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(72) Inventors:

- **Scavarda, Gianfranco**
10080 Lusiglie' (IT)
- **Gastaldo, Giuseppe**
10020 San Sebastian Da Po (IT)

(74) Representative: **Borsano, Corrado et al**
Notarbartolo & Gervasi S.p.A.
Corso di Porta Vittoria, 9
20122 Milano (IT)

whose function is to convey a portion of cooling fluid (3) directly from an input opening (21) to an output opening (22) of the radiator, when the internal pressure of the radiator exceeds a predetermined value.



Description

Field of the invention

[0001] This invention relates to the cooling radiator field, in particular to a cooling radiator with overpressure bypass and endothermic engine including said radiator.

Description of the prior art

[0002] Cooling radiators of the cooling fluid usually include a bundle of tubes parallel with each other that merge into two lateral tanks. The input and output openings of the liquid are placed in said lateral tanks.

[0003] When one of said openings is placed on one tank, while the other is placed on the opposite tank, the radiator is called "I" radiator, because the fluid passes through the radiator in one direction only.

[0004] Whereas the radiators called "U" radiators have both openings, input and output opening, placed on the same tank. In this case said tank has a dividing baffle which defines two volumes, upper and lower volume, so that the tube bundle is connected with an extremity to said upper volume and with the other extremity to the lower volume. It is still usually present the second lateral tank: in this case the fluid enters the upper volume of the tank and passes through the tube bundle in one direction and in the opposite. Said tube bundle bends connecting the two volumes, then fluid goes back, following an ideal "U".

[0005] The thermal efficiency of the "U" radiators is higher than the efficiency of the "I" radiators, moreover, the use of such radiators simplifies the disposition of the pipes that bring the fluid from the engine to the radiator and vice versa, therefore it optimizes the use of the space in the engine compartment.

[0006] On the other hand, however, the "U" radiators have higher friction loss than the "I" radiators, in particular the friction loss curve as a function of the flow rate is steeper in "U" radiators than in "I" radiators.

[0007] The rate flow of the cooling fluid in the radiator is variable because it is generated by a pump directly or not directly operated by the driving shaft. This means that the rate flow and therefore the losses increase with the number of engine revolutions, creating a condition of overpressure in the radiator, which may become critical in terms of the sealing performance of the radiator itself. On the other hand, it is not possible to reduce the flow rate of said pump of cooling fluid, because at a medium-low rpm, the flow rate will not be sufficient to assure the correct cooling of the cooling fluid. This problem is particularly evident in last generation engines, which have an almost flat torque trend, so as the maximum torque value is already available at moderate rpm, while the pump of the cooling fluid is far from reaching the highest possible flow rate.

[0008] These problems lead to keep using "I" radiators, in order to not to have problems of inefficiency at medium-

low rpm or of sealing at high rpm, even if "I" radiators are bulkier and more thermally inefficient than "U" radiators.

[0009] Therefore, the radiator is often oversized for mechanical reasons rather than for thermodynamic reasons.

Summary of the invention

[0010] The aim of this invention is to provide a cooling radiator that solves all the problems set forth above.

[0011] Therefore the object of this invention is a cooling radiator with overpressure bypass.

[0012] This invention also relates to an endothermic engine including said cooling radiator with overpressure bypass.

[0013] According to another aspect of this invention, said radiator is to be used in endothermic engines characterized by a flat torque curve, as that the dimensions of the radiator may be reduced, the cooling pump being equal, without having sealing problem on the radiator itself at high rpm.

[0014] This invention refers in particular to a cooling radiator with overpressure bypass and endothermic engine including said radiator, as described more fully in the claims, which are an integral part of this description.

Brief description of the Figures

[0015] Further characteristics and advantages of the invention will be more apparent in light of a detailed description of a preferred, but non-exclusive, embodiment of a cooling radiator with overpressure bypass, shown with the help of the drawings that are attached hereto, which are merely illustrative and not limitative, in which:

- Fig. 1 schematically shows a "U" radiator provided with bypass;
- Fig. 2 shows the graph of the friction loss as a function of the flow rate of the cooling fluid both for the "U" radiator and for the "I" radiator. The point highlighted in the graph is the intervention point of the overpressure valve that levels the friction loss value of the "U" radiator;
- Fig. 3 shows a cross-sectional view of a tank included in a "U" radiator, with the baffle dividing the upper and lower volume put in evidence;
- Fig. 4 shows an overpressure valve coupled to the dividing baffle described above;
- Fig. 5 shows said dividing baffle;
- Fig. 6 shows a longitudinal section of the overpressure valve of figure 4;
- Fig. 7 schematically shows an "I" radiator provided with bypass;

Detailed description of a preferred embodiment of the invention

[0016] With reference to figures 1 and 2, a preferred

embodiment applied to a "U" radiator includes a tank 2 with an input opening 21 and an output opening 22 of a cooling fluid 3 and a dividing baffle 23 which divides the tank in two volumes V_{sup} and V_{inf} and a tube bundle 1 whose function is to connect said volumes with each other, as to allow the cooling fluid to pass through the radiator first in a direction and then in the opposite.

