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(54) **EGR/COOLING INTEGRATED MODULE FOR AN IC ENGINE**

INTEGRIERTES AGR/KÜHLMODUL FÜR EINEN VERBRENNUNGSMOTOR

MODULE INTEGRE D'EGR/REFROIDISSEMENT POUR UN MOTEUR A COMBUSTION INTERNE

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Description

TECHNICAL FIELD

[0001] The present invention relates to an EGR/cooling integrated module for an IC engine.

BACKGROUND ART

[0002] It is well known that NOx emissions can be reduced by exhaust gas recirculation (EGR), i.e. by recirculating a portion of exhaust gases to engine intake.

[0003] An EGR system includes a number of components: an EGR cooler, i.e. a heat exchanger adapted to cool the exhaust gases before re-introducing them into the engine intake, a bypass valve associated to the EGR cooler and adapted to selectively route the EGR gases through the EGR cooler or bypass the cooler depending on engine operating parameters, and an EGR valve which controls the EGR flow rate.

[0004] In order to reduce the number of components that have to be individually assembled onto the engine and the number of associated parts, such as connecting pipes, and therefore the overall cost of the system, it is well known to group such components into pre-assembled modules that can be mounted to the engine as a single unit.

[0005] The EGR cooler uses the engine coolant as the cooling fluid, therefore the module must be connected to the engine cooling system; furthermore, the EGR and bypass valve also require proper cooling because of the extremely high temperature of the exhaust gases.

[0006] Because of this necessary interaction between the EGR and the cooling systems, and the general goal to reduce manufacturing and assembly costs, it has been proposed to include one or more components of the cooling circuit into the EGR module.

[0007] An example of these known multifunctional EGR/cooling integrated modules modules is disclosed in EP-A-1 793 115. This prior art module includes an EGR/cooling integrated module for an IC engine including an interface member adapted to be mounted to the engine, and further including an EGR valve, an EGR cooler and a bypass valve carried and interconnected by the interface member, wherein

- the interface member includes a coolant inlet aperture and an EGR gas inlet aperture adapted to be connected directly to corresponding ports of said engine upon assembling said module to said engine,
- the interface member defines a housing of said EGR valve and a cooling circuit for cooling said EGR valve,
- the EGR valve is housed in a cavity of said interface member, and includes a shutter and a valve seat provided in said cavity,
- said cooling circuit includes a cooling cavity provided within said interface member and communicating with the coolant inlet aperture said cooling cavity being adjacent to said EGR valve,
- said bypass valve includes a bypass valve chamber said bypass valve chamber being provided within said interface member , wherein the cooling cavity is adapted for cooling the EGR valve chamber.

DISCLOSURE OF INVENTION

[0008] An object of the present invention is to provide an EGR/cooling module that is more efficient and still more compact and less expensive to manufacture.

[0009] This object is achieved by an EGR/cooling integrated module as claimed in claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] For a better comprehension of the present invention, a preferred embodiment is described hereafter, by way of a non-limiting example and with reference to the attached drawings, in which:

Figure 1 is a front view of an EGR/cooling integrated module in accordance with the present invention;
Figure 2 in a back view thereof;
Figure 3 is a perspective view of an interface member of the module;
Figure 4 is an axial cross section of an EGR valve of the module
Figure 5 and 6 are partial cross-sections of the module, showing a gas circuit in two different operating configurations;
Figure 7 is a perspective view of an EGR cooler of the module which is part of the integrated module of the invention;
Figure 8 is a perspective view of a thermostat/vacuum tank subassembly which is part of the integrated module of the invention;
Figure 9 is a partial cross-section of the module showing a coolant circuit and the connection between the interface member of Figure 3 and the subassembly of Figure 8;
Figure 10 is a cross section of a different embodiment of an EGR cooler; and
Figure 11 is a front view of a connecting flange of the EGR cooler of Figure 10.

BEST MODE FOR CARRYING OUT THE INVENTION

[0011] With reference to Figures 1 and 2, numeral 1 designates as a whole an EGR/cooling integrated module in accordance with the present invention (hereinafter "module 1".

[0012] Module 1 includes an EGR valve 2, an EGR cooler 3 and a bypass valve 4 that are carried and interconnected by a an interface member 5 (hereinafter "member 5") which is adapted to be directly assembled onto a vehicle IC engine (not shown). Module 1 also includes an electrically operated EGR valve actuator 6, a

vacuum-operated bypass valve actuator 7, a vacuum tank 8 for actuator 7, and a coolant thermostat valve 9 (Figures 8, 9).

[0013] Member 5 (Figure 3) is conveniently an aluminium alloy die-casting and includes a plurality of internal passages for EGR gases and coolant, as will be described below in a more detailed manner.

[0014] Member 5 includes has a substantially flat base flange 10 (Figure 2) which is adapted to be fixed to the engine and has, to this end, a plurality of peripheral bores adapted to receive fixing bolts (not shown). Flange 10 is delimited by a flat surface 11 that rests, in use, against a corresponding wall of the engine; a gasket (not shown) is conveniently provided between the engine and surface 11.

[0015] Member 5 is provided with a coolant inlet aperture 12 and an EGR gas inlet aperture 13, both opening onto surface 11, so that they communicate with corresponding ports of the engine coolant circuit and, respectively, EGR gas circuit upon assembly onto the engine, with no need for additional connection tubings.

[0016] As can be clearly seen also from Figure 3, member 5 has a first lateral flange 14 for connection with EGR cooler and a second lateral flange 15 for connection with a subassembly 16 including vacuum tank 8 and thermostat valve 9, as better described hereinafter.

[0017] EGR gas inlet aperture 13 communicates with a through cavity 17 (Figure 4) extending across member 5 and a tubular housing 18 integrally protruding from member 5 on the side opposite to base flange 10 and enclosing a control assembly 19 of the EGR valve 2.

[0018] As can be clearly seen from the cross-section of Figure 4, EGR valve 2 is not a conventional, drop-in valve provided with an housing of its own; rather, the housing of EGR valve 2 is constituted by member 5, which delimits a valve chamber 20 defined by a portion of cavity 17. Valve chamber 20 communicates with an EGR valve outlet passage 21 internal to member 5 and leading to bypass valve 4. Control assembly 19, which can be of any known type, according to the present embodiment includes a disk shutter 22 which is rigidly fixed to an end of an axially sliding stem 23. A spring 24 is housed in a spring chamber 28 within tubular housing 18, and is axially compressed between a stop member 25 fixed to an opposite end of stem 23 and a fixed shoulder 26, defined by member 5 and located between valve chamber 20 and spring chamber 28, so as to bias disk shutter 22 against an annular valve seat 27 axially interposed between gas inlet aperture 13 and valve chamber 20.

[0019] EGR valve actuator 6 is assembled axially onto the tubular housing 18 and controls the axial position of stem 23 so as to vary the EGR gas flow through a port formed between valve seat 27 and disk shutter 22.

[0020] Bypass valve 4 (Figure 5, 6) includes a valve chamber 31 provided within member 5 and having an inlet port 32 communicating with EGR valve outlet passage 21, a first outlet port 33 communicating with a cooler gas admission duct 34 and a second outlet port 35 communicating with a gas exit duct 36, as well as with a cooler gas return duct 37. Bypass valve 4 also includes a flap 38 that is pivotally mounted within valve chamber 31 about a pivot 39, and may rotate between a first position (Figure 5), in which second outlet port 35 is closed and inlet port 32 communicates with first outlet port 33, and a second position (Figure 6), in which first outlet port 33 is closed and inlet port 32 communicates with second outlet port 35. Cooler gas admission duct 34 and cooler gas return duct 37 open onto a front surface of flange 14 to form a gas inlet chamber 40 and a gas outlet chamber 41 (Figure 3).

[0021] The position of flap 38 is controllable by means of vacuum-operated actuator 7 (Figure 1), having an axially reciprocating actuating rod 42 that is coupled to pivot 39 of the valve flap 38 by means of a link 43 having one end rigidly connected to pivot 39 and one end articulated to rod 42.

