(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 653 062 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
03.05.2006 Bulletin 2006/18

(21) Application number: **04744079.7**

(22) Date of filing: **27.07.2004**

(51) Int Cl.:
F01P 7/16 *(1968.09)* ***F01M 5/00*** *(1968.09)*

(86) International application number:
PCT/IB2004/002425

(87) International publication number:
WO 2005/010327 (03.02.2005 Gazette 2005/05)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR

(30) Priority: **29.07.2003 ES 200301880**

(71) Applicant: **Valeo Termico S.A.**
50011 Saragosse (ES)

(72) Inventors:
- **SANTO DOMINGO, Sergio**
  E-50011 Saragosse (ES)
- **GAMBON, Vicente**
  F-78231 La Verriere (ES)
- **GESSIER, Bertrand**
  F-78690 Les Essarts Le Roi (FR)
- **PERRIN, Patrick**
  Querétaro, QRO 76730 (MX)

(74) Representative: **Rolland, Jean-Christophe**
Valeo Thermique Moteur,
Propriété Industrielle,
8, rue Louis-Lormand
78321 La Verrière (FR)

(54) OIL TEMPERATURE CONTROL SYSTEM FOR VEHICLES WITH A LIQUID COOLING CIRCUIT AND METHOD THEREFOR

(57) It comprises an internal-combustion engine (1), a radiator (2), a coolant liquid for the engine (1), a heat exchanger (3), and a first heat-regulation device (4) for the engine (1). It is characterized in that it comprises a single coolant liquid inlet to the heat exchanger (3) coming from the radiator (2) or from the engine (1), and a second temperature-regulation device (6), controlled by means of the oil temperature at the entry to or at the exit from the exchanger (3), allowing the oil to be heated in a forced-heating step and a natural-heating step, and the oil temperature to be regulated in order to keep it at its ideal operating temperature. The oil-temperature-regulation system is greatly simplified.

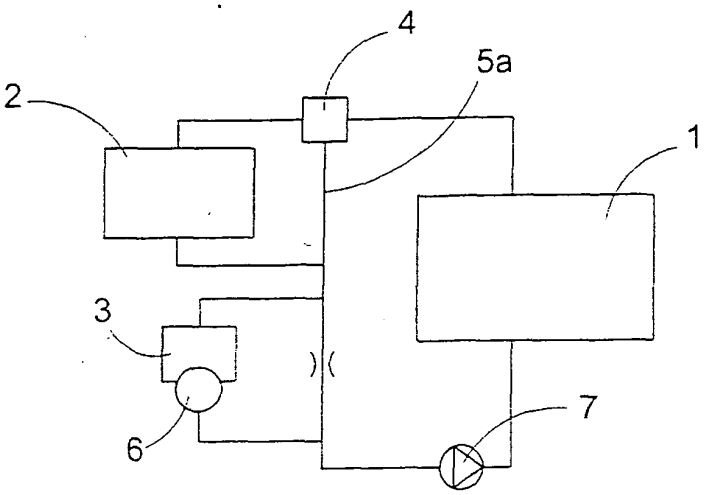

FIG. 1

EP 1 653 062 A1

Description

[0001] The present invention relates to an oil-temperature-regulation system for vehicles equipped with a liquid-cooling circuit. The invention also relates to the corresponding method therefor.

[0002] The oil-temperature-regulation system for vehicles equipped with a liquid-cooling circuit of the present invention is of the type that comprises an internal-combustion engine, a radiator connected to the outlet from the engine, a coolant liquid for the engine, a heat exchanger that comprises a first circuit for circulating the coolant liquid and a second circuit for circulating the oil to be heated or cooled by heat exchange with said coolant liquid and a first heat-regulation device for the engine, which regulates the passage of coolant liquid from the engine either via the radiator in order to cool it or via a bypass line, which directs it toward the heat exchanger, as a function of a first operating temperature of the coolant liquid.

BACKGROUND OF THE INVENTION

[0003] It is known that operation of a vehicle gives rise to heat dissipation in the oil for lubricating certain components, such as the engine, the gearbox, etc., and requires this oil to be cooled (engine oil or transmission oil, or another oil circuit) in order to prevent an excess of heat that may be detrimental to its functional characteristics.

[0004] The oil may be cooled naturally, i.e. by exchange of heat with the exterior or with the liquid-cooling circuit through the walls of the oil pan or of other parts of the oil circuit, or its cooling may be forced.

