

(19)



(11)

EP 2 792 988 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

22.10.2014 Bulletin 2014/43

(51) Int Cl.:

F28D 9/00 (2006.01)

F01P 3/20 (2006.01)

F01M 5/00 (2006.01)

F28F 3/08 (2006.01)

(21) Application number: **12858280.6**

(86) International application number:

PCT/KR2012/009779

(22) Date of filing: **19.11.2012**

(87) International publication number:

WO 2013/089357 (20.06.2013 Gazette 2013/25)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

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(30) Priority: **13.12.2011 KR 20110133946**

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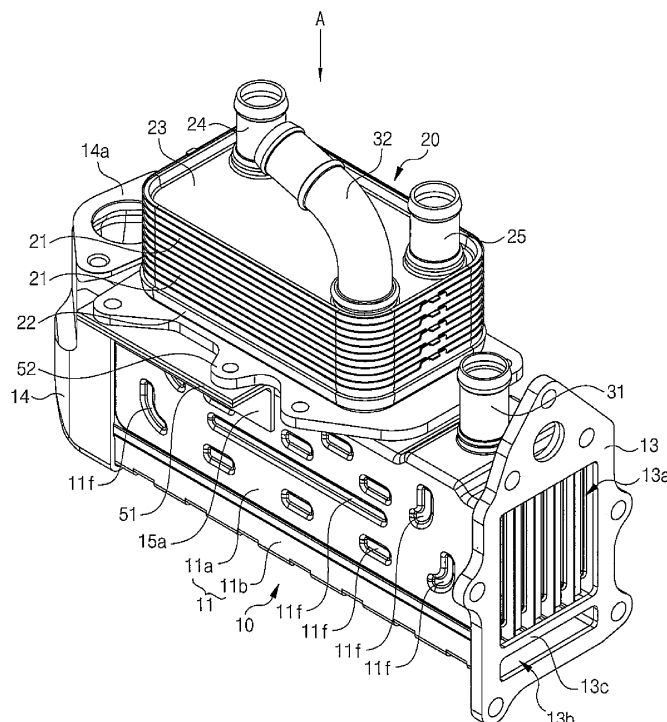
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(54) **INTEGRATED HEAT EXCHANGER FOR A VEHICLE**

(57) Disclosed is an integrated heat exchanger for a vehicle, in which an exhaust gas heat exchanging part (exhaust gas recirculation (EGR) cooler) and an oil heat

exchanging part (oil cooler) are integrated to be able to optimize the use of a space within the vehicle.

[Fig. 1]



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Description

[Technical Field]

[0001] The present invention relates, in general, to a heat exchanger for a vehicle and, more particularly, to an integrated heat exchanger for a vehicle, in which an exhaust gas recirculation (EGR) cooler and an oil cooler are integrated, thereby making it possible to optimize the use of space within the vehicle and considerably improve the heat exchanging performance of exhaust gas, coolant, and oil.

[Background Art]

[0002] Vehicles are equipped with various heat exchangers such as a radiator for cooling a coolant of an engine, an automotive transmission oil cooler for cooling oil of an automotive transmission, an engine oil cooler for cooling oil for the engine, an exhaust gas recirculation (EGR) cooler for cooling an EGR gas, a fuel cooler for cooling fuel, and a charge air cooler for cooling air suctioned toward the engine.

[0003] Other heat exchangers such as a condenser of an air conditioner are densely installed around the radiator disposed in the front of the vehicle, along with the automotive transmission oil cooler, the engine oil cooler, the charge air cooler, and the fuel cooler.

[0004] As the various heat exchangers are densely installed around the radiator of the vehicle in this way and the front space of the vehicle is very narrow, the various pipes have a complicated layout. As such, it is very difficult to install or replace a variety of parts.

[0005] The EGR cooler is installed on an exhaust system of the vehicle, and a coolant line for supplying the coolant for the engine to the EGR cooler is provided. The EGR cooler is far away from the engine, and the coolant line passes through the oil cooler. As such, the coolant line is very long and complicated.

[Disclosure]

[Technical Problem]

[0006] Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide an integrated heat exchanger for a vehicle, in which an exhaust gas recirculation (EGR) cooler and an oil cooler are integrally and closely coupled, thereby making it possible to reduce a space around the radiator, simplify the layout of coolant and oil lines, and thus effectively overcome space restrictions within the vehicle.

[0007] Another object of the present invention is to provide an integrated heat exchanger for a vehicle, in which a coolant rapidly warms up automotive transmission oil in the event of cold starting of the vehicle, thereby making it possible to effectively realize improvement in fuel econ-

omy and reduction in exhaust gas.

[Technical Solution]

[0008] In order to accomplish the above object, the present invention provides an integrated heat exchanger for a vehicle, which includes:

an exhaust gas heat exchanging part that exchanges heat between a coolant and an exhaust gas; and an oil heat exchanging part that exchanges heat between the coolant and oil, wherein the exhaust gas heat exchanging part has a housing, to one side of which a coolant inflow pipe into which the coolant flows is connected, and a plurality of exhaust gas tubes which are stacked in the housing at regular intervals, in which respective exhaust gas channels are formed, and between the neighboring ones of which first coolant channels communicating with the coolant inflow pipe are formed, the oil heat exchanging part has a plurality of plates which are stacked at regular intervals and between which a plurality of oil channels and a plurality of second coolant channels are alternately formed, and a coolant discharge pipe through which the coolant is discharged and which is connected to one side of an upper end thereof, a lower end of the oil heat exchanging part and an upper surface of the housing of the exhaust gas heat exchanging part are coupled via at least one mounting plate, and the first coolant channels of the exhaust gas heat exchanging part and the second coolant channels of the oil heat exchanging part are sealed against the mounting plate and communicate with each other, and the second coolant channels communicate with the coolant discharge pipe.

[0009] Here, the mounting plate may include a first mounting plate coupled to the upper surface of the housing of the exhaust gas heat exchanging part and a second mounting plate coupled to the lower end of the oil heat exchanging part, both of which are mutually coupled by fasteners, and

the first and second mounting plates may have holes communicating with each other. Further, the hole of the first mounting plate may communicate with the first coolant channels of the exhaust gas heat exchanging part, and the hole of the second mounting plate may communicate with the second coolant channels of the oil heat exchanging part.

[0010] Further, the housing of the exhaust gas heat exchanging part may be coupled with a pair of fixing brackets on opposite left and right sides of an upper end thereof. The first mounting plate may be coupled to the fixing brackets. The second mounting plate may be coupled to an upper surface of the first mounting plate.

[0011] Further, the second mounting plate may have

an annular sealing groove which is formed around the hole thereof and into which a sealing member is fitted.

[0012] In addition, the exhaust gas tubes of the exhaust gas heat exchanging part may be stacked in a direction perpendicular to a direction in which the plates of the oil heat exchanging part are stacked.

[Advantageous Effects]

[0013] As described above, the exhaust gas heat exchanging part and the oil heat exchanging part are closely integrated by the first and second mounting plates and the sealing member. Thereby, it is possible to reduce a space around the radiator, simplify the layout of the coolant and oil lines, and effectively overcome space restrictions within the vehicle.

[0014] Further, as a coolant whose temperature is increased by exchanging heat with an exhaust gas heats oil within the oil heat exchanging part, the coolant rapidly warms up the automotive transmission oil in the event of initial cold starting of the vehicle. Thereby, it is possible to effectively realize improvement in fuel economy and reduction in exhaust gas.

[Description of Drawings]

[0015]

FIG. 1 is a perspective view showing an integrated heat exchanger for a vehicle according to an embodiment of the present invention.

FIG. 2 is an exploded perspective view showing a state in which an exhaust gas heat exchanging part and an oil heat exchanging part are disassembled in the integrated heat exchanger for a vehicle according to the embodiment of the present invention. FIG. 3 is a plan view when viewed from the direction of arrow A of FIG. 1.

