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(54) Heat exchange device

(57) The present invention is a device for heat exchange particularly suitable for cooling recirculated gas in EGR (Exhaust Gas Recirculation) systems, with a constructive configuration incorporating the heat exchanger together with a bypass conduit and a bypass valve, where most of the parts forming said device allow manufacturing same in stamped sheet metal, thereby reducing manufacturing costs.

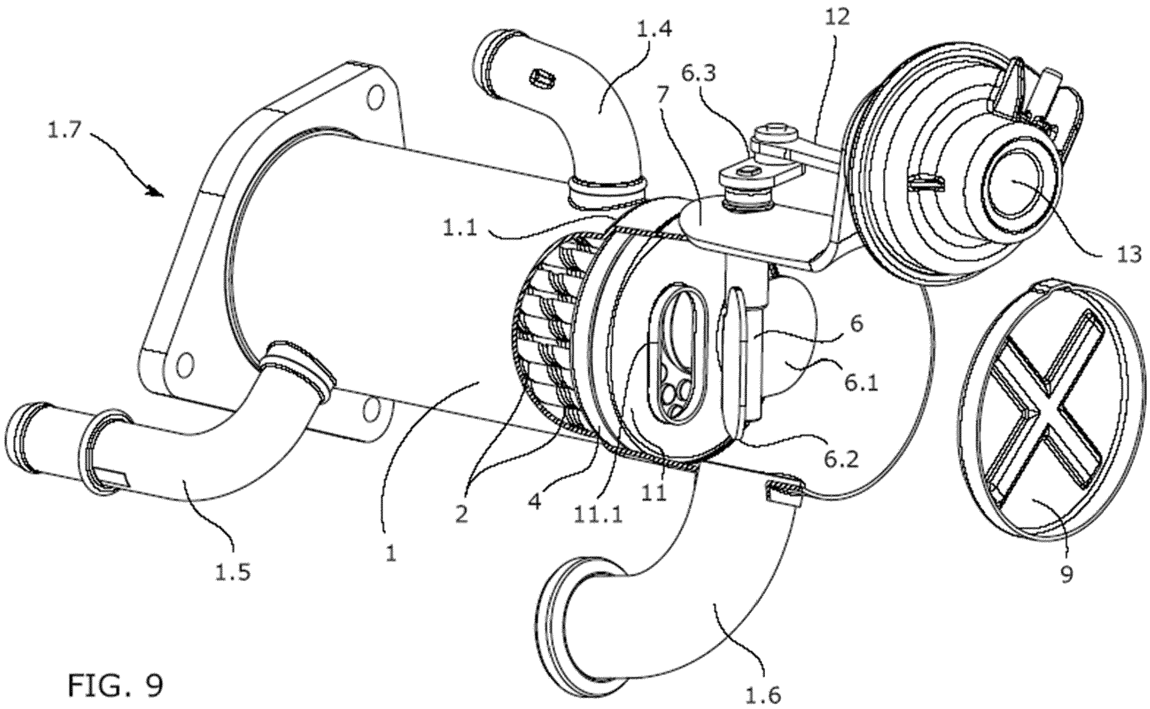

FIG. 9

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Description

Object of the Invention

[0001] The present invention is a device for heat exchange particularly suitable for cooling recirculated gas in EGR (Exhaust Gas Recirculation) systems, with a constructive configuration incorporating the heat exchanger together with a bypass conduit and a bypass valve, where most of the parts forming said device allow manufacturing same in stamped sheet metal, thereby reducing manufacturing costs.

Background of the Invention

[0002] Heat exchanger devices for EGR systems are devices intended for cooling recirculated gas originating from combustion in an internal combustion engine until it reaches a temperature suitable for being reintroduced into the intake. The reintroduction of recirculated gas reduces the amount of oxygen entering the combustion chamber, such that nitrogen oxide emission is reduced.

[0003] Cooling of exhaust gases is not suitable when the engine has just been started and the temperature thereof is too low. It is of interest for the engine and specific conduits to reach a specific temperature in the shortest time possible, since the existence of condensates causes very significant engine damage.

[0004] To prevent cooling of said exhaust gases in these conditions, the heat exchanger of the EGR system has a bypass conduit which is open depending on the position of a bypass valve. The exhaust gas goes through the bypass conduit without giving off its heat to the coolant circulating in the heat exchanger.