[0005] In the case of forced cooling, the oil circuit comprises an exchanger for dissipating the heat from the oil into the ambient air (oil/air cooler) or into the coolant liquid (oil/water cooler).

[0006] In certain systems for forced cooling of oil, regulation of oil cooling is obtained by incorporating a regulation device, such as, for example, a thermostat, into the oil circuit. In these systems, the regulation device is generally based on regulating the cooling intensity, for example by modifying the flow of oil or water in the exchanger as a function of temperature in order to keep it constant.

[0007] These systems for regulating oil cooling may switch continuously between two states: no oil cooling and maximum oil cooling. However, these systems do not allow the oil to be heated.

[0008] In practice, it has been found that, in certain circumstances, for example when starting up the vehicle, the coolant liquid from the engine may be at a higher temperature than the oil, while the oil has a temperature that is as yet too low for optimum functioning, it being, in this case, appropriate to heat the oil.

[0009] In order to improve this situation, other forced oil-cooling systems are used that involve an oil/water exchanger, and these comprise a function of heating the oil by means of the incorporation into the system of an inlet for hot water, for example coming directly from the engine. In this case, the regulation device is based on conveying hot water (which comes, from example, from the engine) or cold water (which comes, for example, from a low-temperature radiator) through the oil exchanger, as a function of its temperature. This system thus allows heating of the oil to be speeded up.

[0010] Patent US 6 196 168 relates to a device and method for preheating and cooling especially a transmission fluid of an internal-combustion engine.

[0011] Said device is characterized in that it comprises a thermostatic valve that makes it possible to switch between two states: a first state causing the coolant fluid to circulate from the engine to the heat exchanger, without passing via the radiator, in order to heat the oil; and a second state causing the coolant fluid to circulate from two different paths toward the heat exchanger, specifically from the radiator (for cooling) and from the engine (for heating), so that the oil reaches the desired temperature.

[0012] In these oil-temperature-regulation systems that comprise both a heating function and a cooling function, the oil exchanger is constantly in operation, either functioning in oil-heating mode (temperature of the oil below the temperature of the cooling water), or in oil-cooling mode (temperature of the oil higher than the temperature of the cooling water).

[0013] These systems may switch continuously between these two states (heating or cooling), passing via an intermediate specific-point state (temperature of the oil equal to the temperature of the cooling water), when exchanger efficiency is canceled out.

[0014] However, it may be that the oil temperature is higher than the temperature of the cooling water but below its ideal temperature. In this case, this second type of system will always function in cooling mode, and will therefore halt the desirable heating of the oil up to its ideal temperature, thereby giving rise to friction wear on the lubricated components.

DESCRIPTION OF THE INVENTION

[0015] The object of the oil-temperature-regulation system and method for vehicles equipped with a liquid-cooling circuit of the present invention is to resolve the drawbacks of systems known in the prior art by providing a major simplification of the system by means of a single coolant fluid inlet and allowing the function of heating or cooling the oil.

[0016] The oil-temperature-regulation system for vehicles equipped with a liquid-cooling circuit, which is the subject of the present invention, is characterized in that it comprises a single coolant liquid inlet to the heat exchanger coming from the radiator or from the engine, and a second temperature-regulation device, controlled by means of the oil temperature at the entry to or at the exit

from the exchanger, which regulates the heat exchange between the coolant liquid and the oil, allowing the oil to be heated in a forced-heating step and a natural-heating step, and the oil temperature to be regulated in order to keep it at its ideal operating temperature.

[0017] This provides a more simplified oil-temperature-regulation system, since, by means of a single inlet of coolant fluid to the exchanger, as in the case of a conventional passive exchanger, the system is also able to carry out the function of heating the oil in two stages: forced heating of the oil by means of the coolant fluid ("water-forced heating-up") and then natural heating of the oil ("self-heating-up"), owing to circulation in the engine and the function of regulating the temperature of the oil.

[0018] Furthermore, it is unnecessary to make any modification to the oil circuit as compared to a conventional passive exchanger.

[0019] Preferably, the first temperature-regulation device may be a thermostat or a pneumatically or electrically controlled thermostatic valve.

[0020] Preferably, also, the second temperature-regulation device is a thermostat or a pneumatically or electrically controlled thermostatic valve.

[0021] Advantageously, the ideal temperature of the oil is between 90°C and 130°C.