FIG. 4 is a cross-sectional view taken along line B-B of FIG. 3.

FIG. 5 is a cross-sectional view taken along line C-C of FIG. 3.

FIG. 6 is a cross-sectional view taken along line D-D of FIG. 3.

FIG. 7 is a cross-sectional view taken along line E-E of FIG. 3.

FIG. 8 is a cross-sectional view taken along line F-F of FIG. 3.

FIG. 9 is an exploded perspective view showing the exhaust gas heat exchanging part in the integrated heat exchanger for a vehicle according to the embodiment of the present invention.

FIG. 10 shows a state in which the integrated heat exchanger of the present invention is applied to a coolant system of the vehicle.

[Mode for Invention]

[0016] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0017] FIGS. 1 to 9 show an integrated heat exchanger for a vehicle according to an embodiment of the present invention.

[0018] As shown in FIGS. 1 and 2, an integrated heat exchanger for a vehicle includes an exhaust gas heat exchanging part 10 that exchanges heat between an exhaust gas and a coolant, and an oil heat exchanging part 20 that exchanges heat between oil and the coolant.

[0019] The exhaust gas heat exchanging part 10 includes a housing 11 and a plurality of exhaust gas tubes 12 installed in the housing 11.

[0020] As shown in FIG. 9, the housing 11 includes a first housing 11a and a second housing 11b assembled with each other, and the first housing 11a and the second housing 11b are formed in a structure having a C-shaped cross section. The first housing 11a is provided with a fitting flange 11c at a lower end thereof, and the second housing 11b is provided with a fitting ridge 11d at an upper end thereof. The fitting flange 11c of the first housing 11a and the fitting ridge 11d of the second housing 11b are engaged and coupled by welding.

[0021] As shown in FIGS. 4 to 8, a plurality of exhaust gas tubes 12 are disposed in an inner upper space of the housing 11. Particularly, the plurality of exhaust gas tubes 12 are fitted and assembled into the first housing 11a. A bypass passage 43 sealed against the exhaust gas tubes 12 is formed in an inner lower space of the housing 11. Especially, the bypass passage 43 corresponds to an inner space of the second housing 11b.

[0022] An exhaust gas inflow flange 13 is coupled to one end of the housing 11, and an exhaust gas outflow block 14 is coupled to the other end of the housing 11. The first housing 11a is provided with first and second protrusions 18a and 18b on an upper surface thereof. A coolant inflow pipe 31 is connected to the first protrusion 18a, and the second protrusion 18b is provided with a hole 18c through which the coolant flows. An upper surface of the second protrusion 18b is coupled with a first mounting plate 51 (to be described below) in an airtight way.

[0023] The exhaust gas inflow flange 13 is configured so that a first inflow opening 13a and a second inflow opening 13b are divided by a partition 13c. An exhaust gas introduced through the first inflow opening 13a flows through exhaust gas channels 41 of the exhaust gas tubes 12, and an exhaust gas introduced through the second inflow opening 13b flows through the bypass passage 43. Further, a bypass valve (not shown) and an exhaust gas recirculation (EGR) valve (not shown) are installed on a side of the exhaust gas inflow flange 13.

[0024] One end of the exhaust gas outflow block 14 is provided with an opening 14b. The opening 14b communicates with the exhaust gas channels 41 of the exhaust

gas tubes 12 and the bypass passage 43. The other end of the exhaust gas outflow block 14 is provided with a flange 14a to which an exhaust pipe (not shown) is connected.

[0025] The exhaust gas channels 41 are formed in the respective exhaust gas tubes 12. A turbulator (not shown) made up of, for instance, wavy fins or offset fins may be installed in each exhaust gas channel 41. A plurality of embossments 12f are formed on an outer surface of each exhaust gas tube 12. When the exhaust gas tubes 12 are stacked in a leftward/rightward direction, i.e. in a direction perpendicular to a direction in which plates 21 of the oil heat exchanging part 20 (to be described below) are stacked, the embossments 12f of the exhaust gas tubes 12 come into contact with one another, and are coupled by welding. The embossments 12f of the outermost exhaust gas tubes 12 come into contact with embossments 11f of the housing 11, and are coupled by welding.

[0026] A plurality of first coolant channels 42 are airtightly formed between the stacked exhaust gas tubes 12 by the housing 11, particularly the first housing 11a. As shown in FIG. 8, the first coolant channels 42 directly communicate with the coolant inflow pipe 31. Thus, the coolant flows through the coolant inflow pipe 31 into the first coolant channels 42.

[0027] As shown in FIG. 9, the embossments 12f of the exhaust gas tubes 12, which are in contact with inner lateral surfaces of the housing 11, particularly the first housing 11a, among the exhaust gas tubes 12 come into contact with the embossments 11f of the first housing 11a, and are coupled by welding. The second housing 11b is provided with a plurality of reinforcing embossments 11e on the bottom thereof. Rigidity of the second housing 11b can be reinforced by the reinforcing embossments 11e.

[0028] As shown in FIG. 9, one end of each exhaust gas tube 12 is provided with a first tube expansion 12a, and the other end of each exhaust gas tube 12 is provided with a second tube expansion 12b. Thus, as the plurality of exhaust gas tubes 12 are stacked in the leftward/rightward direction, the neighboring first tube expansions 12a are airtightly coupled, and the neighboring second tube expansions 12b are airtightly coupled. Further, the first tube expansions 12a of the exhaust gas tubes 12 are airtightly coupled to the side of the first exhaust gas inflow opening 13a of the exhaust gas inflow flange 13, and the second tube expansions 12b of the exhaust gas tubes 12 are airtightly coupled to the side of the opening of the exhaust gas outflow block 14.

[0029] As shown in FIG. 9, the lower end of each exhaust gas tube 12 is provided with a cross-section expansion 17 whose cross section is expanded to be greater than the other portion. As shown in FIGS. 6 to 8, as the plurality of exhaust gas tubes 12 are stacked, the neighboring cross-section expansions 17 are airtightly coupled. Thus, the bypass passage 43 is formed in the inner lower space of the housing 11 so as to be sealed

against the first coolant channels 42 between the exhaust gas tubes 12.

[0030] As shown in FIGS. 4 to 7, the oil heat exchanging part 20 is configured so that a plurality of plates 21, 22 and 23 are vertically stacked at regular intervals. In detail, the plurality of plates 21 are stacked between the lowermost plate 22 and the uppermost plate 23. A coolant discharge pipe 32 through which the coolant is discharged is connected to one side of an upper end of the oil heat exchanging part 20. A lower end of the oil heat exchanging part 20 and an upper surface of the housing 11 of the exhaust gas heat exchanging part 10 are coupled via mounting plates 51 and 52. Thereby, the integrated heat exchanger can be formed.

[0031] The plates 21, 22 and 23 are provided with inclined edges 21a, 22a and 23a, respectively. As the plates 21, 22 and 23 are vertically stacked, the neighboring inclined edges 21a, 22a and 23a of the plates 21, 22 and 23 are mutually coupled. As a result, a predetermined gap is formed between the neighboring plates 21 and 22, between the neighboring plates 21 and 23, and between the neighboring plates 21 and 21. These predetermined gaps are formed into the plurality of oil channels 44 and the plurality of second coolant channels 45. The plurality of oil channels 44 and the plurality of second coolant channels 45 are alternately formed. A turbulator (not shown) made up of, for instance, wavy fins or offset fins may be disposed in each oil channel 44. No turbulator is provided in each second coolant channel 45 in order to prevent a pressure loss of the coolant.

[0032] Each plate 21 is provided with a pair of oil openings 21b, and a pair of flanges protruding downward around the respective oil openings 21b. The oil openings 21b of the plates 21 are formed to correspond to each other in a vertical direction. Thus, as the plurality of plates 21 are vertically stacked, the oil openings 21b of the neighboring plates 21 are closely coupled, and the oil opening 21b and the oil channel 44 communicate with each other.

