculation system (EGR) of an internal combustion engine, and more specifically, a heat exchanger with an integrated by-pass duct.

BACKGROUND OF THE INVENTION

[0002] In the current state of the art, different exhaust gas recirculation systems in internal combustion engines are known, which are called EGR systems.

[0003] These systems recirculate exhaust gases from the exhaust manifold towards the intake manifold of the engine after subjecting them to a cooling process with the object of reducing the amount of NO_x emissions.

[0004] As it is not ideal to cool the exhaust gases in certain engine functioning conditions, it has been proposed in the art to use by-pass ducts permitting the escape gases to be recirculated without passing through the heat exchanger, under the control of a valve driving the exhaust gases either towards the heat exchanger or towards said by-pass duct, according to pre-established conditions.

[0005] One of those proposals is that which is disclosed in US patent 4,147,141, describing an EGR system with a by-pass duct parallel to the heat exchanger and an EGR valve keeping the module closed until the temperature of the engine reaches a certain predetermined value and, once opened, directing the exhaust gases towards the by-pass duct when its temperature is lower than a certain limit and to the heat exchanger in the opposite case.

[0006] Another proposal is disclosed in US patent 5,203,311, including a first control valve in the by-pass duct and a second valve in the heat exchanger.

[0007] Another proposal is disclosed in US patent 5,617,726 in which a by-pass duct is used in a different manner according to the circumstances of the load of the engine and its components.

[0008] Another proposal is disclosed in patent application WO 02/10574, including a heat exchanger for exhaust gases with a refrigeration chamber, a by-pass duct and means for directing the exhaust gases either towards the refrigeration chamber or towards the by-pass duct and in which those components are suitably integrated to form a unit being easily assembled in the engine.

[0009] The automobile industry demands improvements in the known EGR systems in order to tend to different needs. One of them is motivated by the increasing requirements of the administrative regulations on the admissible NO_x emissions limitations. Another need to satisfy is to aid in the automobile engine assembly by simplifying the design of its components to improve its integration capacity.

SUMMARY OF THE INVENTION

[0010] The object of the present invention is to provide a heat exchanger as an integral element of an EGR system for recirculated exhaust gases of an internal combustion engine with an integrated by-pass duct through which the exhaust gases can recirculate during the engine starting and/or in low temperature or load conditions.

[0011] In other words, the problem the present invention proposes to solve is to provide a heat exchanger for recycled exhaust gases including, in a single unit, both the refrigeration chamber for cooling the gases as well as a by-pass duct through which the gases must circulate when their cooling is not necessary, and that this unit be easily integrated in the engine.

[0012] According to the invention, the heat exchanger is formed by a cylindrical casing inside of which the refrigeration chamber is arranged, in a well-known manner, constituted of a plurality of tubes (which we shall call refrigerating tubes hereinafter) through which a refrigerating liquid circulates and a by-pass tube.

[0013] On the gas intake side of the casing and as a coupling means to the EGR system gas intake device, a flange is arranged with a housing for the refrigerating tubes of the refrigeration chamber and another housing for the by-pass duct, a separation area existing between said housings.

[0014] The shape of these housings is related to both the desired distribution of the areas intended for the refrigeration chamber and the by-pass duct as well as the shape of the latter.

[0015] Taking the inner circular section of the cylindrical casing as a reference, the preferred shape for said housings would be that of two circular segments delimited in said circular section by means of a separation strip, the one intended for the refrigeration chamber being larger than a semicircle. The present invention also comprises other shapes and particularly oval shapes.

[0016] Said separation strip or area acts as a closing means of the exchanger gas intake side in combination with a valve suitable for opening one of said two housings and simultaneously closing the other, depending on the needs established by the EGR system.

[0017] An additional feature of the invention is that said casing is closed by means of external caps enveloping its edges to aid in assembling the refrigerating tubes and to aid in carrying out the welds.

[0018] Said coupling flange to the gas intake device would be welded to the corresponding casing cap.

[0019] An additional feature of the invention is that said by-pass duct is a double-walled duct with an intermediate air chamber.

[0020] Other features and advantages of the present invention will be seen in the detailed description following an illustrative and by no means limiting embodiment of its object in relation to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

[0021]

Figure 1 shows a perspective view of a heat exchanger for exhaust gases according to the present invention and Figure 2 shows a perspective view of an ordered dismantling thereof.