[0022] Referring now to Figures 2, 3 and 9, member 5 internally defines a cooing circuit including a main cooling cavity 46 which communicates with coolant inlet aperture 12 and extends adjacent to base flange 10 beside the EGR valve chamber 20 and below bypass valve chamber 31 (Figure 3), so as to provide optimized cooling to both chambers. Cooling cavity 46 is a blind cavity whose inlet 47 is closed, in use, by a cover 48 (only partially shown in Figure 3). Inlet 47 has thus no function but to allow cavity 46 to be obtained by introducing a movable core during casting.

[0023] Cooling cavity 46 serves as a coolant distribution chamber and communicates with a plurality of ducts provided within member 5, namely a cooler admission duct 49 ending with an opening 50 on first lateral flange 14 and a thermostat inlet duct 51 ending into a thermostat chamber 52. Thermostat chamber 52 opens onto lateral flange 15 to receive thermostat valve 9, as hereinafter explained. It is to be noted that ducts 49 and 51 significantly contribute to refrigerating member 5 and, therefore, EGR valve 2 and bypass valve 4.

[0024] EGR cooler (Figures 5 to 7) includes a housing 53 laterally delimiting a cooling chamber 54 that is closed at both ends by a first and second head plates 55, 56 supporting internal tubes collectively referenced 57. First head plate 55 also has a circular coolant inlet opening 58 communicating with cooling chamber 54. Internal tubes 57 have their opposite ends engaging respective bores 59 in head plates 54, 55 and are sealingly brazed therein. Internal tubes 57 form two different sets 57a, 57b; tubes 57a face gas inlet chamber 40, tubes 57b face gas outlet chamber 41. EGR cooler also includes an end cup member 60 which is peripherally brazed to head plate 55 so as to form a distribution chamber 61 connecting tubers 57a to tubes 57b.

[0025] EGR cooler 3 includes a mounting flange 62 which surrounds housing 53 at head plate 55, and is adapted to be mounted to first lateral flange 14, with an interposed gasket not shown, so that coolant inlet open-

ing 58 is connected to cooler admission duct 49, tubes 57a are connected to gas inlet chamber 40, and tubes 57b are connected to gas outlet chamber 41.

[0026] Finally, EGR cooler 3 includes two coolant outlets 65, 66 provided on housing 53 and adapted to be connected to external devices using engine coolant, such as an oil cooler and a cabin heater (both not shown). Coolant outlets 65, 66 conveniently include quick connectors, rather than conventional spigots, so as to provide the utmost packaging flexibility. The same module can thus be used in different applications, as layout differences are dealt with by connecting pipes.

[0027] Figure 8 shows subassembly 16 in greater detail. Subassembly 16 includes a single-piece plastics body 67 forming vacuum tank 8 and a coolant outlet pipe 68 adapted to be connected to the vehicle radiator. Subassembly 16 includes a mounting flange 69 surrounding an inlet 70 (Figure 8) of the outlet pipe 68; thermostat valve 9, per se known and not described in detail, includes a control assembly 71 which is pre-assembled onto the mounting flange 69 in a cantilever fashion, so as to be housed into thermostat chamber 52 when the subassembly is mounted onto second lateral flange 15 of member 5.

[0028] Control assembly includes a shutter 72 cooperating with inlet 70 to define a variable port. Shutter 72 is balanced between a closure force exerted by a biasing spring 73 and an opening force exerted by a heat-sensitive linear actuator 74, e.g. a wax actuator.

[0029] Operation of module 1 is as follows.

[0030] Coolant enters module 1 through inlet aperture 12 and reaches main cooling chamber 46. It is to be noted that chamber 46 receives the whole flow rate of coolant exiting from the engine. Therefore, member 25 is cooled efficiently.

[0031] Coolant is splitted into two flows: a first flow is routed via duct 49 to refrigerating chamber 54 of cooler 3, and hence to coolant outlets 65, 66.

[0032] The other portion of flow is routed via duct 51 to thermostat chamber 52. Flow rate to outlet pipe 68, and thus to the vehicle radiator, is controlled by thermostat valve 9.

[0033] EGR gas enter module 1 through gas inlet aperture 13. Gas flow is controlled by EGR valve 2, that is located on the "hot side", i.e. upstream, of the EGR cooler 3. Flow rate is controlled as a function of engine operating parameters.

[0034] Past EGR valve 3, gases flow along valve outlet passage 21 and arrive to bypass valve 4. Depending on the engine operative conditions, EGR gases are either routed to EGR cooler 3 or to gas exit duct 36 directly, thus bypassing EGR cooler 3.

[0035] In the first case gases flow through tubes 57a, distribution chamber 61, tubes 57b, gas cooler return 37 and gas exit duct 36, which in use is connected to engine air intake system (not shown).

[0036] An analysis of module 1 reveals the advantages brought by the present invention.

[0037] First of all, the module includes a stand-alone EGR valve 2 that is mounted directly within member 5, i.e. without a casing of its own. This allows valve 2 to be cooled very efficiently and thus to be located on the hot side of EGR cooler. Positioning EGR valve 2 on the hot side of the cooler, when the engine layout so permits, allows module 5 to be more compact with respect to the prior art, and thus cheaper. Also, since EGR valve is subjected to hotter gases, the risk of sticking due to fouling with residual combustion products is reduced.

[0038] Integrated subassembly 16, including vacuum tank 8, coolant outlet tube 68 and thermostat valve 9, contributes to reducing assembly costs and to making the module more compact and cheaper.

[0039] The use of quick connectors at coolant outlets 65, 66 makes module 1 more flexible and adaptable to different configurations of the engine by "personalizing" the coolant connecting pipes.

[0040] Figure 10 discloses a different embodiment of EGR cooler 103, that is described hereinafter using the same numerals as for cooler 3 to reference like parts. In cooler 103, head plate 56 is obtained in a single piece together with lateral housing 53. At the opposite end of the cooler, housing 53 integrally includes an outwardly bent planar flange 104, onto which head plate 55 is brazed. Housing 53 also has a lateral bulge 105 adjacent to flange 104. Head plate 55 is stamped so as to form a short inlet sleeve 106 that is axially aligned with bulge 105; in this manner, coolant inlet does not subtract any useful volume inside cooling chamber 54, that can therefore be totally occupied by internal tubes 57. Sleeve 106 sealingly engages an OR sealing 107 provided within opening 50 of flange 14.

[0041] Flange 62 surrounds housing 53 and backs flange 104 on the side opposite to flange 104 to increase the mechanical strength of the coupling; in this manner, there is no contact between flange 62 and member 5 and flange 62 can be made of carbon steel or aluminium or sintered material, rather than stainless steel, and thus be cheaper. To allow flange 62 to be mounted without interfering with outlets 65, 66, flange 62 can be made in two parts connected to one another by means of dovetail joints 108.

[0042] Tubes 57a, 57b, end cup member 60 and coolant outlets 65, 66 are identical to corresponding parts described with reference to cooler 3.

[0043] Cooler 103, that is particularly compact and efficient, can obviously be used in any different applications requiring a double-pass cooler.

[0044] Clearly, variants and modifications can be brought to the module as herein described without departing from the scope of the claims.

[0045] In particular, the EGR valve actuator can be of any type and can be assembled differently onto interface member 5. Furthermore, the bypass valve actuator can be of any type other than a vacuum-operated actuator, e.g. an electrical actuator or a pressure-operated actuator.

Claims

1. An EGR/cooling integrated module (1) for an IC engine including an interface member (5) adapted to be mounted to the engine, and further including an EGR valve (2), an EGR cooler (3) and a bypass valve (4) carried and interconnected by the interface member (5), wherein

   • the interface member (5) includes a coolant inlet aperture (12) and an EGR gas inlet aperture (13) adapted to be connected directly to corresponding ports of said engine upon assembling said module (1) to said engine,
   • the EGR valve (2) is located on the hot side of the EGR cooler (3) and that the interface member (5) defines a housing of said EGR valve (2) and a cooling circuit (46, 49, 51) for cooling said EGR valve (2),
   • the EGR valve (2) is housed in a cavity (17) of said interface member (5), and includes a shutter (22) and a valve seat (27) provided in said cavity (17) between a valve chamber (20) defined by said cavity (17) and the EGR gas inlet (13),
   • said cooling circuit (46, 49, 51) includes a cooling cavity (46) provided within said interface member (5) and communicating with the coolant inlet aperture (12), in such a way that the cooling cavity (46) receives the whole flow rate of coolant exiting from the engine, said cooling cavity (46) being adjacent to said EGR valve (2),
   • said bypass valve (4) includes a bypass valve chamber (31) having an inlet port (32) connected to said EGR valve chamber (20) via an EGR valve outlet passage (21), a first outlet port (33) communicating with a cooler gas admission duct (34) and a second outlet port (35) communicating with a gas exit duct (36) and as well as with a cooler gas return duct (37); said bypass valve chamber (31), EGR valve outlet passage (21), cooler gas admission duct (34), gas exit duct (36) and cooler gas return duct (37) being provided within said interface member (5); and, wherein the cooling cavity (46) is adapted for cooling the EGR valve chamber (20) and the bypass valve chamber (31).