[0033] Each plate 21 is provided with a pair of coolant openings 21c, and a pair of flanges protruding upward around the respective coolant openings 21c. The oil openings 21c of the plates 21 are formed to correspond to each other in a vertical direction. Thus, as the plurality of plates 21 are vertically stacked, the oil openings 21c of the neighboring plates 21 are closely coupled, and the oil opening 21c and the second coolant channel 45 communicate with each other.

[0034] Meanwhile, the protrusion of the oil opening 21b and the protrusion of the coolant opening 21c protrude in opposite directions.

[0035] As shown in FIG. 4, the lowermost plate 22 is provided with one coolant opening 22c. The coolant opening 22c of the lowermost plate 22 communicates with a hole 51c of the first mounting plate 51 (to be described below) and a hole 52c of the second mounting plate 52 (to be described below). A pair of oil pipes 24 and 25 are connected to the respective oil openings 23b

of the uppermost plate 23. Oil flows through the plurality of oil channels 44, and then circulates through the oil pipes 24 and 25 toward an automotive transmission 4 (see FIG. 10). Further, a coolant discharge pipe 32 communicating with the second coolant channels 45 is connected to the coolant opening 23c of the uppermost plate 23.

[0036] The upper surface of the housing 11 of the exhaust gas heat exchanging part 10 and the lower end of the oil heat exchanging part 20 are firmly coupled via the mounting plates 51 and 52. The first mounting plate 51 of the mounting plates 51 and 52 is coupled to the upper surface of the housing 11 of the exhaust gas heat exchanging part 10, and the second mounting plate 52 is coupled to the lower end of the oil heat exchanging part 20. The first and second mounting plates 51 and 52 are mutually coupled by fasteners.

[0037] A pair of fixing brackets 15a and 15b are coupled on opposite left and right sides of the upper end of the housing 11 of the exhaust gas heat exchanging part 10 by welding. The first mounting plate 51 is coupled to the fixing brackets 15a and 15b by bolts. The second mounting plate 52 is coupled to the top of the first mounting plate 51 by bolts. The first mounting plate 51 and the second mounting plate 52 have respective holes 51c and 52c communicating with each other.

[0038] As shown in FIG. 4, an annular sealing groove 52a is formed around the hole 52c of the second mounting plate 52. A sealing member 55 such as an O-ring is fitted into the sealing groove 52a. Thus, it is possible to secure sealability against the surroundings of the holes 52c and 51c of the second and first mounting plates 52 and 51.

[0039] The second protrusion 18b of the housing 11 of the exhaust gas heat exchanging part 10 is airtightly coupled with the bottom of the first mounting plate 51. As a result, the hole 18c of the second protrusion 18b communicates with the holes 51c and 52c of the first and second mounting plates 51 and 52 in a sealed state.

[0040] As shown in FIGS. 4 to 8, the exhaust gas tubes 12 of the exhaust gas heat exchanging part 10 are configured to be stacked in the leftward/rightward direction, whereas the plates 21, 22 and 23 of the oil heat exchanging part 20 are configured to be stacked in the vertical direction. In other words, the stacking direction of the exhaust gas tubes 12 of the exhaust gas heat exchanging part 10 and the stacking direction of the plates 21, 22 and 23 of the oil heat exchanging part 20 are perpendicular to each other, so that it is possible to make the overall size more compact and slim.

[0041] FIG. 10 shows a state in which the integrated heat exchanger of the present invention is applied to an engine 1 and an automotive transmission 4. Coolant lines of an engine 1 and a radiator 2 are connected via a water pump 1a and a thermostat 1b, and a part of the coolant line of the engine 1 branches off so that a part of the coolant of the engine 1 is supplied to the exhaust gas heat exchanging part 10, and is in contact with the coolant

inflow pipe 31 of the exhaust gas heat exchanging part 10. Another coolant line extends from the coolant discharge pipe 32 of the oil heat exchanging part 20, passes through the heater core 3, and is connected to the engine 1. Further, oil pipes 24 and 25 of the oil heat exchanging part 20 are connected to oil lines 4a and 4b of the automotive transmission 4 so that the oil heat-exchanged by the oil heat exchanging part 20 circulates toward the automotive transmission 4.

[0042] With this configuration, when the coolant circulating between the engine 1 and the radiator 2 partly flows into the coolant inflow pipe 31 of the exhaust gas heat exchanging part 10, the coolant exchanges heat with the exhaust gas discharged from the engine 1, so that a temperature of the coolant is increased, and a temperature of the exhaust gas is reduced. The coolant whose temperature is increased flows into the oil heat exchanging part 20, and increases a temperature of the oil of the automotive transmission 4, so that the temperature of the coolant is reduced, and the oil whose temperature is increased circulates toward the automotive transmission 4. The coolant whose temperature is reduced is subjected to heat exchange again while passing through the heater core 3, and then circulates toward the engine 1.

[0043] In this way, the exhaust gas heat exchanging part 10 and the oil heat exchanging part 20 are closely integrated by the first and second mounting plates 51 and 52 and the sealing member 44. Thereby, among a plurality of heat exchangers disposed around the radiator 2, some heat exchangers such as an oil cooler can be changed in position toward an EGR cooler (i.e. an exhaust gas heat exchanger). Thereby, it is possible to effectively reduce a space around the radiator, simplify the layout of the coolant and oil lines, and effectively overcome space restrictions within the vehicle.

[0044] As the exhaust gas heat exchanging part 10 and the oil heat exchanging part 20 are airtightly coupled, the first coolant channels 42 of the exhaust gas heat exchanging part 10 and the second coolant channels 45 of the oil heat exchanging part 20 are airtightly connected. Thus, the coolant whose temperature is increased by heat exchanging (cooling) with the exhaust gas passing through the exhaust gas channels 41 within the exhaust gas heat exchanging part 10 flows into the second coolant channels 45 of the oil heat exchanging part 20, and efficiently exchanges heat with the oil passing through the oil channels 44 of the oil heat exchanging part 20.

[0045] Above all, as the coolant whose temperature is increased by exchanging heat with the exhaust gas heats the oil within the oil heat exchanging part 20, the coolant rapidly warms up the automotive transmission oil in the event of initial cold starting of the vehicle, so that it is possible to effectively realize improvement in fuel economy and reduction in exhaust gas.

Claims

1. An integrated heat exchanger for a vehicle comprising:

an exhaust gas heat exchanging part that exchanges heat between a coolant and an exhaust gas; and

an oil heat exchanging part that exchanges heat between the coolant and oil,

wherein the exhaust gas heat exchanging part has a housing, to one side of which a coolant inflow pipe into which the coolant flows is connected, and a plurality of exhaust gas tubes which are stacked in the housing at regular intervals, in which respective exhaust gas channels are formed, and between the neighboring ones of which first coolant channels communicating with the coolant inflow pipe are formed; the oil heat exchanging part has a plurality of plates which are stacked at regular intervals and between which a plurality of oil channels and a plurality of second coolant channels are alternately formed, and a coolant discharge pipe through which the coolant is discharged and which is connected to one side of an upper end thereof;

a lower end of the oil heat exchanging part and an upper surface of the housing of the exhaust gas heat exchanging part are coupled via at least one mounting plate; and

the first coolant channels of the exhaust gas heat exchanging part and the second coolant channels of the oil heat exchanging part are sealed against the mounting plate and communicate with each other, and the second coolant channels communicate with the coolant discharge pipe.

2. The integrated heat exchanger of claim 1, wherein:

the mounting plate includes a first mounting plate coupled to the upper surface of the housing of the exhaust gas heat exchanging part and a second mounting plate coupled to the lower end of the oil heat exchanging part, both of which are mutually coupled by fasteners; and the first and second mounting plates have holes communicating with each other, the hole of the first mounting plate communicating with the first coolant channels of the exhaust gas heat exchanging part, and the hole of the second mounting plate communicating with the second coolant channels of the oil heat exchanging part.