[0022] According to a first aspect of the invention, the second temperature-regulation device is arranged in the cooling circuit and is controlled by the oil temperature at the entry to or at the exit from the exchanger, regulating the passage of coolant liquid either through the heat exchanger or through a bypass line of said exchanger.

[0023] In this case, when the coolant liquid coming from the engine circulates through the heat exchanger, the forced oil-heating stage takes place, whereas, when the coolant liquid circulates through the bypass line, natural heating of the oil is obtained.

[0024] According to a first embodiment of the invention, the supply of coolant liquid in the exchanger is caused by a pressure drop in its corresponding bypass line.

[0025] According to a second embodiment of the invention, the supply of coolant liquid in the exchanger is achieved by a bypass line directly from the engine.

[0026] In this way, direct supply to the exchanger avoids the creation of a pressure drop in the circuit, as happens in the case described in the first embodiment, and therefore the thermal performance is improved.

[0027] According to a second aspect of the invention, the second temperature-regulation device is arranged in the oil circuit and is controlled by means of the oil temperature at the entry to or at the exit from the exchanger, regulating the passage of oil either through the heat exchanger or through a bypass line of said exchanger.

[0028] In this other case, when the oil circulates through the heat exchanger, forced heating of the oil takes place by thermal exchange with the coolant liquid coming from the engine, whereas, when the oil circulates through the bypass line, natural heating of the oil is obtained.

[0029] According to a third embodiment of the invention, the heat exchanger is located at the exit from a discharge valve of the oil pump.

[0030] The oil-temperature-regulation method for vehicles equipped with a liquid-cooling circuit, applied to the system of the invention, is characterized in that, in a first stage, it consists in carrying out the following steps:

a) when the oil temperature is below its ideal temperature, allowing the coolant liquid to circulate from the engine through the heat exchanger in order to heat the oil until its temperature reaches a value slightly below the operating temperature of the coolant liquid, by forced heating;

b) while the oil temperature is higher than or equal to the operating temperature of the coolant liquid but below its ideal value, stopping the coolant liquid or oil from circulating in the exchanger, conveying it through its corresponding bypass line in order for the oil temperature to increase progressively until it reaches its ideal value, by natural heating;

and, in a second stage, the following step is carried out:

c) when the oil temperature has reached its ideal, progressively re-establishing circulation of coolant liquid or of oil through the exchanger so as to obtain oil-temperature regulation in order to keep it at its ideal value.

[0031] Advantageously, each one of the above steps a), b) and c) is controlled by the second temperature-regulation device as a function of the oil temperature at the entry to or at the exit from the heat exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] In order to facilitate the description of that which has been set forth above, drawings are attached in which, diagrammatically and solely by way of nonlimiting example, three practical embodiments of the oil-temperature-regulation system for vehicles equipped with a liquid-cooling circuit of the invention are shown, in which:

Figure 1 is a diagrammatic circuit of the regulation system of the invention, according to a first embodiment;

Figure 2 is a diagrammatic circuit of the regulation system of the invention, according to a second embodiment; and

Figure 3 is a diagrammatic circuit of the regulation system of the invention, according to a third embodiment.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0033] A first embodiment of the invention is shown in

Figure 1, which shows the coolant liquid circuit.

[0034] As may be seen from Figure 1, the oil-temperature-regulation system comprises an internal-combustion engine 1, a radiator 2 connected to the outlet from the engine 1, a coolant liquid for the engine, a heat exchanger 3 located in the water circuit, which comprises a first circuit for circulating water and a second circuit for circulating the oil to be heated or to be cooled by heat exchange with the water, and a first thermostat 4 of the engine 1 that regulates the passage of water from the engine 1 either through the radiator 2 in order to cool it or through a bypass line 5a that directs it toward the heat exchanger 3 as a function of a first operating temperature of the water.

[0035] It also comprises a single inlet of water to the heat exchanger 3 coming from the radiator 2 or from the engine 1, a second thermostat 6 controlled by means of the oil temperature at the entry to or at the exit from the exchanger 3, and a pump 7 that recirculates the water toward the engine 1.

[0036] In the circuit of Figure 1, it is possible to see that the supply of coolant liquid in the exchanger 3 is achieved by means of a pressure drop in its corresponding bypass line.

[0037] A second embodiment of the invention is shown in Figure 2, which also shows the coolant liquid circuit.