[0005] The configuration of this bypass valve usually has seats made on injected or molten metal parts, where these metal parts are machined to assure both the proper operation of the moving portions of the valve and the correct closure of the flap on the seats.

[0006] It is expensive to manufacture these metal parts obtained either by injection or by melting and subsequently assemble them compared to other types of techniques such as stamping. Nevertheless, stamping is also severely limited by the shapes that each of the stamped parts can adopt.

[0007] An object of the present invention is to provide a configuration of a heat exchanger with a bypass conduit and bypass valve, where most of the parts of the device allow manufacturing same in stamped sheet metal, reducing manufacturing costs.

Description of the Invention

[0008] The heat exchange device establishes exchange between a first fluid and a second fluid. In the preferred example, the first fluid is the gas to be cooled in an internal combustion engine with an EGR system for reintroduction into the intake manifold; and the second fluid is a coolant absorbing the heat given off by the gas. The heat exchanging device is intercalated between the conduit of the first fluid and the conduit of the second fluid existing in an internal combustion engine.

[0009] It is of particular interest to reduce manufacturing costs by establishing a configuration in which most of the parts of the exchanger can be manufactured in die cut and/or pressed sheet metal. The expression "can be manufactured" is used because although the invention establishes a particular configuration that allows the manufacture of part of the exchanger in sheet metal, some of the parts that allow said manufacture in sheet metal can be reproduced by means of injection or machining techniques, but this by itself does not mean that the invention is not being reproduced.

[0010] The heat exchanger comprises:

- *a sheet metal shell having a tubular configuration,*
- *a first sheet metal baffle and a second sheet metal baffle assembled in the sheet metal shell spaced from one another,*
- *a bundle of conduits extending along a longitudinal direction X-X' at least from the first baffle to the second baffle,*
- *a bypass conduit extending at least from the first baffle to the second baffle and it is parallel to the bundle of conduits.*

[0011] The tubular configuration of the shell must be interpreted in the most generic sense, where the section of the tubular body is the generatrix and the longitudinal direction is the directrix. By way of example, the tubular configuration of the sheet metal shell can be formed by two U-shaped stamped sheet metal bodies that are attached to one another giving rise to a tubular configuration having a square or rectangular section.

[0012] The same applies to use of the expression bundle of conduits. By way of example, the bundle of conduits can be formed as a bundle of tubes, a bundle of hybrid tubes, each of them having a flat or oval section, or each of them can also be obtained by stamping two half-portions which are subsequently attached to one another by brazing. The bundle of conduits can also be interpreted as a bundle formed by a stack of stamped metal sheets, being able to have exchange fins, giving rise to the bundle of conduits.

[0013] The second fluid, the coolant in the preferred example, flows through the inside of the shell in contact with the conduits of the bundle of conduits. The first fluid, the gas to be cooled in the preferred example, usually circulates through this bundle of conduits such that the surface of the conduits of the bundle of conduits is the exchange surface for transferring heat from the first fluid to the second fluid.

[0014] The bypass conduit is arranged parallel to the bundle of conduits. The bypass conduit is sized to allow the partial or complete passage of the first fluid, depending on the position of the flaps, preventing the complete or partial passage of said first fluid through the conduits of the bundle of conduits, and therefore preventing cooling thereof. When the bypass conduit has a large diameter, even if it is immersed in the second fluid or coolant, the ratio between the volume of circulating second fluid and the exchange surface with respect to said second fluid is high, so heat transfer is small, and although cooling occurs, the cost reduction resulting from the incomplete insulation of the bypass conduit can be justified considering the small heat transfer that has been indicated. From another point of view, the bypass conduit has a diameter that is much larger than the diameter of the conduits of the bundle of conduits, such that the ratio between the exchange surface and the flow is much lower in this case, giving rise to a much lower degree of heat transfer. Diverting gas flow through the bypass conduit involves drastically reducing the heat removed from the gas flow.

[0015] According to other embodiments, the bypass conduit is located inside another conduit or tube having a larger diameter, leaving a chamber therein which drastically reduces the heat transfer capacity between the first fluid and the second fluid.