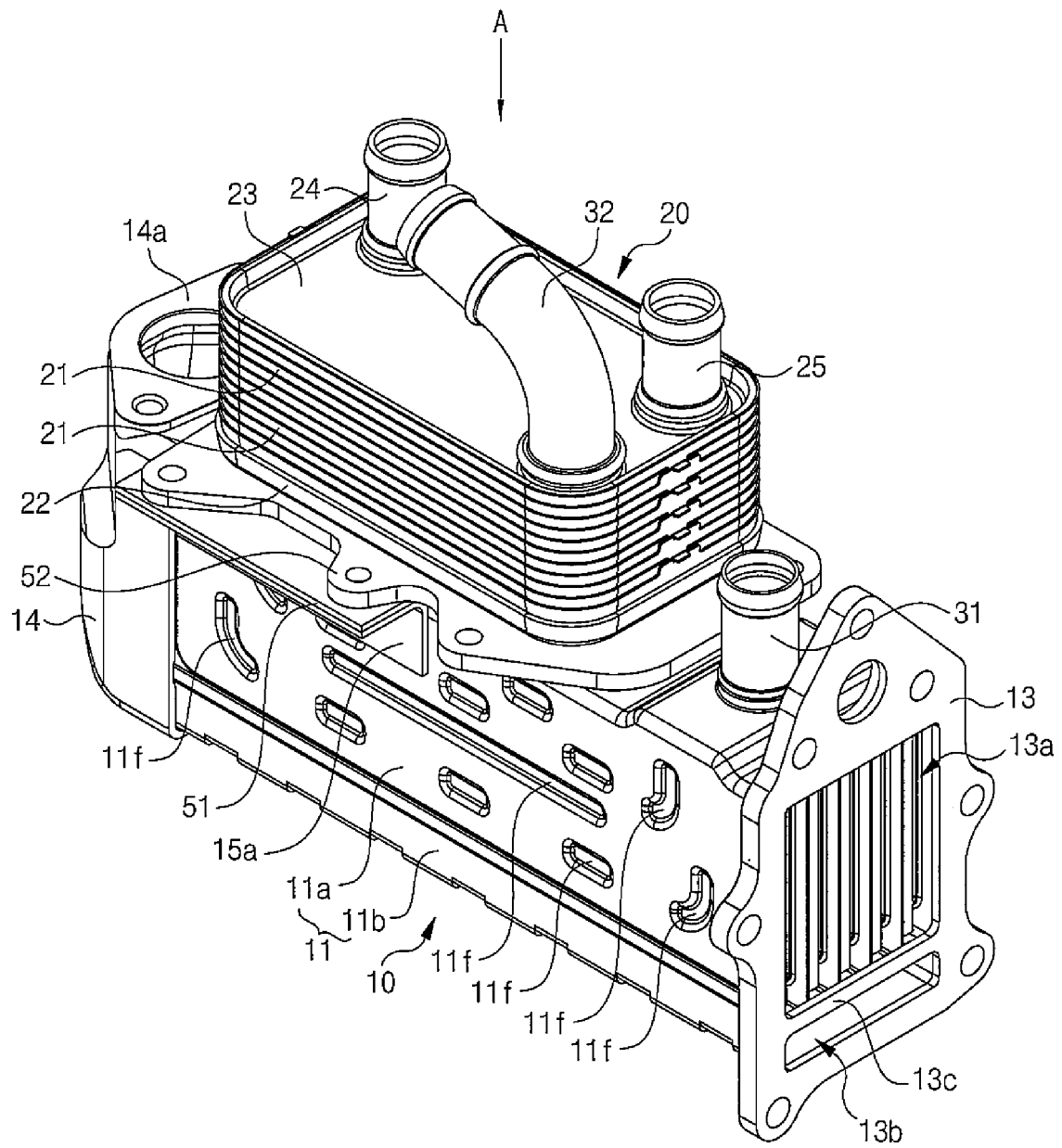
3. The integrated heat exchanger of claim 2, wherein: the housing of the exhaust gas heat exchanging part is coupled with a pair of fixing brackets on opposite

left and right sides of an upper end thereof; the first mounting plate is coupled to the fixing brackets; and the second mounting plate is coupled to an upper surface of the first mounting plate.

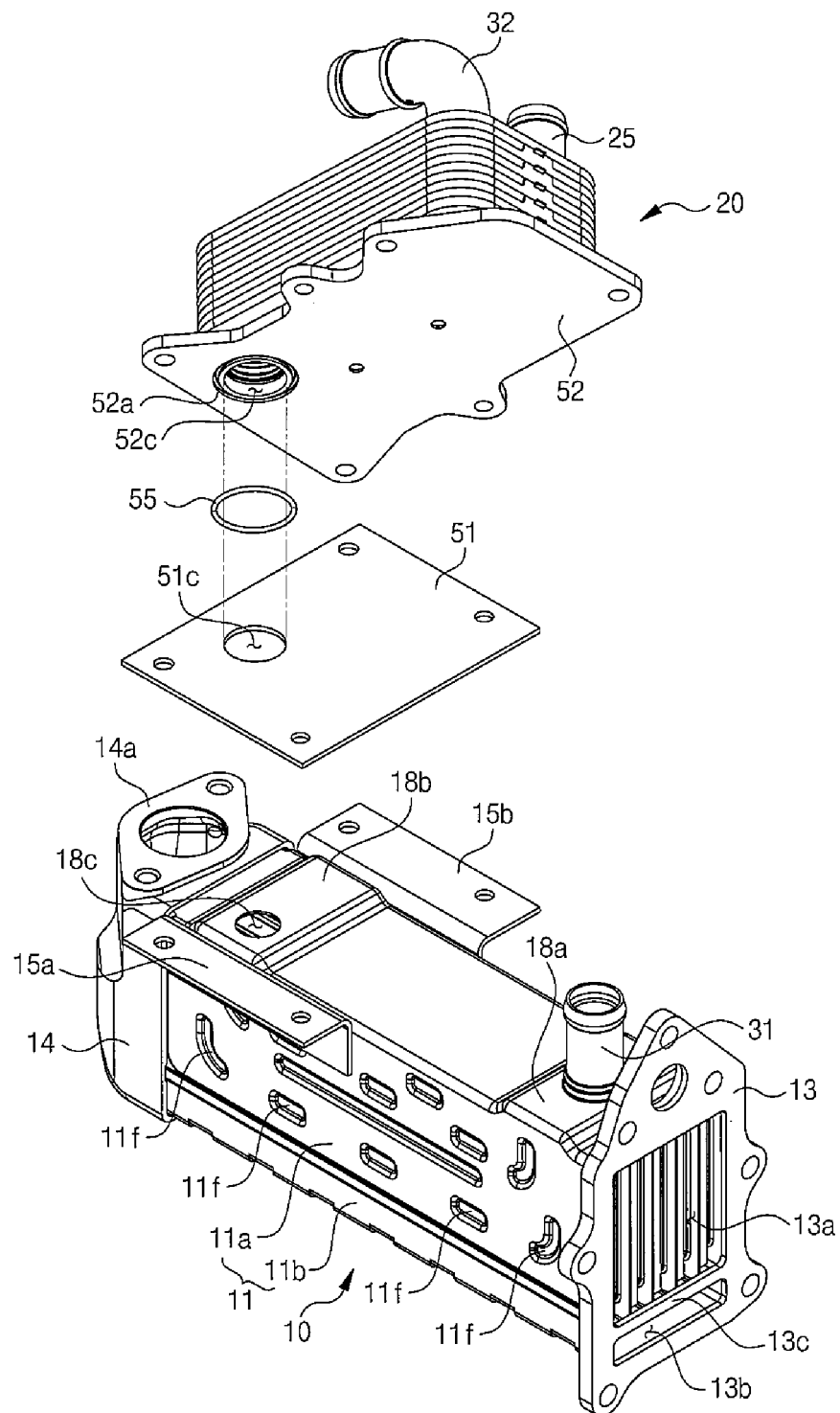
4. The integrated heat exchanger of claim 2, wherein the second mounting plate has an annular sealing groove which is formed around the hole thereof and into which a sealing member is fitted.