2. A module as claimed in claim 1, **characterised in that** said cavity (17) of said interface member (5) forms a spring chamber (28) separated from said valve chamber (20) by an intermediate shoulder (26); said EGR valve (2) including a stem (23) rigidly connected to said shutter (22), and a spring (24) located inside said spring chamber (28) and acting between said shoulder (26) and a stop member (25) fixed to the stem (23) so as to bias said shutter (22) against said valve seat (27).

3. A module as claimed in claim 2, **characterised in that** said spring chamber (28) is formed within a tubular housing (18) integrally protruding from said interface member (5), said cavity (17) of said interface member (5) being constituted by a through cavity extending through said interface member (5) and said tubular housing (18).

4. A module as claimed in claim 3, **characterised in that** said interface member (5) includes a first duct (49) connecting said cooling cavity (46) to said EGR cooler (3) and a second duct (51) connecting said cooling cavity (46) to a coolant exit (68).

5. A module as claimed in any of the preceding claims, **characterised by** including a subassembly (16) including a vacuum tank (8) for a vacuum-operated bypass valve actuator (7) and a thermostat valve (9).

6. A module as claimed in claim 4 and 5, **characterised in that** said subassembly (16) includes a coolant outlet pipe (68) formed in a single piece with said vacuum tank (8) and defining said coolant exit.

7. A module as claimed in claim 6, **characterised in that** said subassembly (16) includes a connecting flange (69) for connection with said interface member (5), said thermostat valve (9) being carried by said connecting flange (69) and including a shutter (72) cooperating with an inlet (70) of said coolant outlet pipe (68) formed in said connecting flange (69), said thermostat valve (9) extending within a thermostat chamber (52) defined by said second duct (51).

8. A module as claimed in any of the preceding claims, **characterised in that** said EGR cooler (3) is a double-pass cooler.

9. A module as claimed in any of the preceding claims, **characterised in that** said EGR cooler includes at least a coolant exit (65, 66) for connection with an external device.

10. A module as claimed in claim 9, **characterised in that** said coolant exit (65, 66) includes a quick coupling.

11. A module as claimed in any of claims 8 to 10, **characterised in that** said EGR cooler (3) includes an outer housing (53) defining a cooling chamber (54), a first and second head plates (55, 56) and a plurality of internal tubes (57) fixed to said head plates (55, 56), said outer housing (53) defining integrally said first head plate (56) and a connecting flange (104) for connection with said second head plate (55), said second head plate (55) being interposed between said connecting flange (105) and said interface

member (5).

12. A module as claimed in claim 11, **characterised in that** said EGR cooler (3) includes a backing flange (62) axially contacting said connecting flange (104) on the side opposite to said second head plate (55).

13. A module as claimed in claim 11, **characterised in that** said housing (53) formed a lateral bulge (105), and that said first head plate (55) forms a coolant inlet sleeve (106) axially facing said bulge (105).

Patentansprüche

1. Integriertes AGR/Kühl-Modul (1) für einen Verbrennungsmotor, das ein Schnittstellenelement (5) enthält, das zur Anbringung an dem Motor eingerichtet ist, und das des Weiteren ein AGR-Ventil (2), einen AGR-Kühler (3) sowie ein Umgehungs-Ventil (4) enthält, die von dem Schnittstellenelement (5) getragen werden und über dieses miteinander verbunden sind, wobei

• das Schnittstellenelement (5) eine Kühlmittel-Einlassöffnung (12) sowie eine AGR-Gas-Einlassöffnung (13) enthält, die so eingerichtet sind, dass sie nach dem Anbringen des Moduls (1) an dem Motor direkt mit entsprechenden Anschlüssen des Motors verbunden sind,
• sich das AGR-Ventil (2) an der Heißgasseite des EGR-Kühlers (3) befindet und das Schnittstellenelement (5) ein Gehäuse des AGR-Ventils (2) sowie einen Kühlkreis (46, 49, 51) zum Kühlen des AGR-Ventils (2) bildet,
• das AGR-Ventil (2) in einem Hohlraum (17) des Schnittstellenelementes (5) aufgenommen ist und einen Verschluss (22) sowie einen Ventilsitz (27) enthält, die in dem Hohlraum (17) zwischen einer durch den Hohlraum (17) gebildeten Ventilkammer (20) und dem AGR-Gas-Einlass (13) vorhanden sind,
• der Kühlkreis (46, 49, 51) einen Kühl-Hohlraum (46) enthält, der im Inneren des Schnittstellenelementes (5) vorhanden ist und so mit der Kühlmittel-Einlassöffnung (12) in Verbindung steht, dass der Kühl-Hohlraum (46) den gesamten Durchfluss von Kühlmittel aufnimmt, das aus dem Motor austritt, wobei der Kühl-Hohlraum (46) an das AGR-Ventil (2) angrenzt,
• das Umgehungs-Ventil (4) eine Umgehungs-Ventilkammer, (31) enthält, die einen Einlassanschluss (32), der mit der AGR-Ventilkammer (20) über einen AGR-Ventil-Auslasskanal (21) verbunden ist, einen ersten Auslassanschluss (33), der in Verbindung mit einer Kühler-Gaseintrittsleitung(34) steht, sowie einen zweiten Auslassanschluss (35) aufweist, der mit einer Gasaustrittsleitung (36) sowie mit einer Kühler-Gasrückführleitung (37) in Verbindung steht, wobei die Umgehungs-Ventilkammer (31), der AGR-Ventil-Auslasskanal (21), die Kühler-Gaseintrittsleitung (34), die Gasaustrittsleitung (36) und die Kühler-Gasrückführleitung (37) im Inneren des Schnittstellenelementes (5) vorhanden sind und der Kühl-Hohlraum (46) zum Kühlen der AGR-Ventilkammer (20) und der Umgehungs-Ventilkammer (31) eingerichtet ist.

2. Modul nach Anspruch 1, **dadurch gekennzeichnet, dass** der Hohlraum (17) des Schnittstellenelementes (5) eine Feder-Kammer (28) bildet, die von der VentilKammer (20) durch einen Zwischenabsatz (26) getrennt ist, wobei das AGR-Ventil (2) einen Schaft (23), der starr mit dem Verschluss (22) verbunden ist, sowie eine Feder (24) enthält, die sich im Inneren der Feder-Kammer (28) befindet und zwischen dem Absatz (26) und einem an dem Schaft (23) befestigten Anschlagelement (25) wirkt, um so den Verschluss (22) an den Ventilsitz (27) zu spannen.

3. Modul nach Anspruch 2, **dadurch gekennzeichnet, dass** die Feder-Kammer (28) im Inneren eines röhrenförmigen Gehäuses (18) ausgebildet ist, das integral von dem Schnittstellenelement (5) vorsteht, und der Hohlraum (17) des Schnittstellenelementes (5) von einem durchgehenden Hohlraum gebildet wird, der sich durch das Schnittstellenelement (5) und das röhrenförmige Gehäuse (18) hindurch erstreckt.

4. Modul nach Anspruch 3, **dadurch gekennzeichnet, dass** das Schnittstellenelement (5) eine erste Leitung (49), die den Kühl-Hohlraum (46) mit dem AGR-Kühler (3) verbindet, sowie eine zweite Leitung (51) enthält, die den Kühl-Hohlraum (46) mit einem Kühlmittel-Austritt (68) verbindet.

5. Modul nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** es eine Teilbaugruppe (16) enthält, die einen Vakuumbehälter (8) für ein vakuumbetriebenes Umgehungs-Ventil-Betätigungselement (7) und ein Thermostat-Ventil (9) enthält.