[0038] In this case, the oil-temperature-regulation system comprises the same elements as those described in the first embodiment, the difference being that the supply of coolant liquid in the exchanger 3 is achieved by means of a bypass line 5b directly from the engine 1.

[0039] In this way, direct supply to the exchanger 3 avoids the creation of a pressure drop in the circuit, as happens in the case described in the first embodiment, and therefore the thermal performance is improved.

[0040] A third embodiment of the invention is shown in Figure 3, which shows the oil circuit.

[0041] In this case, the oil-temperature-regulation system comprises the same elements as those described in the first and second embodiments, the difference being that the heat exchanger 3 is located in the oil circuit.

[0042] In the same way, the second thermostat 6 is controlled by means of the oil temperature at the entry to or at the exit from the exchanger 3.

[0043] It also comprises a pump 8 that aspirates the oil toward the heat exchanger 3, and a discharge valve 9 located between said oil pump 8 and the heat exchanger 3.

[0044] For any of the embodiments described above, the second thermostat 6 regulates the heat exchange between the water and the oil, in accordance with the following mode of operation:

[0045] Firstly, the second thermostat 6 allows circulation of the water from the engine 1 (water temperature higher than the oil temperature) to the exchanger 3, until the oil reaches a temperature close to or below the temperature of the water, which is at 90°C. This stage corresponds to forced heating of the oil.

[0046] Next, the second thermostat 6 stops circulation of the water or oil to the exchanger 3 and conveys it toward its corresponding bypass line such that the oil temperature will increase from 90°C to 115°C. This stage corresponds to natural heating of the oil and allows the oil temperature to increase to its ideal temperature, which in this example is 115°C.

[0047] Lastly, the second thermostat 6 progressively re-establishes circulation of the water or oil in order to keep the oil at its ideal temperature of 115°C.

[0048] Therefore, major simplification of the water circuit is achieved with a single inlet of water to the exchanger 3, also allowing the function of heating to be achieved in two stages: forced heating of the oil by heat exchange with the water, and then natural heating, and the function of regulating the oil temperature.

[0049] In addition, it is unnecessary to make any modification to the oil circuit as compared to a conventional passive exchanger.

[0050] Furthermore, although these three preferred embodiments have been described, it should be pointed out that the proposed system could function solely in natural-heating mode owing to circulation in the engine. This natural heating could be forced by means of the incorporation of an element providing an artificial-heating stage, such as an electrical resistance element within the oil, or a three-fluid exchanger to allow, for example, heating of the oil using the gases from the EGR system (exhaust gas recirculation system of an engine).

Claims

1. Oil-temperature-regulation system for vehicles equipped with a liquid-cooling circuit, which comprises an internal-combustion engine (1), a radiator (2) connected to the outlet from the engine (1), a coolant liquid for the engine (1), a heat exchanger (3) that comprises a first circuit for circulating the coolant liquid and a second circuit for circulating the oil to be heated or cooled by heat exchange with said coolant liquid and a first heat-regulation device (4) for the engine (1), which regulates the passage of coolant liquid from the engine (1) either via the radiator (2) in order to cool it or via a bypass line (5a, 5b), which directs it toward the heat exchanger (3), as a function of a first operating temperature of the coolant liquid, **characterized in that** it comprises a single coolant liquid inlet to the heat exchanger (3) coming from the radiator (2) or from the engine (1), and a second temperature-regulation device (6), controlled by means of the oil temperature at the entry to or at the exit from the exchanger (3), which regulates the heat exchange between the coolant liquid and the oil, allowing the oil to be heated in a forced-heating step and a natural-heating step, and the oil temperature to be regulated in order to keep it at its ideal operating temperature.

2. System according to Claim 1, **characterized in that** the first temperature-regulation device (4) is a thermostat.

3. System according to Claim 1, **characterized in that** the first temperature-regulation device (4) is a pneumatically or electrically controlled thermostatic valve.

4. System according to Claim 1, **characterized in that** the second temperature-regulation device (6) is a thermostat.

5. System according to Claim 1, **characterized in that** the second temperature-regulation device (6) is a pneumatically or electrically controlled thermostatic valve.

6. System according to Claim 1, **characterized in that** the ideal temperature of the oil is between 90°C and 130°C.

7. System according to any of Claims 1 to 6, **characterized in that** the second temperature-regulation device (6) is arranged in the cooling circuit and is controlled by the oil temperature at the entry to or at the exit from the exchanger (3), regulating the passage of coolant liquid either through the heat exchanger (3) or through a bypass line of said exchanger (3).