- *a fluid communication inlet and a fluid communication outlet for the second fluid, both arranged in the sheet metal shell and giving access to the space located between the first baffle and the second baffle for cooling the bundle of tubes.*

[0016] This fluid communication allows circulating the second fluid through the exchanger discharging, in the various embodiments, the heat provided by the first fluid. The position in the shell of the fluid communication inlet and outlet for the second fluid is found at points located, according to the axial or longitudinal direction X-X', between the end baffles, i.e., the baffles between which the bundle of conduits and the bypass conduit extend. The second fluid is thus circulated through the inside of the space located in the shell, outside of both the conduits of the bundle of conduits and the bypass conduit, and between the baffles.

- *a first fluid communication inlet/outlet arranged at one of the ends of the bundle of conduits and of the bypass conduit, and a second fluid communication inlet/outlet arranged at the opposite end of the bundle of conduits and of the bypass conduit, both the fluid communication inlet/outlet giving access to the first fluid through the bundle of conduits, through the bypass conduit or through both.*

[0017] In most of the examples, the ends of the shell either incorporate manifolds configured as closure parts for closing the ends of the tubular shell which form a cavity, or they prolong the tubular body of the shell leaving a space to form an intermediate chamber. In this second case, in the embodiments that will be described below, the chamber is closed by an end cover. Both the closure parts and the covers are also stamped parts.

where the tubular sheet metal shell extends longitudinally beyond the second baffle giving rise to a chamber such that said chamber comprises a valve that can be actuated from outside the chamber and is adapted to at least close the bypass conduit, and where said valve comprises a shaft attached to the sheet metal shell and capable of rotating with respect to said shell, prolonging into the chamber where said shaft comprises a sheet metal flap adapted to sit on the perimetral edge of the end of the bypass conduit for closing same.

[0018] According to some embodiments, the tubular shell has one or more steps after which the tubular body has a larger diameter. These steps will also be identified in this description as expansions where the term expansion must be interpreted as a change in diameter. The change in diameter being from larger to smaller or vice versa, from smaller to larger, depends on the chosen direction. In all the examples, the use of the term expansion in reference to the step must be interpreted in the broadest sense indicated, i.e., a change in diameter that gives rise to a step formation. When the term diameter is used, it must be interpreted as a characteristic dimension, i.e., if the section is a circular section, it is clearly the diameter of the circumference and if the section is a square section or a section having any other configuration, it is possible to establish a dimension that considers the change of said section in the step formation.

[0019] According to one embodiment, this stepped shape is generated by stamping. The step allows housing one of the baffles, determining the position of the baffle inside the shell. The position thereof will be described in later examples. This solution is the preferred solution of the examples in which an intermediate chamber is defined from the baffle to the closure cover.

[0020] As indicated, according to some embodiments, said one or more steps give rise to a smaller diameter of the tubular body. The step allows quick assembly since it automatically establishes correct positioning of the parts that are fitted therein during assembly.

[0021] According to some embodiments, the tubular shell has the same diameter along its length, reducing shell manufacturing costs.

[0022] Use of the expression closure cover or manifold is primarily determined based on whether the stamping operation gives rise to a flat plate or whether the concavity generates an inner cavity, and therefore an intermediate chamber. The closure cover, the manifold or both are the closure means for closing the ends of the tubular shell.

[0023] The valve is also primarily manufactured in sheet metal. According to embodiments, the base is configured in sheet metal with the curvature of the outer surface of the shell. This base is preferably attached to the shell by brazing. Other brazing techniques such as laser brazing are other possible modes of operation in each of the possible embodiments of the invention. The support of the shaft of the valve emerges from the base, prolonging into the chamber. In the embodiments, the shaft is arranged in cantilever fashion, extending according to a transverse projection of the heat exchanger to one side of the end of the bypass conduit. The rotation of the shaft therefore gives rise to the movement of a flap integral with the shaft, such that in one of its positions, the flap sits on the perimetral edge of the end of the bypass conduit for closing same. In this closed position, the first fluid completely goes through the bundle of tubes, and in any other position, the passage of the first fluid through the bypass conduit is allowed. According to other embodiments, the shaft may not be arranged in cantilever fashion and may have a support capable of rotating with respect to two points of the shell such that the shaft extends into the chamber between both points, thereby increasing robustness. Additionally, the use of a cantilever configuration allows reducing the parameters involved in the correct position of the flap integral with the shaft, allowing better positioning with respect to the closure seat.