6. Modul nach Anspruch 4 und 5, **dadurch gekennzeichnet, dass** die Teilbaugruppe (16) ein Kühlmittel-Auslassrohr (68) enthält, das aus einem Stück mit dem Vakuumbehälter (8) ausgebildet ist und den Kühlmittel-Austritt bildet.

7. Modul nach Anspruch 6, **dadurch gekennzeichnet, dass** die Teilbaugruppe (16) einen Verbindungsflansch (69) zur Verbindung mit dem Schnittstellenelement (5) enthält, wobei das Thermostat-Ventil (9)

von dem Verbindungsflansch (69) getragen wird und einen Verschluss (72) enthält, der mit einem Einlass (70) des Kühlmittel-Auslassrohrs (68) zusammenwirkt, der in dem Verbindungsflansch (69) ausgebildet ist, und sich das Thermostat-Ventil (69) im Inneren einer Thermostat-Kammer (52) erstreckt, die durch die zweite Leitung (51) gebildet wird.

8. Modul nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der AGR-Kühler (3) ein Kühler mit zweifachem Durchlauf ist.

9. Modul nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der AGR-Kühler wenigstens einen Kühlmittel-Austritt (65, 66) zur Verbindung mit einer externen Einrichtung enthält.

10. Modul nach Anspruch 9, **dadurch gekennzeichnet, dass** der Kühlmittel-Austritt (65, 66) eine Schnellkupplung enthält.

11. Modul nach einem der Ansprüche 8 bis 10, **dadurch gekennzeichnet, dass** der AGR-Kühler (3) ein äußeres Gehäuse (53), das eine Kühlkammer (54) bildet, eine erste und eine zweite Kopfplatte (55, 56) sowie eine Vielzahl innerer Röhren (57) enthält, die an den Kopfplatten (55, 56) befestigt sind, das äußere Gehäuse (53) integral die erste Kopfplatte (56) sowie einen Verbindungsflansch (104) zur Verbindung mit der zweiten Kopfplatte (55) bildet und die zweite Kopfplatte (55) zwischen dem Verbindungsflansch (105) und dem Schnittstellenelement (5) angeordnet ist.

12. Modul nach Anspruch 11, **dadurch gekennzeichnet, dass** der AGR-Kühler (3) einen Trageflansch (62) enthält, der mit dem Verbindungsflansch (104) an der der zweiten Kopfplatte (55) gegenüberliegenden Seite axial in Kontakt ist.

13. Modul nach Anspruch 11, **dadurch gekennzeichnet, dass** das Gehäuse (53) eine seitliche Auswölbung (105) bildet und dass die erste Kopfplatte (55) eine Kühlmittel-Einlassmuffe (106) bildet, die der Aufwölbung (105) axial zugewandt ist.

Revendications

1. Module intégré d'EGR/refroidissement (1) pour un moteur IC comprenant un élément d'interface (5) adapté de façon à être monté sur le moteur, et comprenant en outre une soupape EGR (2), un dispositif de refroidissement EGR (3) et une soupape de dérivation (4) supportée et interconnectée par l'élément d'interface (5), dans lequel :

- l'élément d'interface (5) comprend une ouverture d'entrée de fluide de refroidissement (12) et une ouverture d'entrée des gaz EGR (13) adaptées de façon à être connectées directement à des orifices correspondants dudit moteur lors de l'assemblage dudit module (1) sur le moteur ;
- la soupape EGR (2) se situe du côté chaud du dispositif de refroidissement EGR (3) et l'élément d'interface (5) définit un logement de ladite soupape EGR (2) et un circuit de refroidissement (46, 49, 51) destiné à refroidir ladite soupape EGR (2) ;
- la soupape EGR (2) est logée dans une cavité (17) dudit élément d'interface (5), et comprend un volet (22) et un siège de soupape (27) disposés dans ladite cavité (17) entre une chambre de soupape (20) définie par ladite cavité (17) et l'entrée des gaz EGR (13) ;
- ledit circuit de refroidissement (46, 49, 51) comprend une cavité de refroidissement (46) disposée à l'intérieur dudit élément d'interface (5) et en communication avec l'ouverture d'entrée de fluide de refroidissement (12), de telle manière que la cavité de refroidissement (46) reçoive la totalité du débit de fluide de refroidissement qui sort du moteur, ladite cavité de refroidissement (46) étant adjacente à ladite soupape EGR (2) ;
- ladite soupape de dérivation (4) comprend une chambre de soupape de dérivation (31) qui présente un orifice d'entrée (32) connecté à ladite chambre de soupape EGR (20) par l'intermédiaire d'un passage de sortie de soupape EGR (21), un premier orifice de sortie (33) en communication avec un conduit d'admission des gaz du dispositif de refroidissement (34) et un second orifice de sortie (35) en communication avec un conduit de sortie des gaz (36) et aussi avec un conduit de retour des gaz du dispositif de refroidissement (37) ; ladite chambre de soupape de dérivation (31), ledit passage de sortie de soupape EGR (21), ledit conduit d'admission des gaz du dispositif de refroidissement (34), ledit conduit de sortie des gaz (36) et ledit conduit de retour des gaz du dispositif de refroidissement (37) étant disposés à l'intérieur dudit élément d'interface (5) ; et, dans lequel la cavité de refroidissement (46) est adaptée de façon à refroidir la chambre de soupape EGR (20) et la chambre de soupape de dérivation (31).

2. Module selon la revendication 1, **caractérisé en ce que** ladite cavité (17) dudit élément d'interface (5) forme une chambre à ressort (28) séparée de ladite chambre de soupape (20) par un épaulement intermédiaire (26) ; ladite soupape EGR (2) comprenant une tige (23) connectée de manière rigide audit volet (22), et un ressort (24) qui se situe à l'intérieur de ladite chambre à ressort (28) et qui agit entre ledit

épaulement (26) et un élément d'arrêt (25) fixé sur la tige (23) de façon à solliciter ledit volet (22) contre ledit siège de soupape (27).

3. Module selon la revendication 2, **caractérisé en ce que** ladite chambre à ressort (28) est formée à l'intérieur d'un logement tubulaire (18) qui fait saillie d'une pièce à partir dudit élément d'interface (5), ladite cavité (17) dudit élément d'interface (5) étant constituée par une cavité traversante qui s'étend à travers ledit élément d'interface (5) et ledit logement tubulaire (18).

4. Module selon la revendication 3, **caractérisé en ce que** ledit élément d'interface (5) comprend un premier conduit (49) qui relie ladite cavité de refroidissement (46) audit dispositif de refroidissement EGR (3), et un second conduit (51) qui relie ladite cavité de refroidissement (46) à une sortie du fluide de refroidissement (68).

5. Module selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**il comprend un sous-ensemble (16) qui comprend un réservoir à vide (8) destiné à un actionneur de soupape de dérivation actionnée par dépression (7) et une soupape de thermostat (9).

6. Module selon la revendication 4 et la revendication 5, **caractérisé en ce que** ledit sous-ensemble (16) comprend un tube de sortie de fluide de refroidissement (68) formé d'une seule pièce avec ledit réservoir à vide (8) et qui définit ladite sortie de fluide de refroidissement.

7. Module selon la revendication 6, **caractérisé en ce que** ledit sous-ensemble (16) comprend une bride de connexion (69) destinée à une connexion avec ledit élément d'interface (5), ladite soupape de thermostat (9) étant portée par ladite bride de connexion (69) et comprenant un volet (72) qui coopère avec une entrée (70) dudit tube de sortie de fluide de refroidissement (68) formé dans ladite bride de connexion (69), ladite soupape de thermostat (9) s'étendant à l'intérieur d'une chambre de thermostat (52) définie par ledit second conduit (51).

8. Module selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit dispositif de refroidissement EGR (3) est un dispositif de refroidissement à double passage.

9. Module selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit dispositif de refroidissement EGR comprend au moins une sortie de fluide de refroidissement (65, 66) destinée à être connectée à un dispositif extérieur.

10. Module selon la revendication 9, **caractérisé en ce que** ladite sortie de fluide de refroidissement (65, 66) comprend un raccord rapide.