8. System according to Claim 7, **characterized in that** the supply of coolant liquid in the exchanger (3) is caused by a pressure drop in its corresponding bypass line.

9. System according to Claim 7, **characterized in that** the supply of coolant liquid in the exchanger (3) is achieved by a bypass line (5b) directly from the engine (1) .

10. System according to any of Claims 1 to 6, **characterized in that** the second temperature-regulation device (6) is arranged in the oil circuit and is controlled by means of the oil temperature at the entry to or at the exit from the exchanger (3), regulating the passage of oil either through the heat exchanger (3) or through a bypass line of said exchanger (3).

11. System according to Claim 10, **characterized in that** the heat exchanger (3) is located at the exit from a discharge valve (9) of the oil pump (8).

12. Oil-temperature-regulation method for vehicles equipped with a liquid-cooling circuit, applied to the system of the invention, according to any of the preceding claims, **characterized in that**, in a first stage, it consists in carrying out the following steps:

a) when the oil temperature is below its ideal temperature, allowing the coolant liquid to circulate from the engine (1) through the heat exchanger (3) in order to heat the oil until its temperature reaches a value slightly below the operating temperature of the coolant liquid, by forced heating;
b) while the oil temperature is higher than or equal to the operating temperature of the coolant liquid but below its ideal value, stopping the coolant liquid or oil from circulating in the exchanger (3), conveying it through its corresponding bypass line in order for the oil temperature to increase progressively until it reaches its ideal value, by natural heating;

and, in a second stage, the following step is carried out:

c) when the oil temperature has reached its ideal, progressively re-establishing circulation of coolant liquid or of oil through the exchanger (3) so as to obtain oil-temperature regulation in order to keep it at its ideal value.

13. Method according to Claim 12, **characterized in that** each one of the steps a), b) and c) is controlled by the second temperature-regulation device (6) as a function of the oil temperature at the entry to or at the exit from the heat exchanger (3).