5. The integrated heat exchanger of claim 1, wherein the exhaust gas tubes of the exhaust gas heat exchanging part are stacked in a direction perpendicular to a direction in which the plates of the oil heat exchanging part are stacked.

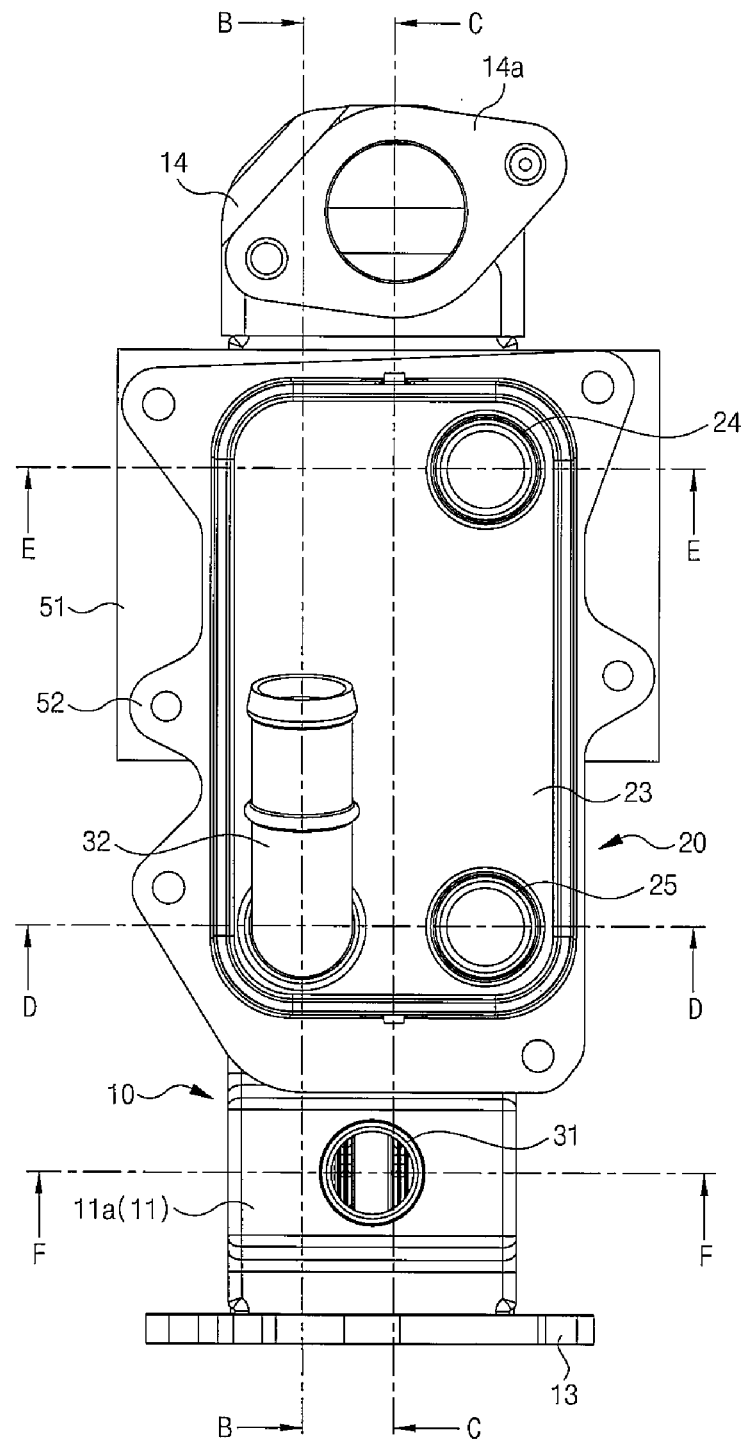
[Fig. 1]



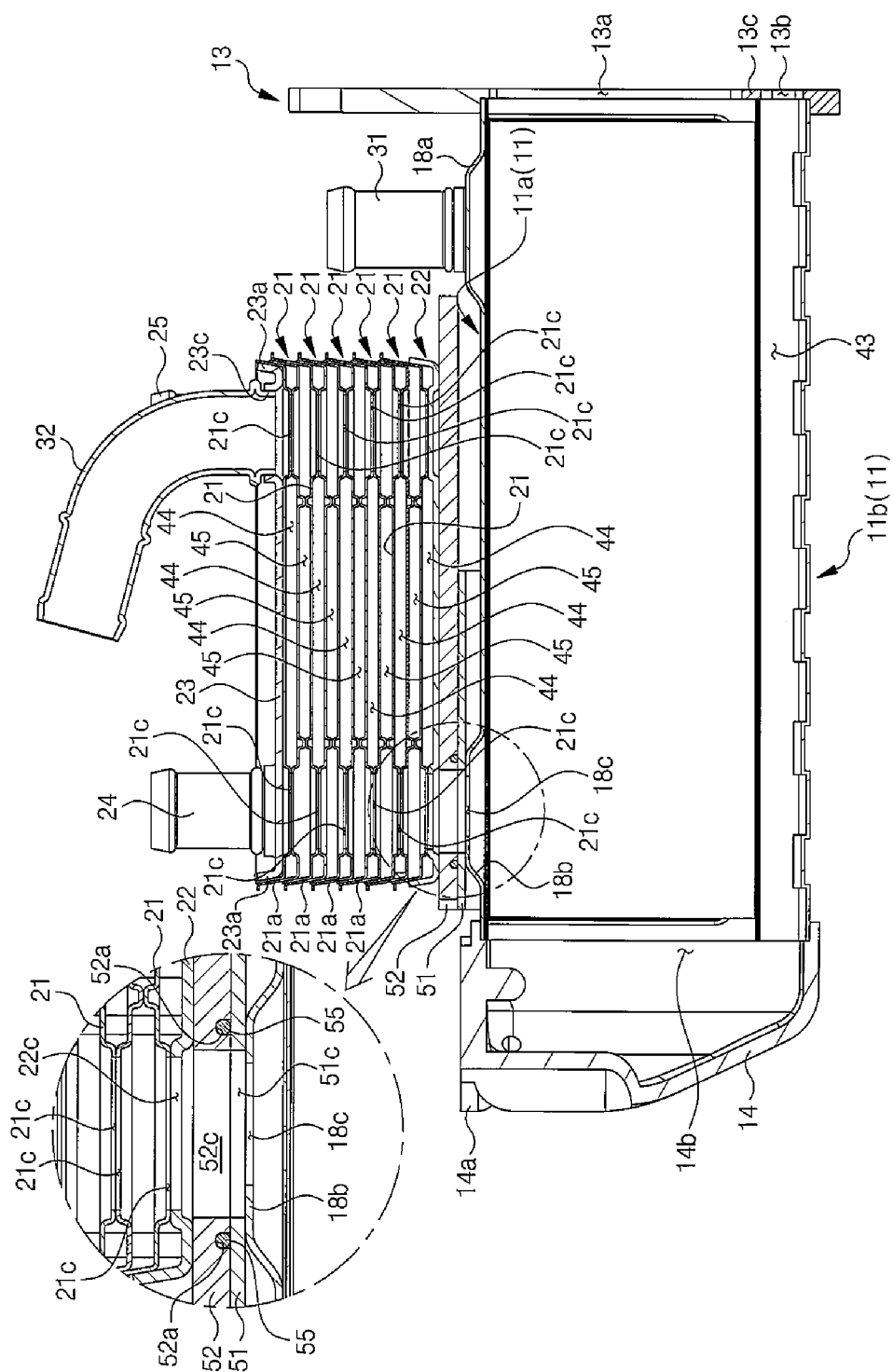
[Fig. 2]