11. Module selon l'une quelconque des revendications 8 à 10, **caractérisé en ce que** ledit dispositif de refroidissement EGR (3) comprend un logement extérieur (53) qui définit une chambre de refroidissement (54), des première et seconde plaques frontales (55, 56) et une pluralité de tubes intérieurs (57) fixés sur lesdites plaques frontales (55, 56), ledit logement extérieur (53) définissant d'une pièce ladite première plaque frontale (56) et une bride de connexion (104) destinée à une connexion avec ladite seconde plaque frontale (55), ladite seconde plaque frontale (55) étant interposée entre ladite bride de connexion (105) et ledit élément d'interface (5).

12. Module selon la revendication 11, **caractérisé en ce que** ledit dispositif de refroidissement EGR (3) comprend une bride de support (62) qui entre en contact de manière axiale avec ladite bride de connexion (104) sur le côté opposé à ladite seconde plaque frontale (55).

13. Module selon la revendication 11, **caractérisé en ce que** ledit logement (53) forme un renflement latéral (105), et **en ce que** ladite première plaque frontale (55) forme un manchon d'entrée de fluide de refroidissement (106) qui fait face de manière axiale audit renflement (105).

FIG. 1

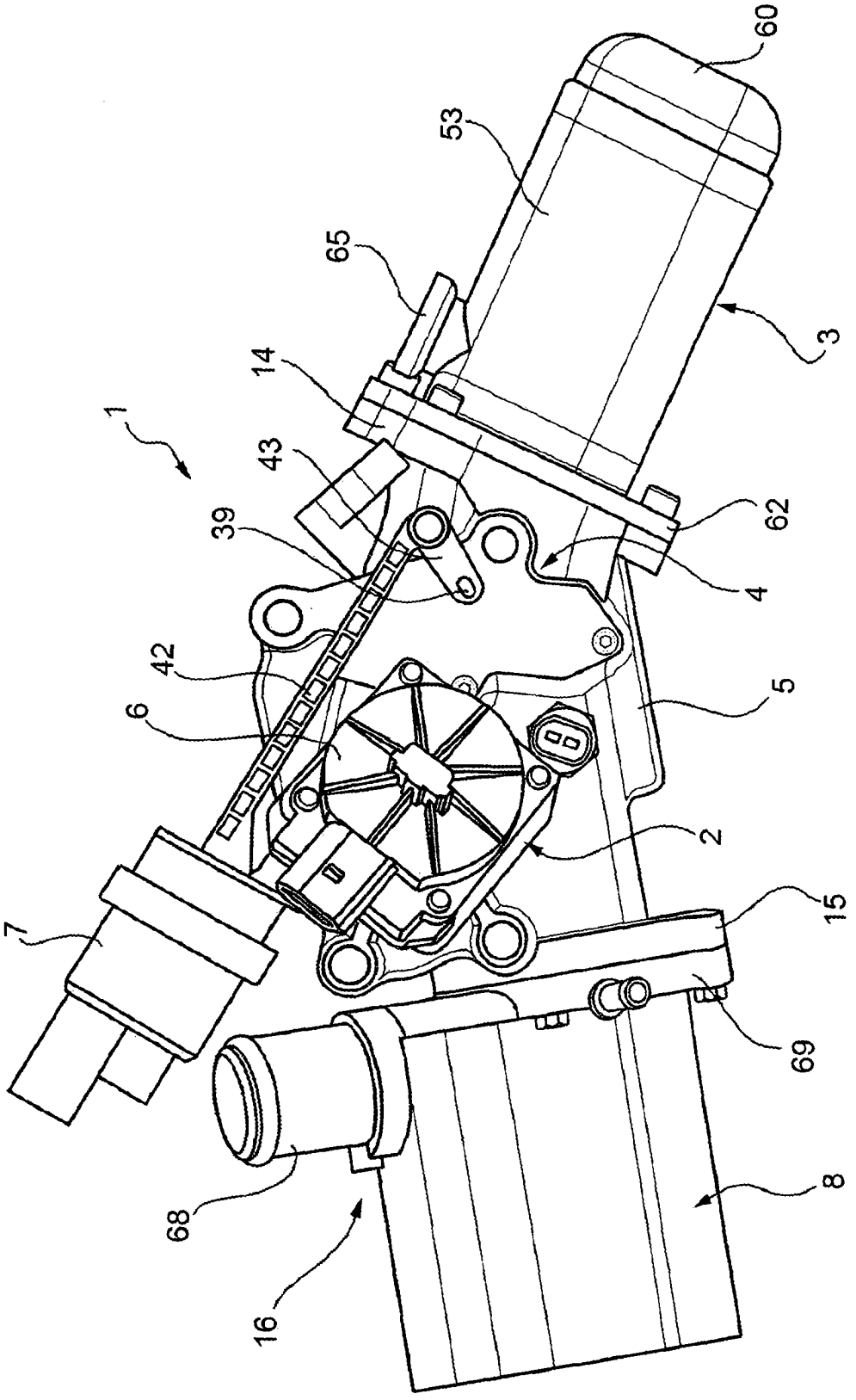


FIG. 2

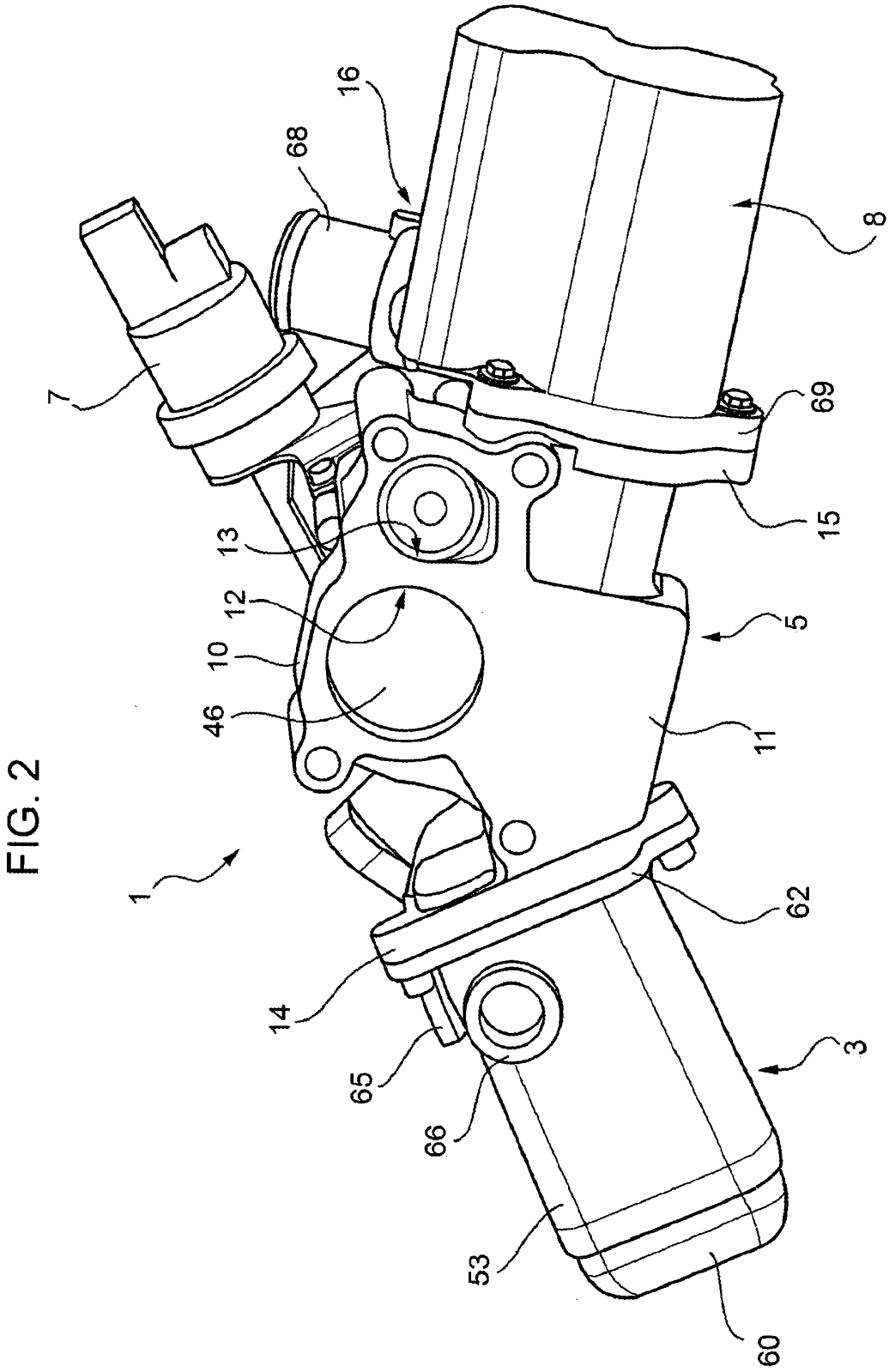


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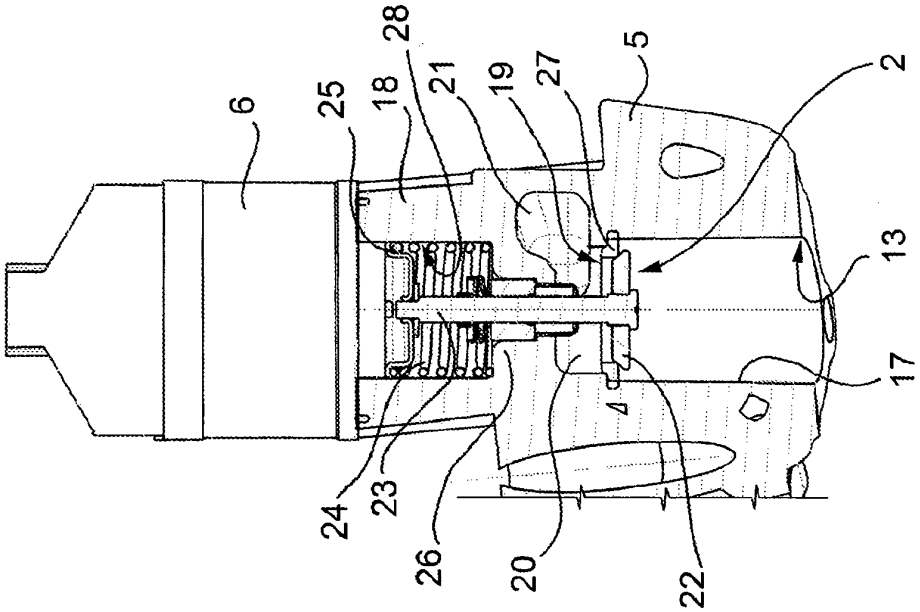