[0024] Among other advantages, the use of the perimetral edge of the bypass conduit allows doing away with the machining of seats made of molten parts. Nevertheless, this perimetral edge could be formed by additional tubular bodies prolonging the bypass conduit according to a complex configuration of more than one part, for example the tubular body that serves as an insulator so that the bypass conduit does not transfer heat to the first fluid. According to some embodiments, the flap of the valve is also obtained from stamped sheet metal, with a suitable convex surface so that said convex surface partially enters the bypass conduit, and where this convex shape provides greater stiffness to the flap.

Description of the Drawings

[0025] The foregoing and other advantages and features of the invention will be better understood from the following detailed description of a preferred embodiment given only by way of illustrative and non-limiting example in reference to the attached drawings.

Figure 1 shows an exploded perspective view of a first embodiment of the invention. In this embodiment, the valve allows closing only the bypass conduit.

Figure 2 shows a perspective view of the same embodiment as in Figure 1 with the parts assembled except for the end cover that gives access to the inside of the chamber.

Figure 3 shows an elevational view of the same embodiment as in the preceding figures, indicating section A-A shown to the left. Cross-section A-A goes through the shaft of the valve.

Figures 4A-4B show an elevational view of the same embodiment as in the preceding figures according to a longitudinal section. A first position leaving the bypass conduit open and a second position leaving the bypass conduit closed are shown in these two sections.

Figure 5 shows an exploded perspective view of a second embodiment of the invention. In this embodiment, a stamped sheet metal part which allows closing the tubes of the bundle of tubes with a particular configuration allowing the passage of the bypass conduit therethrough, is incorporated. The particular configuration of this part allows the valve to be able to close both the passage to the bypass conduit and the passage to the tubes of the bundle of tubes.

Figure 6 shows a perspective view of the same second embodiment with the parts assembled except for the end cover and the assembly of parts giving rise to the valve. These parts are shown in an exploded view.

Figures 7A-7B show an elevational of the same second embodiment according to a longitudinal section. A first position closing the tubes of the bundle of tubes and leaving the bypass conduit open, and a second position closing the bypass conduit and leaving the passage through the tubes of the bundle of tubes open, are shown in these two sections.

Figure 8 shows an exploded partial perspective view of a third embodiment of the invention. This perspective view shows all the components in their final position and only those components associated with the valve and the closure cover are shown in an exploded view. The seat of the valve has been modified in this embodiment, where the shaft does not go through a perforation but rather through a groove. This configurative change allows quicker assembly of the components.

Figure 9 shows a perspective view of the same third example where a partial section has been made which allows showing the valve in its final position and the configuration thereof.

Detailed Description of the Invention

[0026] According to the first inventive aspect, the present invention is a device for heat exchange between a first fluid and a second fluid. The embodiments show three EGR exchangers, where the first fluid is the recirculated gas which is cooled by transferring heat to a second fluid which is a coolant in the three examples.

[0027] In the three embodiments, the heat exchanger has a bypass conduit as well as a closure valve for closing the bypass conduit. The components of the heat exchanger and most of the components of the valve are made of sheet metal formed by stamping.

[0028] Figure 1 shows a first embodiment having a simple construction. According to this embodiment, the main body of the heat exchanger is formed by a sheet metal shell (1) having a tubular configuration. The sheet metal shell (1) has an expansion step (1.1) at one of its ends, the end shown to the right of the drawing, giving rise to an end portion having a larger diameter.

[0029] This step (1.1) defines an end portion having a larger diameter which establishes a chamber (C) when it is closed by means of a cover (9).

[0030] The opposite end of the sheet metal shell (1) also has a ring-shaped step (1.7) at the end. A first sheet metal baffle (3) and a second sheet metal baffle (4) are housed in both the expansion step (1.1) and the ring-shaped step (1.7).

[0031] The first and second sheet metal baffles (3, 4) are configured according to a main flat plate with a perimetral edge generated by pressing, which gives rise to a cylindrical perimetral seat that fits in the inner wall of the sheet metal shell (1), being supported on the corresponding step (1.1, 1.7).

[0032] The flat area of the first and second sheet metal baffles (3, 4) show a perforation (3.1, 4.1) for a bypass conduit (5) and a plurality of perforations (3.2, 4.2) having a smaller diameter for each of the conduits of a bundle of conduits. Given that the conduits are tubes in this embodiment, they will be referred to as tubes of a bundle of tubes (2) hereinafter and for the examples described based on the drawings.