[0017] Said dividing baffle 23 is provided, in said preferred embodiment, with an overpressure valve 24 whose function is to provide a bypass for the tube bundle, allowing the passage of a portion of the fluid directly from the input opening to the output opening. In this way, said portion of flow rate does not pass through the tube bundle and the pressure generated in the radiator levels itself (see Fig. 2).

[0018] Even if said portion of flow rate that is conveyed directly from the input to the output of the radiator is not cooled by the radiator, the engine will not have problems, because the flow rate that passes through the tube bundle is more than sufficient to reach the wanted overall lowering of the temperature of the cooling fluid.

[0019] In figures from 3 to 6 it is shown a preferred embodiment of an overpressure valve 24. It includes (i) a rounded head 242 whose lower part is connected, and is preferably coaxial, with (ii) a small shaft 241; (iii) a support 244 integral with the tank 2 and provided with a hole 245 which is compatible with the section of said small shaft 241; (iv) a counter spring 243 whose function is to maintain the rounded head 242 in contact with the edges of a hole 231 made in the radiator and in particular in the dividing baffle 23.

[0020] Said counter spring is adjusted as to allow the lowering of the rounded head 242 when a predetermined pressure level in the upper volume V_{sup} of the tank 2 is reached, and to allow the passage of a certain quantity of cooling fluid through the hole 231 and also through the support 244 provided with appropriate openings for the passage of the fluid.

[0021] In particular, said hole 245 made in the support 244 constitutes a real baffle leaning out toward the rounded head 242 as to obtain a twofold function:

- keep the small shaft 241 in axis;
- determine the maximum limit of opening of the overpressure valve 24, that is the maximum lowering of the rounded head 242.

[0022] Another possible embodiment of the overpressure valve may be obtained by means of at least a mechanical or pneumatic or electric actuator.

[0023] With reference to figure 7, another preferred embodiment of cooling radiator with overpressure bypass is applied to an "I" radiator. In this case, the radiator comprises a tank 2' in which said input opening 21 is made, a tank 4' in which said output opening 22 is made, and said tube bundle 1 whose function is to interconnect said tanks, as to make the cooling fluid pass through the radiator from a tank to the other. An advantage is that

said bypass means comprise not only the said overpressure valve 24, but also an auxiliary pipe 25 that has the same function of the baffle 23 illustrated in the "U" radiator, that is whose function is to convey a portion of the flow rate of the cooling fluid from the input opening 21 to the output opening 22, when said valve comes into operation. In this case, said hole 231 is bored at the boundary between said tank 2 and said auxiliary pipe 25.

[0024] The particular embodiments described here do not limit the scope of this invention which covers all the alternative embodiments defined by the claims.