Figure 3 shows a plan view of a heat exchanger for exhaust gases according to the present invention. Figure 4 shows a BB section view of Figure 3 of a heat exchanger for exhaust gases according to the present invention.

Figure 5 shows a frontal view of the flange of the heat exchanger shown in the previous figures.

Figures 6 and 7 show frontal views of embodiment variants of the flange of the heat exchanger object of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] In an EGR system, part of the exhaust gases from the engine go to the exterior through the exhaust pipe and another part is recirculated. The amount to be recirculated is controlled by the EGR valve that, in determined circumstances can even be closed and not recirculate anything, for example in a maximum power situation. The recirculated gases mix with the clean air and return to the engine through the intake manifold.

[0023] In the EGR systems including a by-pass duct, the recirculated gases may or may not be cooled, depending on the position of the corresponding valve.

[0024] For this type of EGR systems the present invention provides a heat exchanger with the integrated by-pass duct.

[0025] Figures 1 to 5 show a heat exchanger 1 for exhaust gases according to the present invention formed by a cylindrical casing 2 housing a refrigeration chamber 3 inside constituted of a set of interconnected tubes 4, commonly known in the art, through which a refrigerating liquid circulates entering through the duct 5 and exiting through the duct 7 and a duct 9 acting as a by-pass duct so that those exhaust gases not to be cooled can pass through it.

[0026] The casing 2 is closed with caps 11 and 13 on both sides, serving as fixing means of the tubes 4 and of the by-pass duct 9. These caps envelope the edges of the casing 2, which aids in the assembly process of the tubes 4 and the welding process.

[0027] The heat exchanger 1 for exhaust gases according to the present invention is coupled with the gas intake device (not shown) by means of the flange 15 in which a housing 21 for the refrigerating tubes 4 and a housing for the by-pass duct 9 are delimited.

[0028] A suitable valve (not shown), actuated by the corresponding control means, drive the exhaust gases towards the refrigeration chamber 3 or towards the by-pass duct 9.

[0029] Coupling the heat exchanger to the gas intake manifold of the engine is carried out by using conventional means such as the flange 16, which can be the same as the flange 15 for economic or process reasons, or other known means in the art such as a re-driving cone plus a flange or a re-driving cone and a ring.

[0030] Following Figures 4 and 5 particularly, it can be seen that the flange 15 housing 21 and 22 dimensions are closely related to the areas dedicated to the refrigeration chamber 3 and to the by-pass duct 9. The presence of a separation area 23 of the housings 21 and 22 can also be seen in the flange 15, in relation with the available space between the refrigerating tubes 4 and the by-pass duct, it is useful as a closing means in combination with said valve. The first housing 21 has a circular segment shape of a surface somewhat larger than a semicircle of the casing 2, and the second housing 22 also has a circular segment shape although with rounded vertices. The separation area 23 is located between both housings, with its central span delimited by straight lines. Twelve tubes 4 are located in the first housing 21, and the oval-shaped by-pass duct 9 is located in the housing 22.

[0031] Figures 6 and 7 show flanges 18 and 19 in which the two housings 21 and 22 have a circular segment shape. In the first, the by-pass duct 9 has a semicircular shape, and in the second it has an oval shape. It could also have a circular shape and in each case there would be a different degree of use of the space delimited by the housing 22.

[0032] As a skilled person will understand well, the dimensioning of the housings 21 and 22, the refrigeration area using one or another number and type of refrigerating tubes 4, and the by-pass duct 9 will depend on the functional needs of each case. Thus, for example, the circular shape will be chosen for the by-pass duct 9 if a better relationship is desired between the passing area and the exchange surface to minimize the heat exchange, and a circular segment shape of Figure 6 will be chosen if the intention is to take maximum advantage of the surface delimited by the housing 22 to minimize the load losses, and finally the oval shape of Figure 7 will be chosen if the intention is to have an intermediate option between the previous ones.

[0033] The refrigeration chamber 3 will be permanently active since the circulation of the refrigerating liquid through the tubes 4 will form part of the general cooling circuit of the engine. Subsequently, the possibility of using double-walled by-pass ducts 9 with an intermediate air chamber is considered in order to ensure that the cooling of the gases circulating through it do not exceed a predetermined value.