[0033] Both the bypass conduit (5) and the bundle of tubes (2) extend from the first baffle (3) to the second baffle (4), their ends being housed in the corresponding perforation (3.1, 3.2, 4.1, 4.2). Each end of each tube (2) and of the bypass conduit (5) is perimetrically attached to the also perimetral edge of the corresponding perforation (3.1, 3.2, 4.1, 4.2) by means of brazing.

[0034] The bundle of tubes (2) is housed inside the sheet metal shell (1), giving rise to the exchange surface between the gas to be cooled circulating through the inside of said bundle of tubes (2) and the coolant circulating through the intermediate space between the bundle of tubes (2) and the inner wall of the sheet metal shell (1).

[0035] In this embodiment, the bypass conduit (5) is also in contact with the coolant. Nevertheless, the bypass conduit (5) has a much larger diameter than the tubes of the bundle of tubes (2), such that the ratio between the exchange surface and the flow is much lower in this case, giving rise to a much lower degree of heat transfer. Diverting gas flow through the bypass conduit (5) involves drastically reducing the heat removed from the gas flow.

[0036] The bundle of tubes (2), the bypass conduit (5) and the main axis of the tubular body of the sheet metal shell (1) extend in the same direction referred to as the axial or longitudinal direction X-X'.

[0037] The inside of the sheet metal shell (1) located between the first baffle (3) and the second baffle (4) according to longitudinal direction X-X' is the portion containing the coolant. The fluid communication inlet (1.4) for the coolant is located close to the second baffle (4), and the fluid communication outlet (1.5) for the coolant is located close to the first baffle (3). Depending on whether the exchanger operates in cocurrent or countercurrent mode, the inlet and the outlet (1.4, 1.5) are interchangeable. According to the perspective view and the view point selected for depicting Figure 1, both fluid communication inlet and outlet (1.4, 1.5) for the coolant are concealed by the sheet metal shell (1), only a small portion of the inlet (1.4) being seen through the right end of the sheet metal shell (1) where the chamber (C) is located. Although the exploded perspective view shows the inlet (1.4) through the visual access allowed by the chamber (C), this chamber (C) is not in fluid communication with the inlet (1.4).

[0038] The end of the heat exchanger arranged on the side opposite the chamber (C) is closed by a manifold (10), which is stamped in sheet metal in this embodiment. The manifold (10) forms a chamber that receives or distributes, according to whether the exchanger operates in a cocurrent or countercurrent mode, the exhaust gas circulating through the tubes of the bundle of tubes (2) or the bypass conduit (5). The manifold (10) has a first fluid communication inlet/outlet (10.1) communicated with the engine exhaust system. A second fluid communication inlet/outlet (1.6) for the exhaust gas is located laterally at the other end of the sheet metal shell (1), giving rise to the flow of said exhaust gas through the heat exchanger.

[0039] Both the tubes of the bundle of tubes (2) and the bypass conduit (5) open into the chamber (C) at the end of the heat exchanger arranged on the side of the chamber (C). The chamber (C) is defined according to longitudinal direction X-X' between the second baffle (4) and the cover (9) located at the end of the sheet metal shell (1).

[0040] The heat exchanger transfers heat from the gas to the coolant through the bundle of tubes (2). For the heat exchanger to operate in this manner, a valve closes the bypass conduit (5) so that the flow between the chamber (C) and the manifold (10) located at the end opposite completely goes through the bundle of tubes (2) and not through the bypass conduit (5).

[0041] In view of Figures 1 and 2, the valve of this embodiment is formed by an actuator, not shown in this Figure 1, acting on a connecting rod (6.3) transforming axial movement of the actuator into rotational movement about the rotating shaft (6) where the connecting rod (6.3) is assembled.

[0042] The rotating shaft (6) is housed in a support (8) that retains said shaft axially but allows its rotational movement. This support (8) is attached to a base (7) which in this embodiment is formed by a sheet metal portion curved according to a cylindrical sector, adapted to be supported on the surface of the sheet metal shell (1) of the exchanger.

[0043] In this embodiment, the attachment of the shaft (6) to the sheet metal shell (1) maintaining the rotation, the primary degree of freedom allowed to the shaft (6), is carried out in this embodiment by means of the interposition of a support (8) which is in turn attached to the base (7). Nevertheless, in all the embodiments of the invention, it is possible to link the shaft (6) to the shell (1) in another way. Depending on the stiffness of the attachment, the support (8) can be directly brazed onto the sheet metal shell (1) or be attached to a base (7) which is in turn attached to the shell (1). The presence of the base (7) allows increasing stiffness of the attachment and also allows incorporating extensions offering a fixing seat to the actuator, for example.