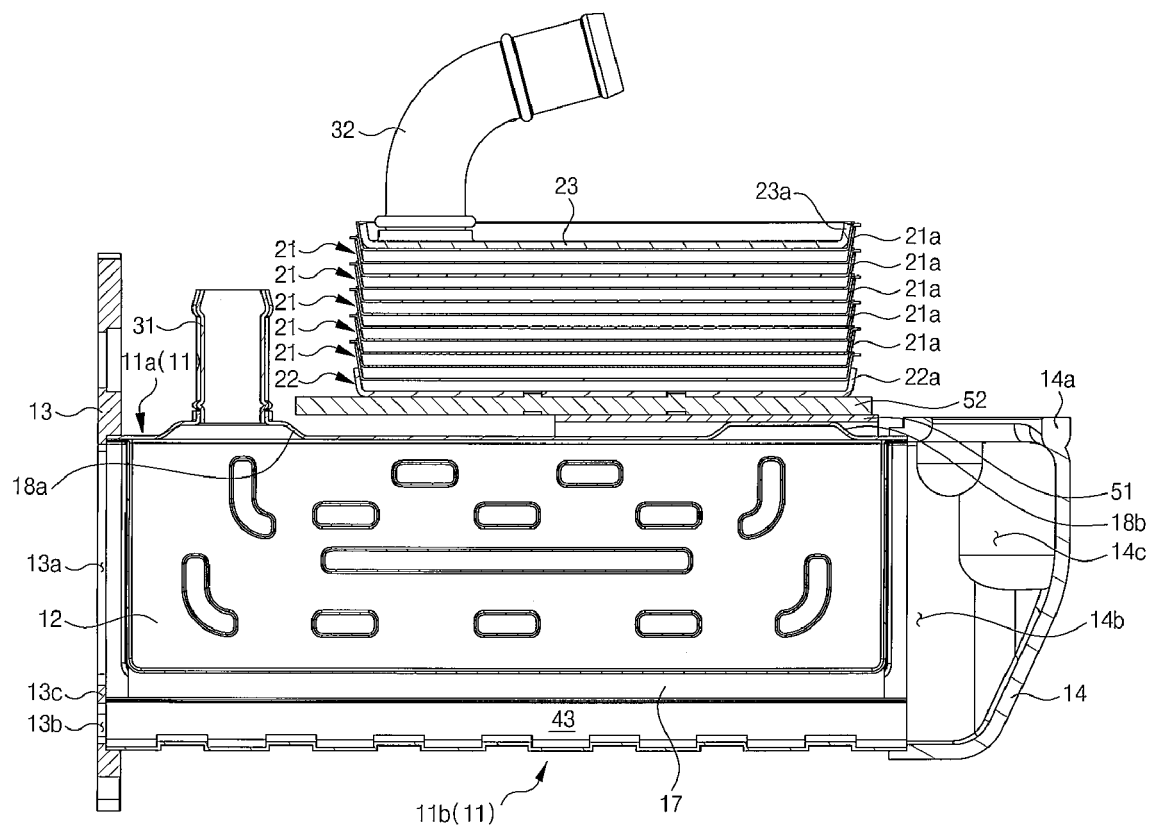
[Fig. 3]



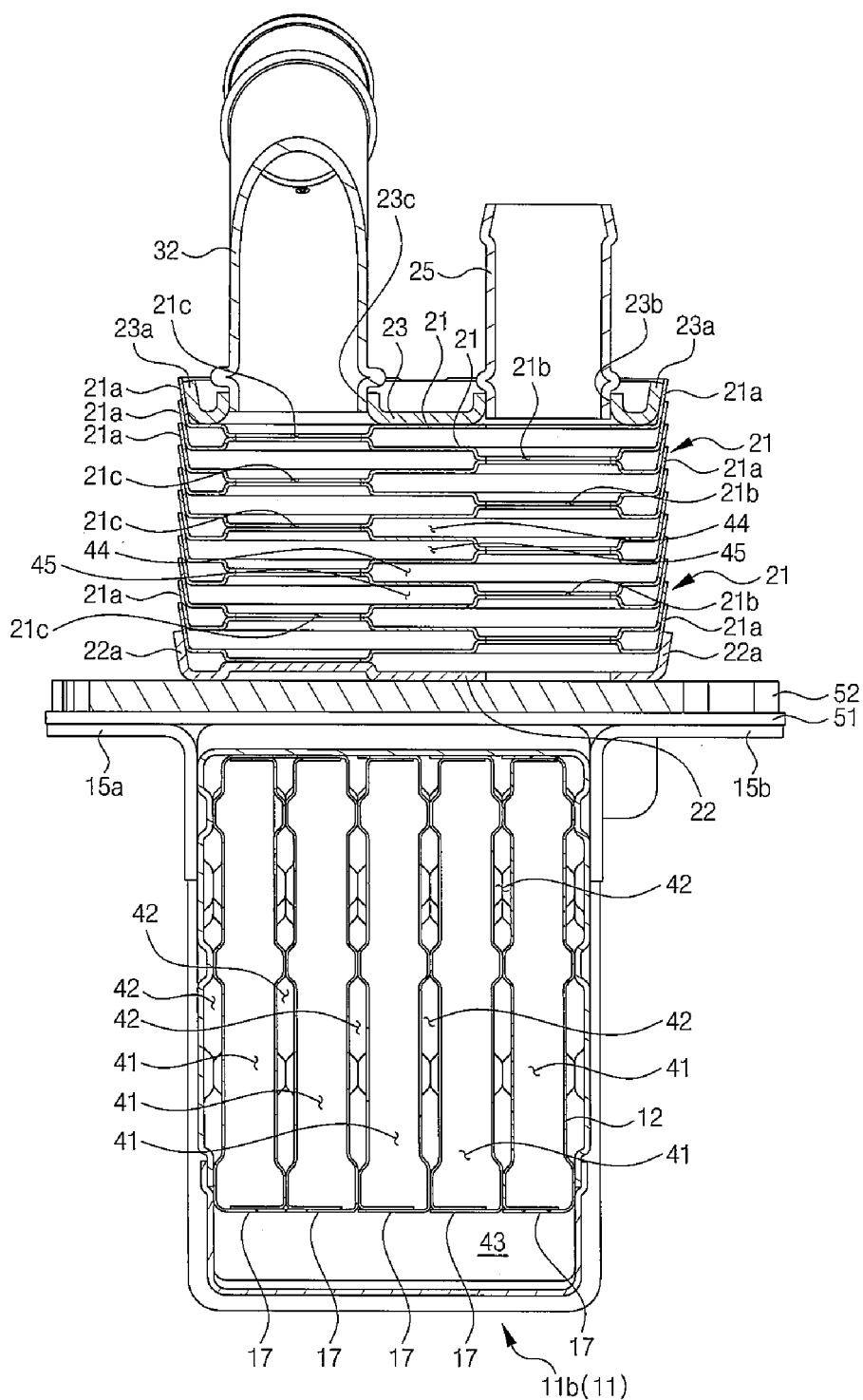
[Fig. 4]