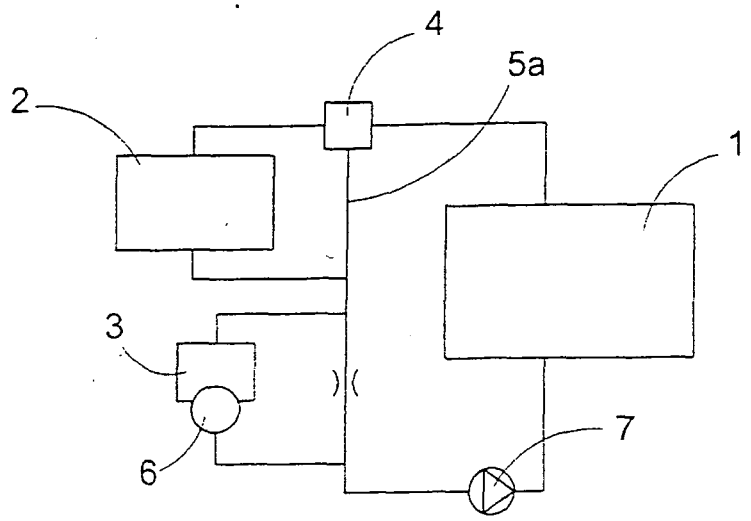

FIG. 1

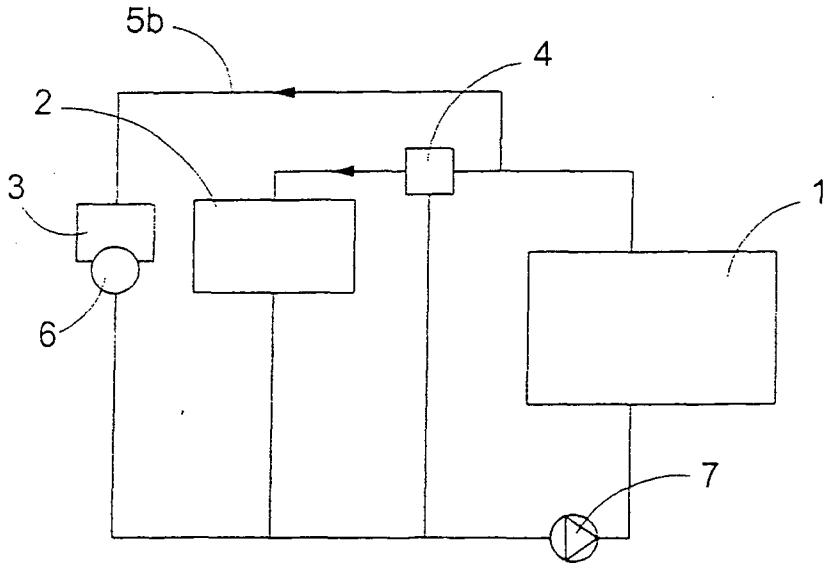

FIG. 2

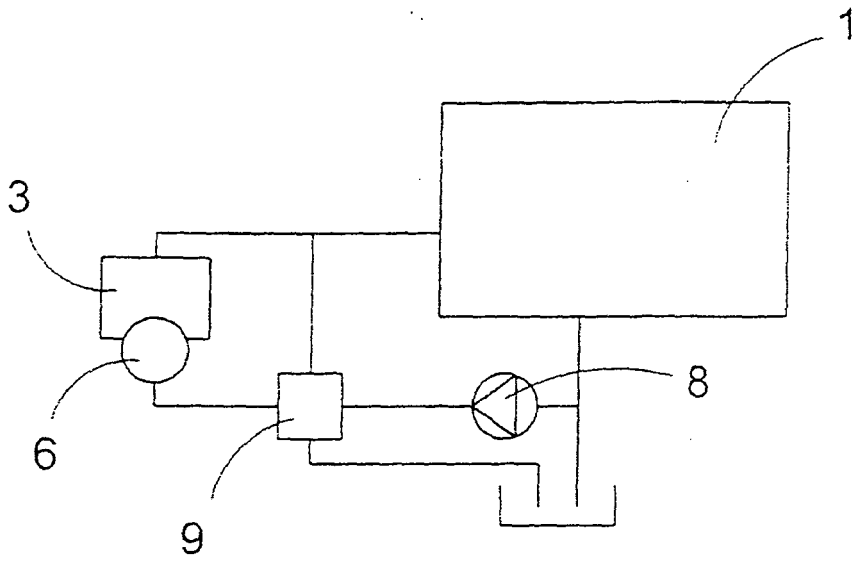

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/002425

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F01P7/16 F01M5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F01P F01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 19, 5 June 2001 (2001-06-05) -& JP 2001 041040 A (HONDA MOTOR CO LTD), 13 February 2001 (2001-02-13)	1-3,6
A	paragraph '0014! paragraph '0016! paragraph '0018! paragraph '0020! paragraph '0021! paragraph '0024! paragraph '0029! paragraph '0031! - paragraph '0033! paragraph '0037! paragraph '0042! - paragraph '0047! figures 1,2 ----- -/--	5,7, 10-12

[X] Further documents are listed in the continuation of box C. [X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 January 2005	14/01/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P B 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Paquay, J

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/002425

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 04, 31 May 1995 (1995-05-31) -& JP 07 026955 A (NIPPONDENSO CO LTD), 27 January 1995 (1995-01-27) abstract	1,4,12, 13
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 353 (M-1288), 30 July 1992 (1992-07-30) -& JP 04 109027 A (CALSONIC CORP), 10 April 1992 (1992-04-10) abstract	1,5,9,12
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 144 (M-1386), 23 March 1993 (1993-03-23) -& JP 04 318215 A (MITSUBISHI MOTORS CORP; others: 01), 9 November 1992 (1992-11-09) abstract	1,2,4, 10-12
A	US 6 053 131 A (MUELLER LUDWIG ET AL) 25 April 2000 (2000-04-25) column 4, line 14 - column 6, line 3; figures	1-5,9,12
A	EP 0 544 552 A (PEUGEOT) 2 June 1993 (1993-06-02) abstract; figures	1,6,7

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB2004/002425

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2001041040 A	13-02-2001	NONE	
JP 07026955 A	27-01-1995	JP 3292217 B2	17-06-2002
JP 04109027 A	10-04-1992	NONE	
JP 04318215 A	09-11-1992	NONE	
US 6053131 A	25-04-2000	DE 19715324 A1	15-10-1998
		DE 59811491 D1	08-07-2004
		EP 0870911 A2	14-10-1998
		ES 2218724 T3	16-11-2004
EP 0544552 A	02-06-1993	FR 2684156 A1	28-05-1993
		EP 0544552 A1	02-06-1993

Form PCT/ISA/210 (patent family annex) (January 2004)