[0034] Regarding the embodiments described in the invention, those amendments comprised within the scope defined by the following claims can be introduced.

Claims

1. A heat exchanger (1) for an EGR system including a refrigeration chamber (3) formed by a plurality of refrigerating tubes (4), a by-pass duct (9) of those exhaust gases that should not enter the refrigeration chamber (3) and coupling means to the gas intake exchanger device (1), **characterized in that:**
 - a) the refrigeration chamber (3) and the by-pass duct (9) are located inside a cylindrical casing (2);
 - b) said coupling means include a flange (15, 18, 19) with a housing (21) for the refrigerating tubes (4) of the refrigeration chamber (3), a housing (22) for the by-pass duct (9) and a separation area (23) between them.
2. A heat exchanger (1) for an EGR system according to claim 1, **characterized in that** said housings (21, 22) of the flange (18, 19) have a circular segment shape.
3. A heat exchanger (1) for an EGR system according to claim 2, **characterized in that** the housing (22) of the flange (15) for the by-pass duct (9) has rounded vertices.
4. A heat exchanger (1) for an EGR system according to claims 1 or 2, **characterized in that** the transversal section of the by-pass duct (9) has a circular segment shape.
5. A heat exchanger (1) for an EGR system according to any of the claims 1 to 3, **characterized in that** the transversal section of the by-pass duct (9) has a circular shape.
6. A heat exchanger (1) for an EGR system according to any of the claims 1 to 3, **characterized in that** the transversal section of the by-pass duct (9) has an oval shape.
7. A heat exchanger (1) for an EGR system according to any of the previous claims, **characterized in that** the casing (2) is closed by means of external caps (11, 13) enveloping its edges, to aid in assembling the refrigerating tubes (4) and in carrying out the welds.
8. A heat exchanger (1) for an EGR system according to any of the previous claims, **characterized in that** the by-pass duct (9) is a double-walled duct with an intermediate air chamber.

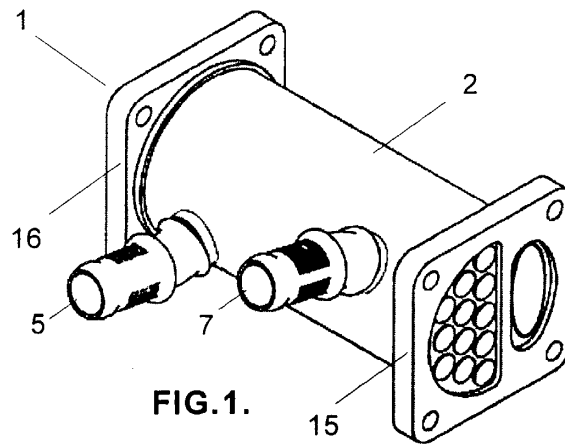


FIG. 1.