Claims

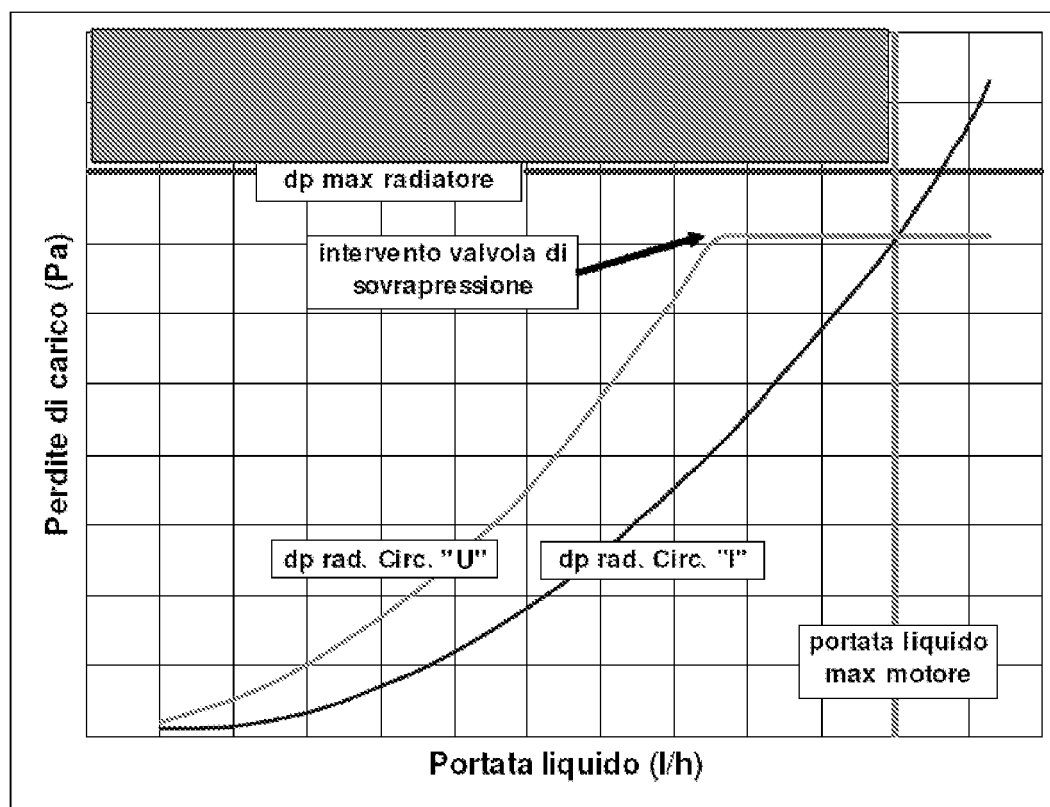
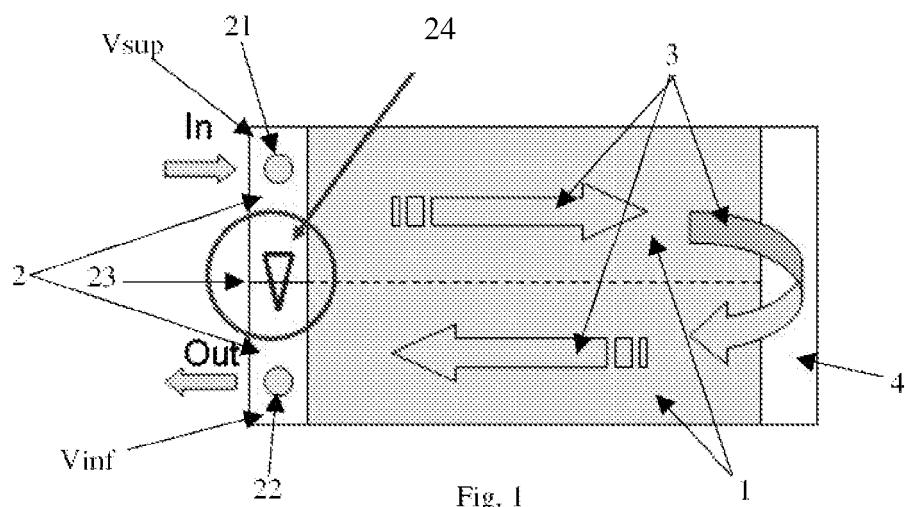
1. Cooling radiator comprising: a tube bundle (1), an input opening (21) and an output opening (22) of a cooling fluid (3), and bypass means (24) whose function is to directly convey a portion of the flow rate of the cooling fluid from said input opening to said output opening, limiting the flow rate of cooling fluid in the tube bundle and the pressure developed in it, when this pressure exceeds a predetermined value.
2. Radiator according to claim 1, of the "I" type comprising also a first tank (2') in which said input opening (21) is made, a second tank (4') in which said output opening (22) is made, and said tube bundle (1) whose function is to interconnect said first and second tanks, as to make the cooling fluid pass through the radiator from a tank to the other, being said first and second tank placed one opposite the other.
3. Radiator according to claim 1, of the "U" type comprising also a third tank (2) divided in two volumes by a baffle (23), and a tube bundle (1) whose function is to interconnect said volumes with each other, as to make the cooling fluid pass through the radiator first in one direction and then in the opposite direction, being a first of said two volumes connected to said input opening (21) and a second of said two volumes connected to said output opening (22).
4. Radiator according to claim 3, provided also with a fourth tank (4) placed opposite to said third tank (2), said fourth tank having the function to take in an extremity of the incoming and outgoing tube bundle (1) of the cooling fluid, in order to interconnect said two volumes.
5. Radiator according to claim 1, in which said bypass means are obtained by means of an overpressure valve (24).
6. Radiator according to claim 5, in which said overpressure valve comprises: (i) a rounded head (242) connected preferably in a coaxial way with (ii) a small

shaft (241); (iii) a support (244) integral with the radiator and provided with a hole (245) in which said small shaft (241) is inserted; (iv) a counter spring (243) whose function is to keep the rounded head (242) in contact with the edges of a hole (231) bored in the radiator. 5