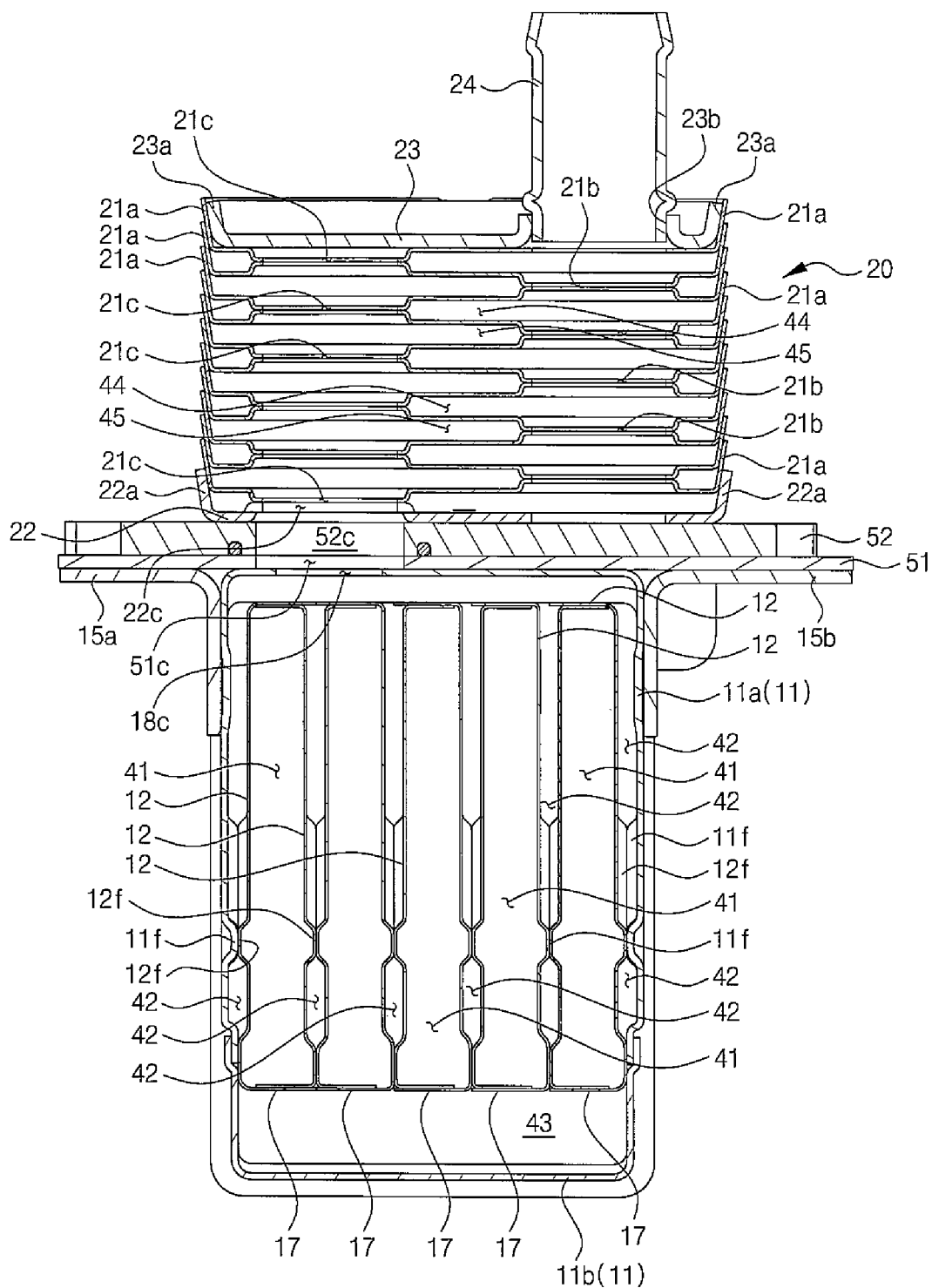
[Fig. 5]



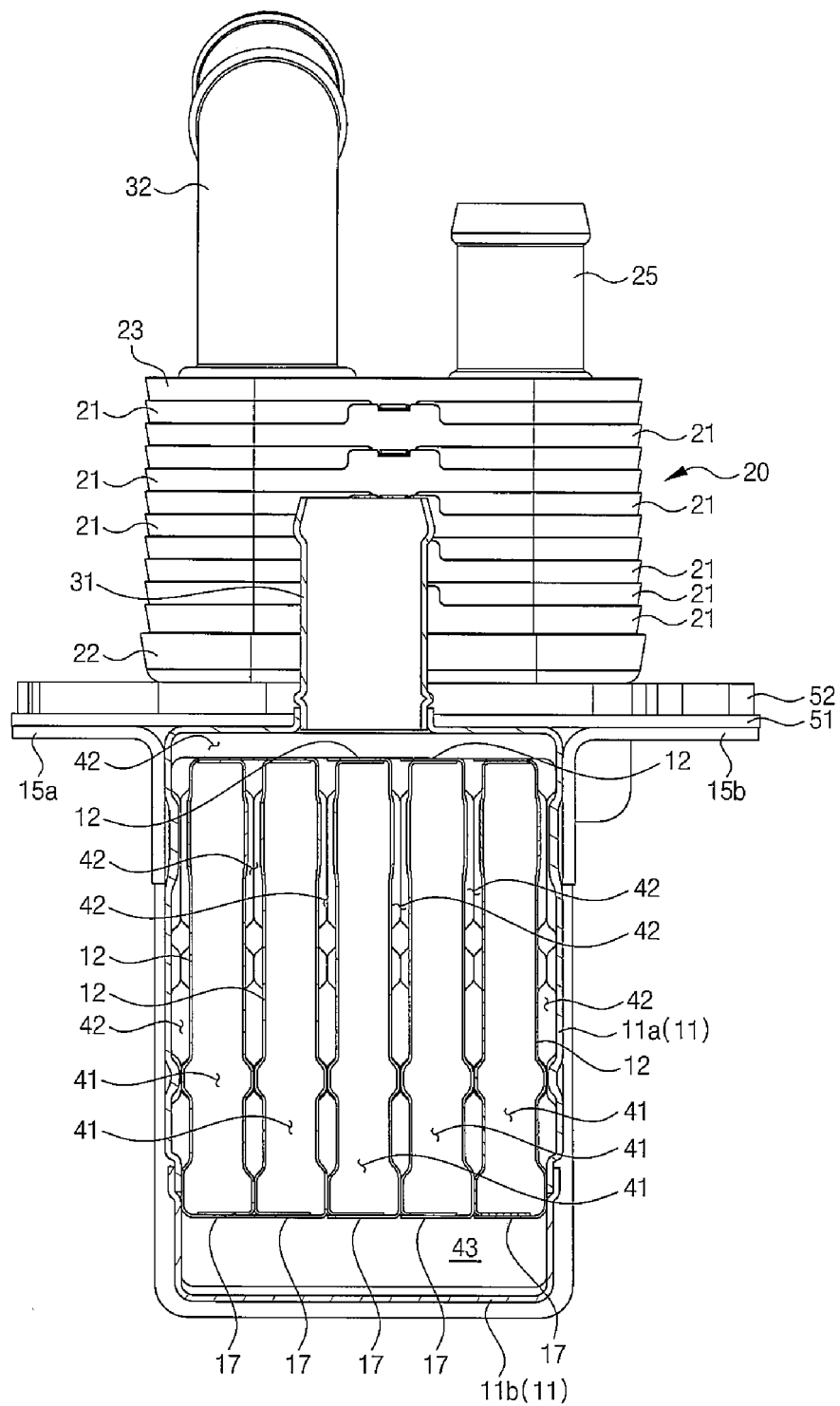
[Fig. 6]