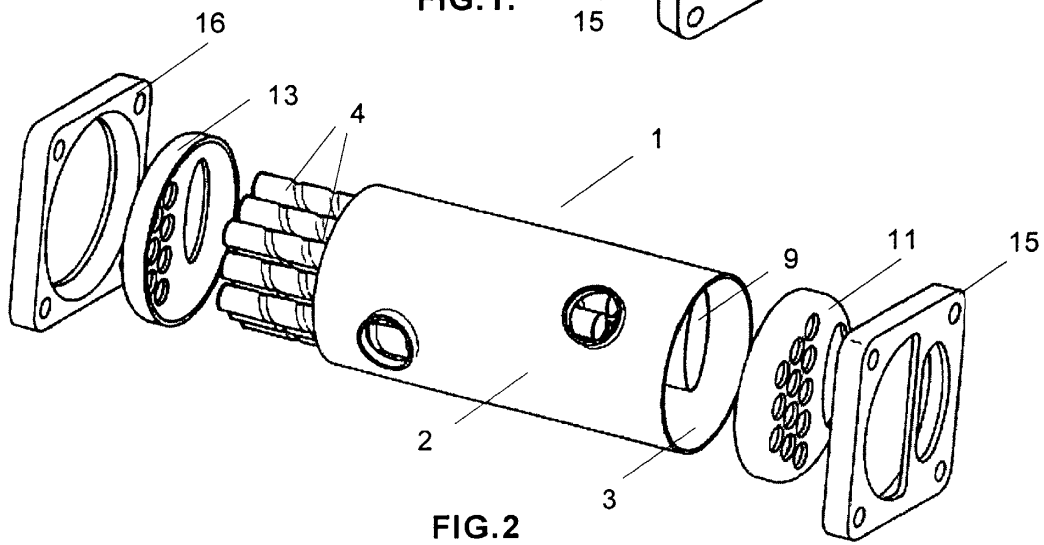


FIG. 2

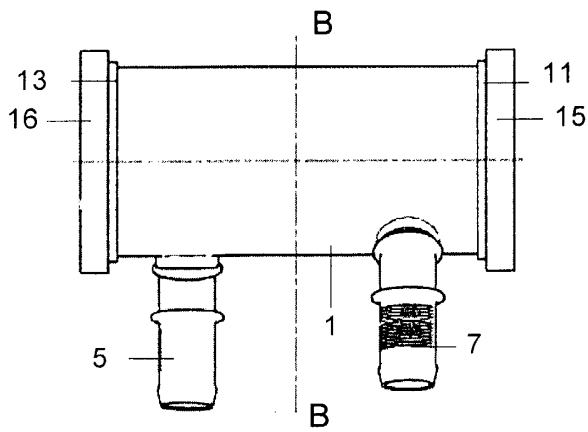


FIG. 3

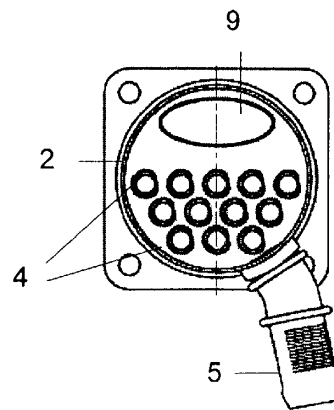


FIG. 4

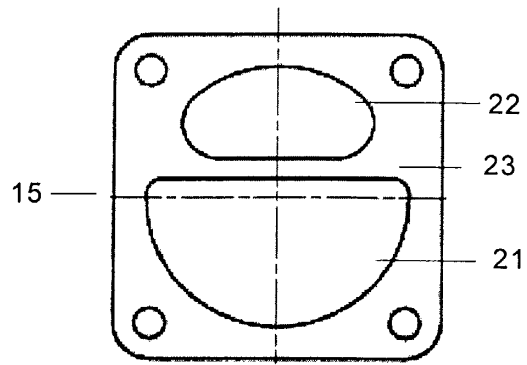


FIG. 5

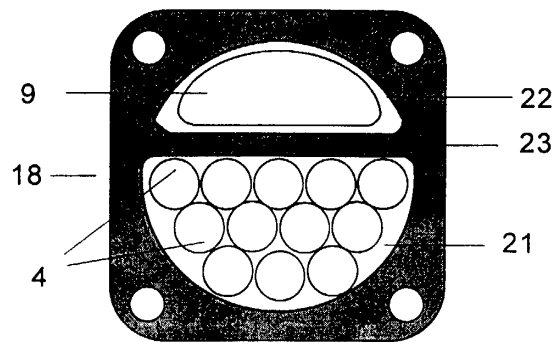


FIG. 6

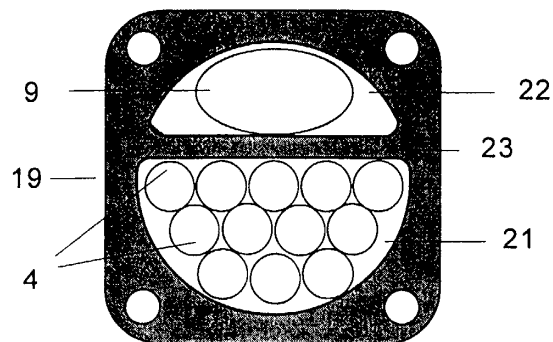


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 03 38 0127

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 914 450 C (HANS WINDHOFF APP UND MASCHINE) 1 July 1954 (1954-07-01) * page 3, line 40 - line 67; figures 4-6 * ---	1-3,5,7	F02M25/07 F28F27/02
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29 August 2003	Examiner Van Zoest, A
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			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 03 38 0127

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29-08-2003

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