7. Radiator according to claims 3 and 6, in which said hole (231) in contact with said rounded head (242) of said overpressure valve (24), is bored in said dividing baffle (23). 10
8. Radiator according to claim 2 and 5 in which said bypass means comprise also an auxiliary pipe (25) through which the exceeding cooling fluid flows, being conveyed by means of said overpressure valve (24). 15
9. Radiator according to claims 2, 6, and 8, in which said hole (231), in contact with said rounded head (242) of said overpressure valve (24), is bored at the boundary between the tank (2), provided with the input opening and said auxiliary pipe (25). 20
10. Radiator according to claim 1 in which said bypass means have the function to limit the pressure developed in the radiator according to a flat trend, when represented in a graph that shows the pressure trend as a function of the flow rate of the cooling fluid introduced in the radiator. 25
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11. Endothermic engine provided with liquid cooling **characterized by** the fact that it comprises said bypass means whose function is to convey a portion of cooling fluid directly from an input opening to an output opening of the radiator, when the internal pressure of the radiator exceeds a predetermined value. 35
12. Vehicle provided with endothermic engine with liquid cooling **characterized by** the fact that it comprises said bypass means whose function is to convey a portion of cooling fluid directly from an input opening to an output opening of the radiator, when the internal pressure of the radiator exceeds a predetermined value. 40
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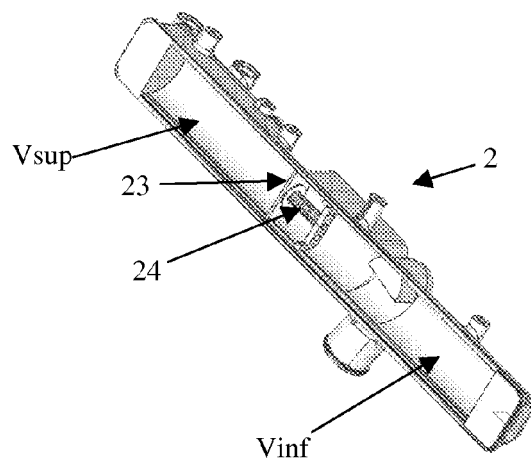