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FIG. 3

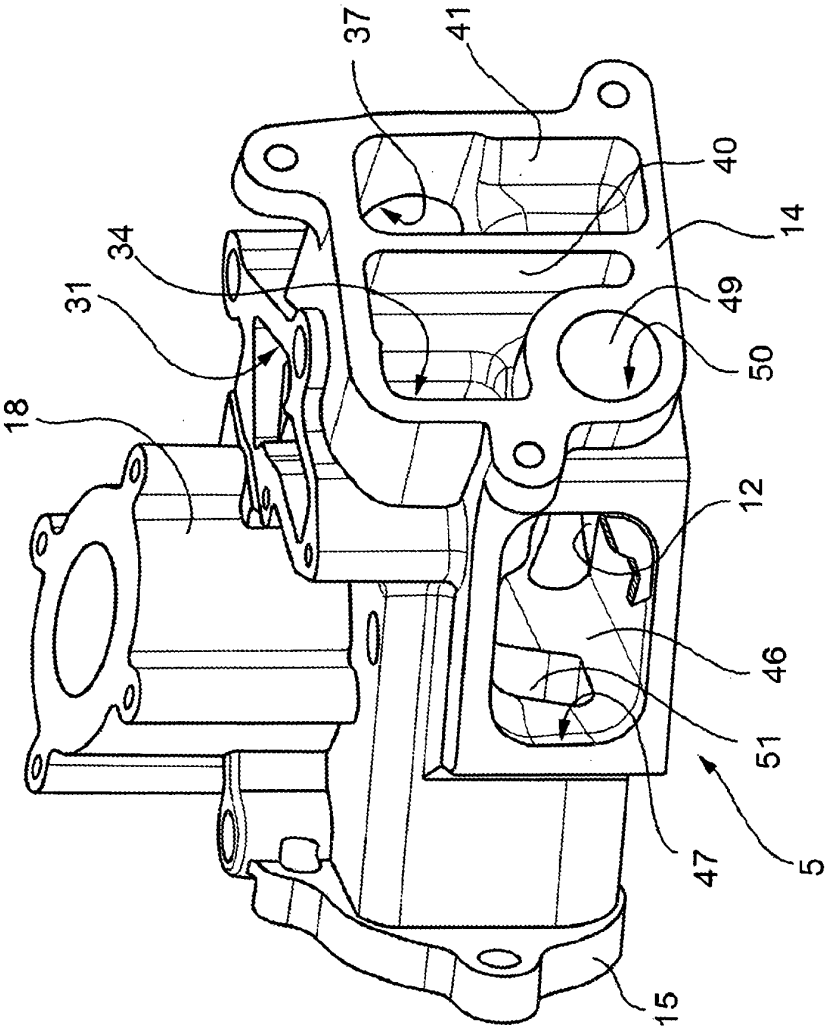

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FIG. 5

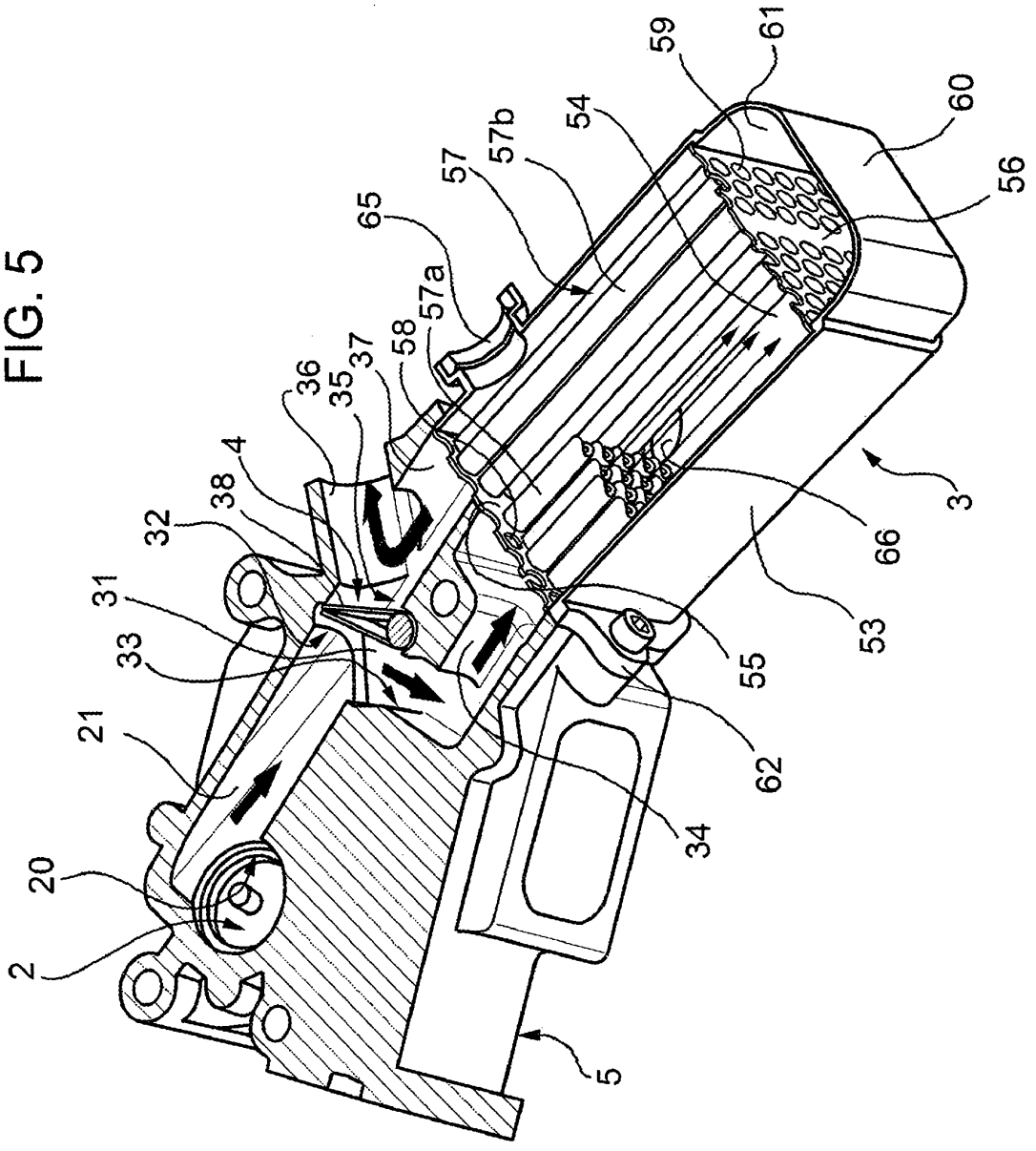

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FIG. 6

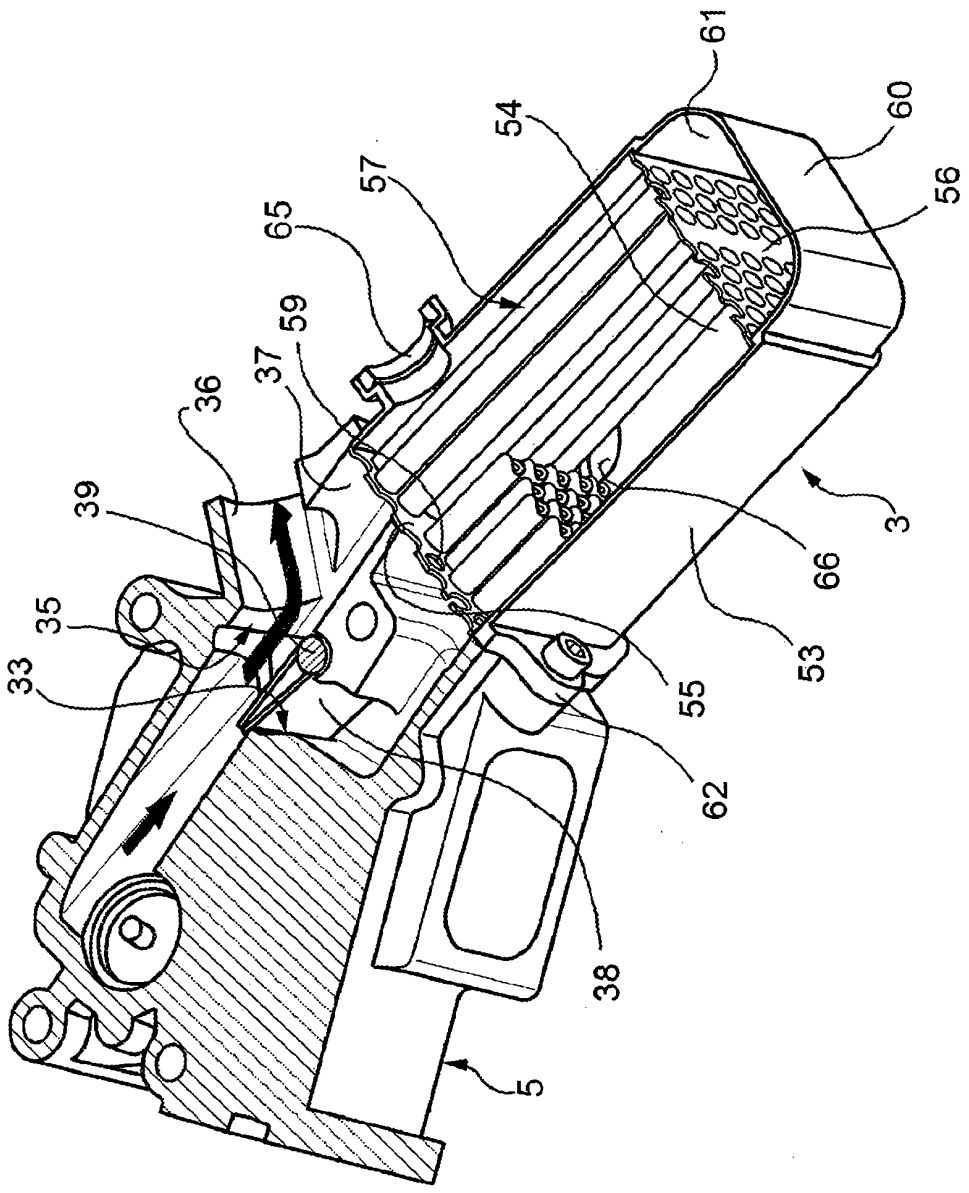