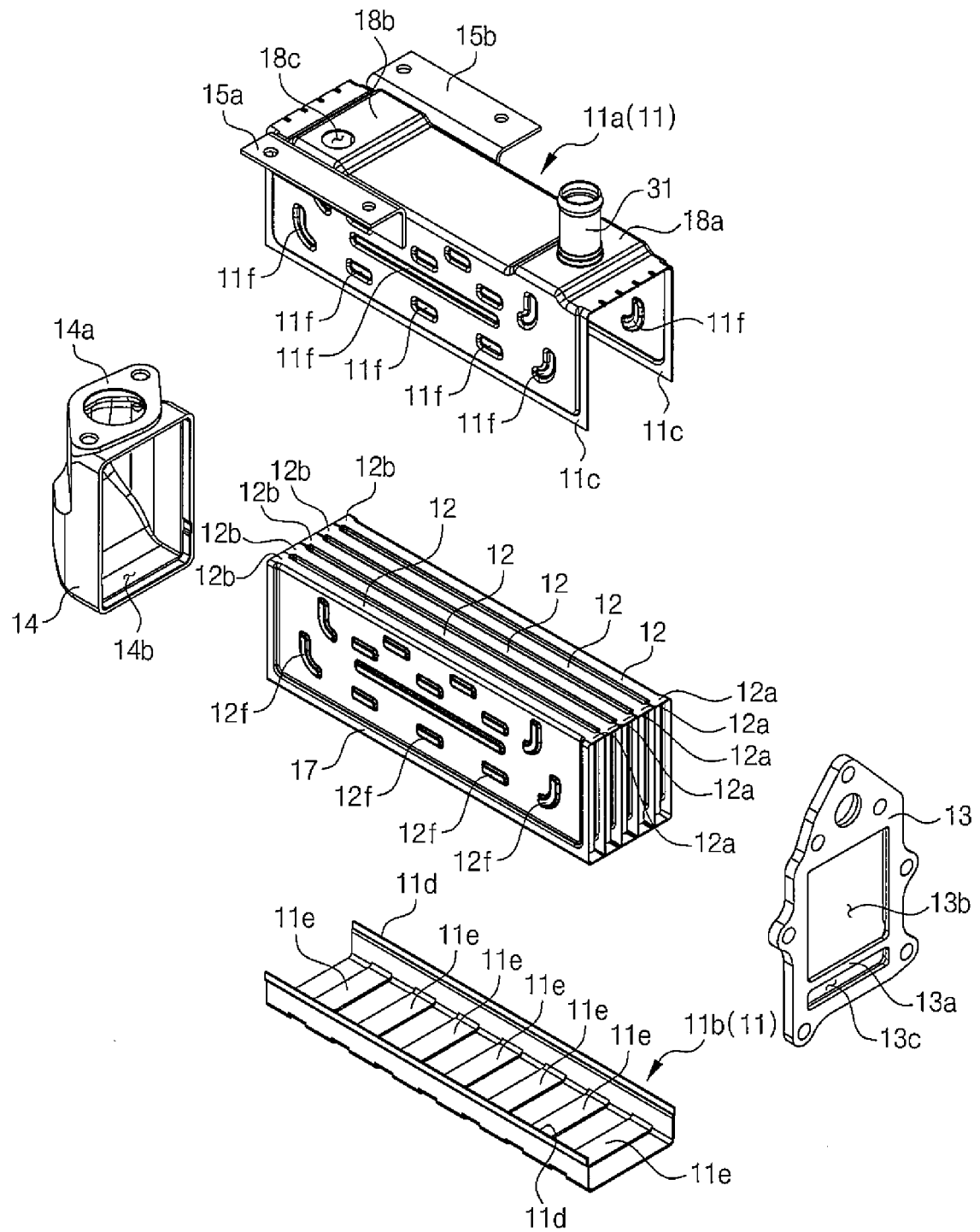
[Fig. 7]



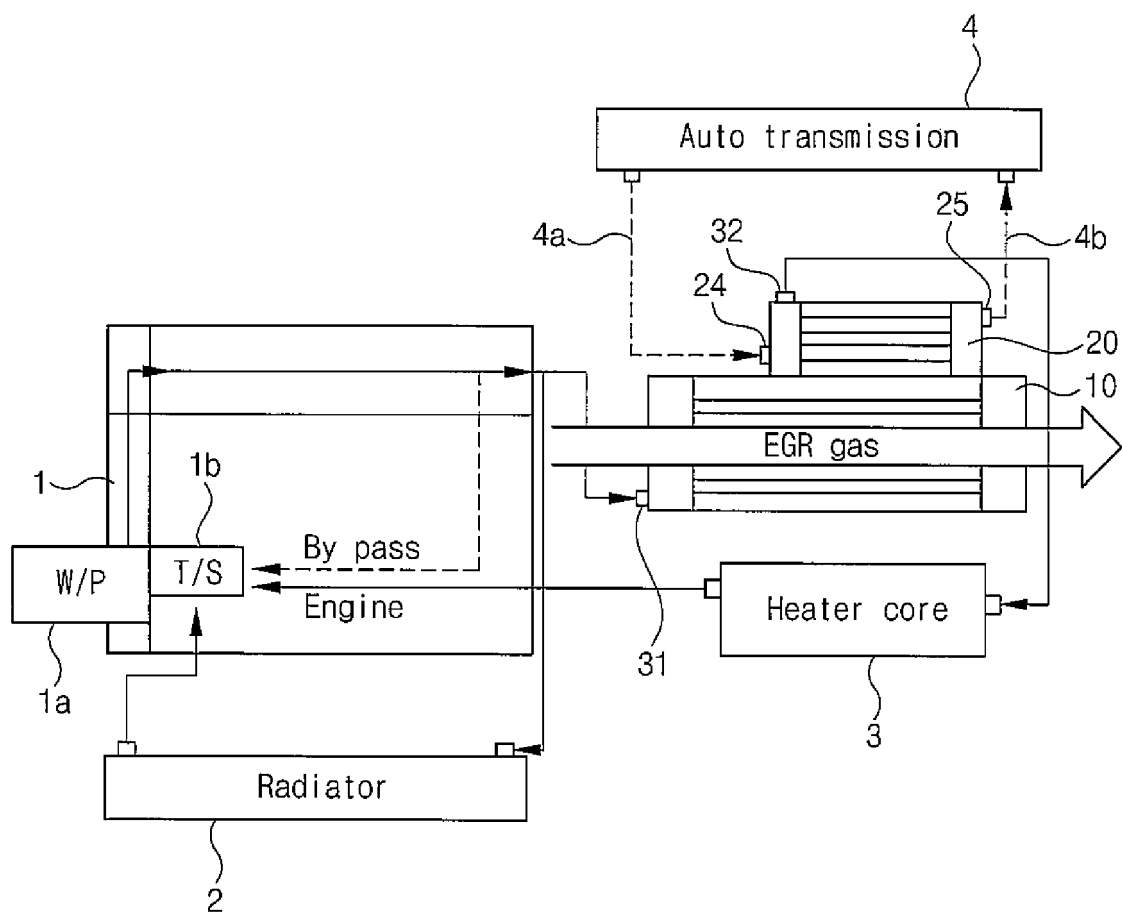
[Fig. 8]



[Fig. 9]



[Fig. 10]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2012/009779

A. CLASSIFICATION OF SUBJECT MATTER

F28D 9/00(2006.01)i, F01M 5/00(2006.01)i, F01P 3/20(2006.01)i, F28F 3/08(2006.01)i

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)

F28D 9/00; F28D 9/02; F01M 5/00; F01P 3/20; F02M 25/07

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

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: exhaust gas, EGR, oil, coolant, heat exchange, plate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-0559592 B1 (HYUNDAI MOTOR COMPANY) 10 March 2006 See abstract, claim 1 and figures 1 to 3	1-5
Y	JP 10-281015 A (CALSONIC CORP) 20 October 1998 See abstract, claims 1, 2 and figure 1	1-5
Y	JP 2008-045477 A (MAHLE FILTER SYSTEMS JAPAN CORP) 28 February 2008 See abstract, paragraph [18] and figures 1, 4	1-5
Y	KR 10-2010-0002383 A (SSANGYONG MOTOR COMPANY) 07 January 2010 See abstract and figures 2, 5	2-4

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

28 MARCH 2013 (28.03.2013)

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International application No.

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