Fig. 3

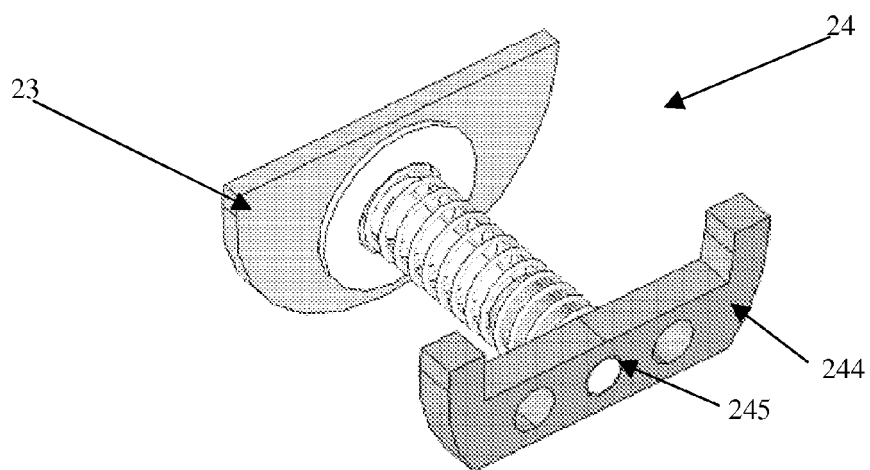


Fig. 4

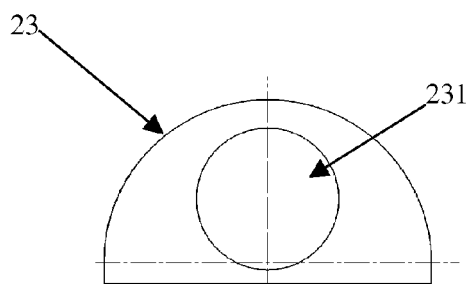


Fig. 5

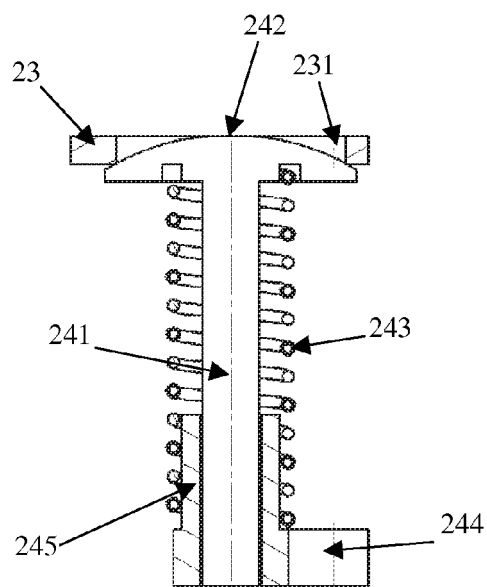


Fig. 6

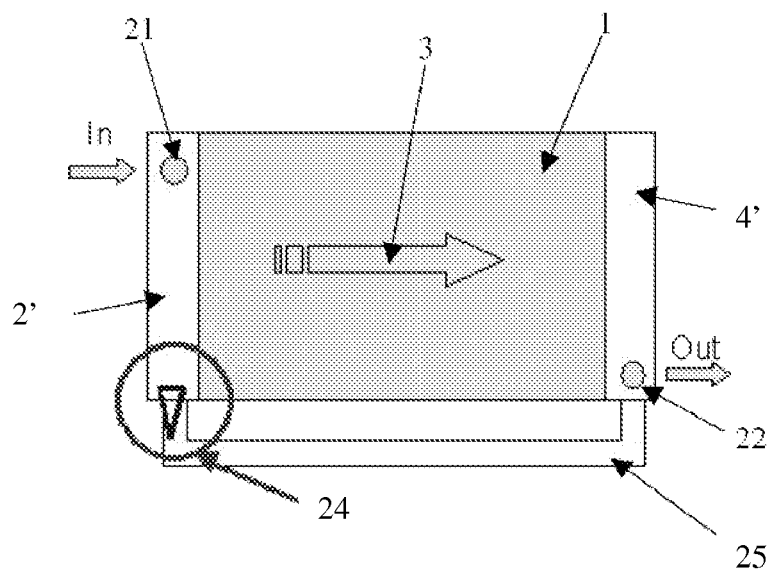


Fig. 7



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 9716

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 161 614 A (WOODHULL JR IVAN D [US] ET AL) 19 December 2000 (2000-12-19) * column 2, line 54 - line 64 * * column 4, line 51 - column 5, line 7; figures *	1-12	INV. F25B39/02
X	US 6 253 837 B1 (SEILER THOMAS F [CA] ET AL) 3 July 2001 (2001-07-03) * column 3, line 31 - column 8, line 64; figures 1-14 *	1-12	
X	US 3 920 067 A (SCHINDLER HERBERT ET AL) 18 November 1975 (1975-11-18) * column 4, line 6 - column 7, line 19; figure 2 *	1-12	
X	US 2003/019620 A1 (PINEO GREGORY MERLE [CA] ET AL) 30 January 2003 (2003-01-30) * the whole document *	1-12	
X	DE 43 37 349 A1 (NIPPON DENSO CO [JP]) 11 May 1994 (1994-05-11) * column 19, line 62 - column 33, line 28; figures fig14a-fig34 *	1-12	TECHNICAL FIELDS SEARCHED (IPC) F25B
A	ANONYMOUS: "Refrigerant bypass mechanism" RESEARCH DISCLOSURE, MASON PUBLICATIONS, HAMPSHIRE, GB, vol. 483, no. 146, July 2004 (2004-07), XP007134132 ISSN: 0374-4353 * the whole document *	1-12	
A	JP 2001 174190 A (DENSO CORP) 29 June 2001 (2001-06-29) * the whole document *	1-12	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 March 2008	Examiner Ritter, Christoph
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 (P04C01)

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

EP 07 11 9716

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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10-03-2008

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 6161614	A	19-12-2000	BR	9903044 A	20-03-2001
US 6253837	B1	03-07-2001	NONE		
US 3920067	A	18-11-1975	NONE		
US 2003019620	A1	30-01-2003	NONE		
DE 4337349	A1	11-05-1994	GB	2272506 A	18-05-1994
JP 2001174190	A	29-06-2001	NONE		

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82