FIG. 7

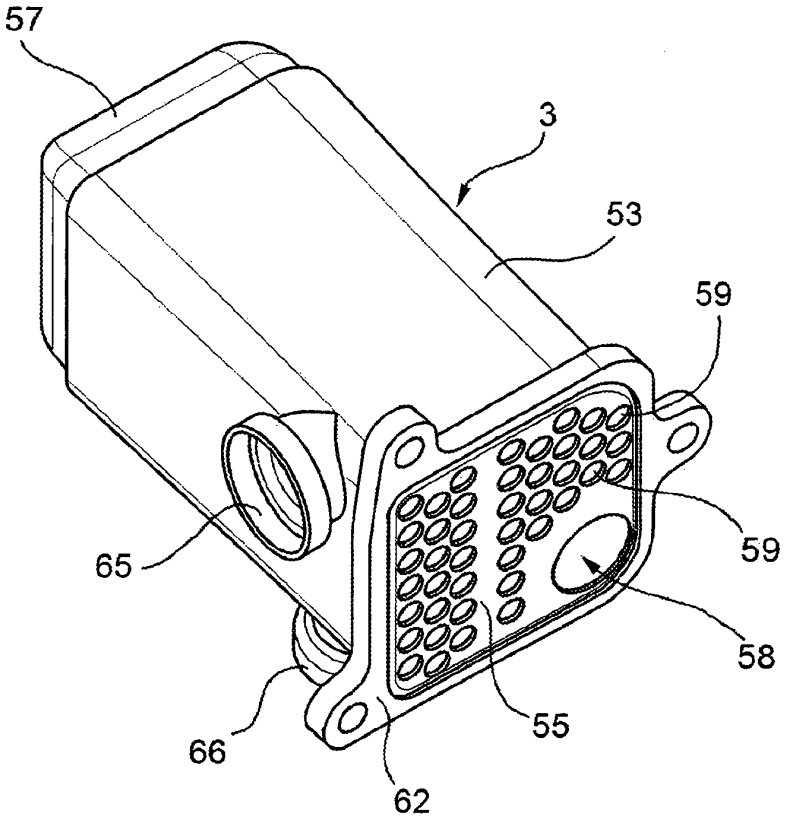


FIG. 8

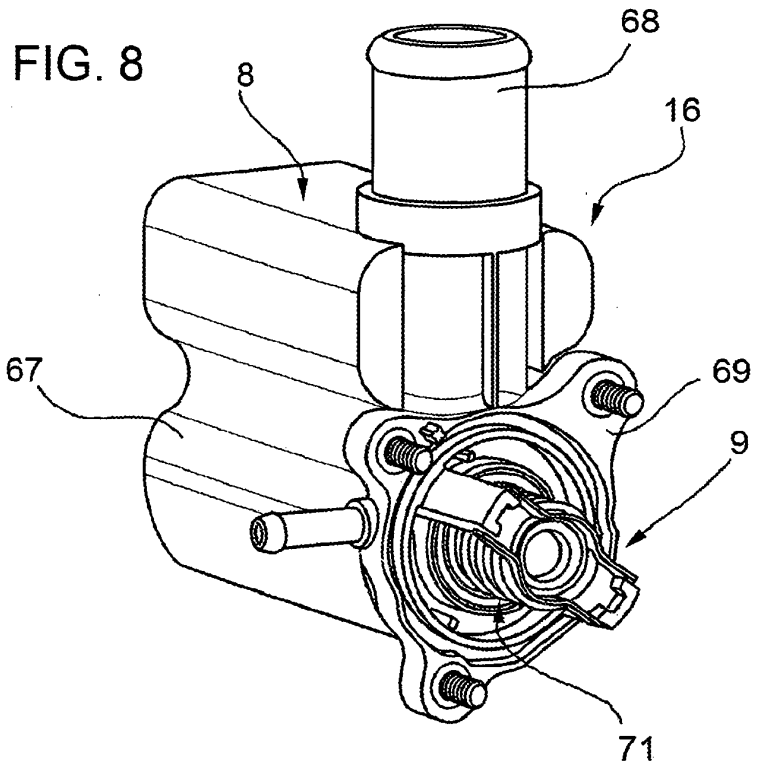


FIG. 9

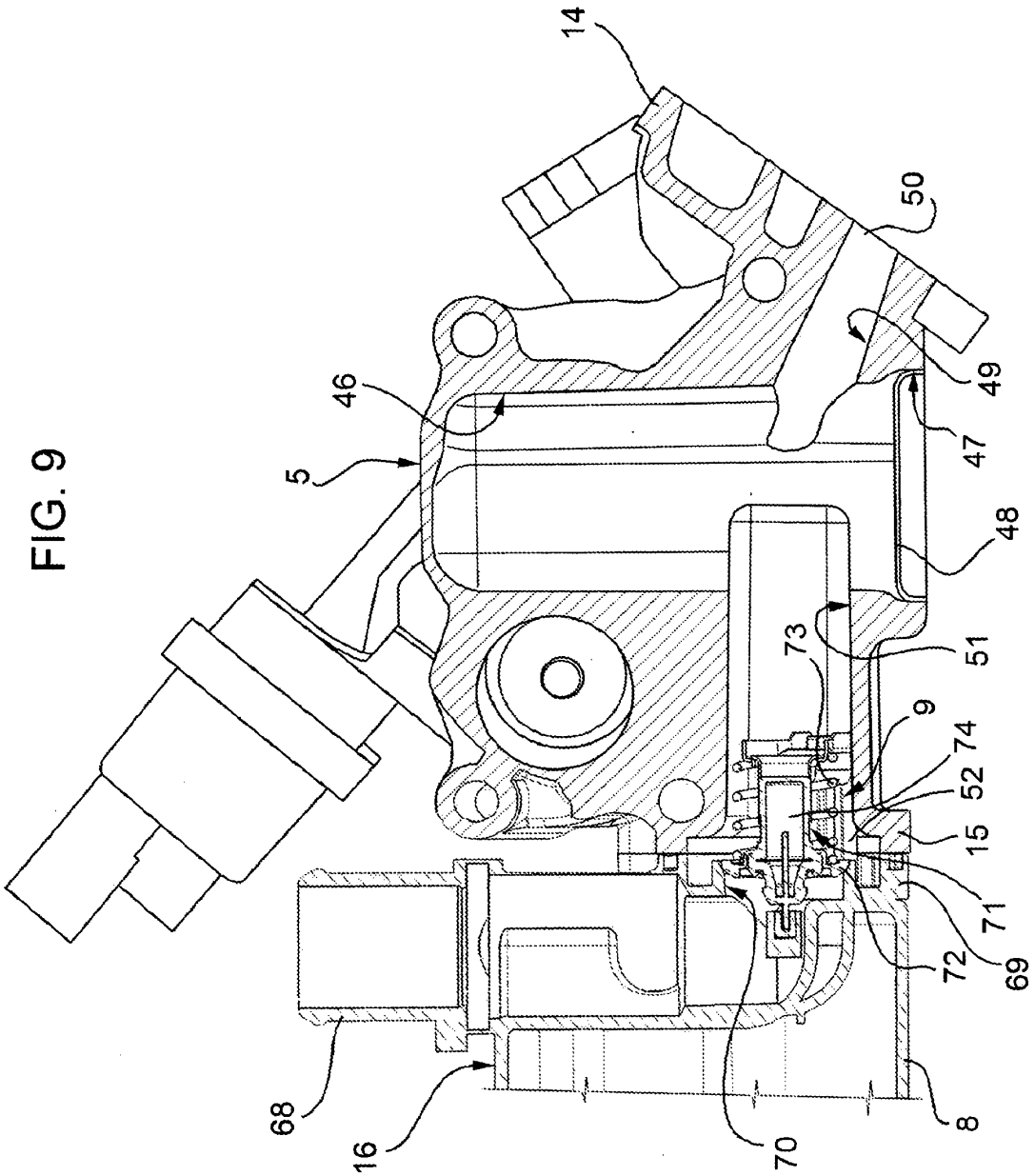


FIG. 10

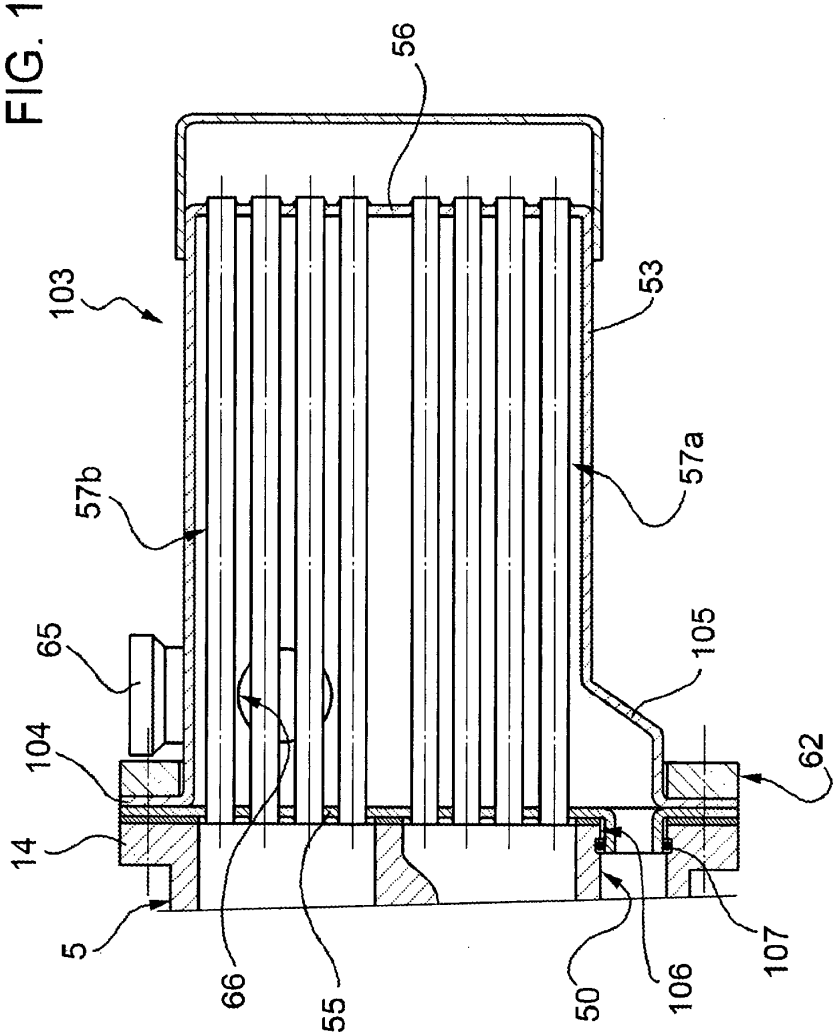
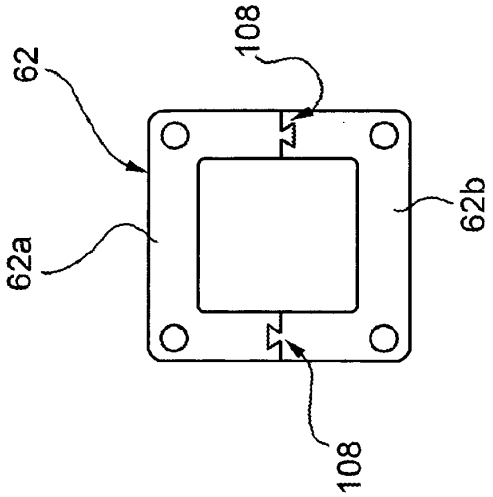

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103
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57b
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105
104
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107

FIG. 11


62
108
62a
62b
108

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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