[0044] Continuing with the description of the first embodiment, the rotating shaft (6) extends from the outside, where it is linked to the connecting rod (6.3), to the inside of the chamber (C) going through a perforation (1.2) for the passage of the rotating shaft (6), where it is prolonged a specific distance in cantilever fashion. As shown in Figure 3, in the cross-section going through the rotating shaft (6), the geometric axis of said rotating shaft (6) is located transverse to the bypass conduit (5) and spaced from said conduit (5).

[0045] There is a flap (6.1) at the cantilevered end such that the rotation of the rotating shaft (6) causes the former to rotate, said flap (6.1) being positioned on the perimetral edge of the bypass conduit (5) and therefore giving rise to the closure of said conduit. The rotation of the shaft (6) in the opposite direction completely or partially opens the passage through the bypass conduit (5) according to the opening angle.

[0046] In view Figures 4A and 4B, the described valve allows closing the bypass conduit (5) so that gas flow goes through the bundle of tubes (2) completely. The opening of the bypass valve leaves the bypass conduit (5) open but does not prevent passage through the bundle of tubes (2). Nevertheless, the smaller diameter of the tubes of the bundle of tubes (2) confers greater resistance against passage than the bypass conduit (5) does and therefore favors passage to a greater extent through the bypass conduit (5). In this case, passage of a large portion of the flow through the bypass conduit (5), which has a much lower degree of heat transfer than the bundle of tubes (2), gives rise to less cooling of the gas.

[0047] Figure 5 shows a second embodiment according to an exploded perspective view where most of the components are common components with respect to the first embodiment, therefore only the differences shown in this second example with respect to the first embodiment are addressed in this description.

[0048] In this second embodiment, instead of being arranged in the wall of the sheet metal shell (1) coinciding with the chamber (C) as indicated with reference 1.6, the second fluid communication inlet/outlet for the gas in this embodiment is located in the cover (9), this fluid communication inlet/outlet (9.1) being arranged in the center of said cover (9).

[0049] As a first improvement, in this embodiment it is possible to completely close the bypass conduit (5) so that the flow goes through the bundle of tubes (2) as well as the passage through the bundle of tubes (2) so that the flow goes through the bypass conduit (5) completely. The possibility of completely closing the passage of flow through the bundle of tubes (2) allows reducing minimum cooling of the device to a greater extent, for example, for applications during engine startup when it is cold.

[0050] To achieve the complete closure of the passage of flow through the bundle of tubes (2), the device according to this embodiment incorporates a stamped sheet metal part (11) housed in the chamber (C). This stamped part (11) is formed by a metal sheet perimetrically fitted to the inner wall of the chamber (C), in this case coinciding with the inner wall of the portion of sheet metal shell (1) closing the chamber (C). The part establishes a partition wall in the chamber (C) except for two openings, a first opening (11.1) and a second opening (11.2). The partition wall in turn gives rise to two sub-chambers, an inner sub-chamber (Ci) located between the second baffle (4) and the stamped sheet metal part (11), and an outer sub-chamber (Co) located between the stamped sheet metal part (11) and the cover (9).

[0051] The first opening (11.1) establishes the passage from the side where the valve is located and the side where access to the tubes of the bundle of tubes (2) is located. This first opening (11.1) has a tube end-shaped termination, such that its perimetral edge establishes a seat for a flap (6.2). The final tube end shape is configured by stamping.

[0052] The second opening (11.2) is also tube end-shaped and receives the end of the bypass conduit (5). According to this embodiment, the bypass conduit (5) is prolonged beyond the second baffle (4) until reaching the stamped sheet metal part (11). Therefore, the inside of the bypass conduit (5) and the inner sub-chamber (Ci) are not in fluid communication. In this embodiment, the bypass conduit (5) is internally housed in the second opening (11.2) until going beyond same such that the perimetral edge of its end continues to be the seat for the flap (6.1) of the valve.

[0053] In this embodiment, therefore, there are two flaps, a first flap (6.1) closing the passage through the bypass conduit (5) and a second flap (6.2) closing the passage through the bundle of tubes (2).

[0054] According to another alternative embodiment, the bypass conduit (5) is not prolonged beyond the second opening (11.2) of the stamped sheet metal part (11) but rather opens into said opening (11.2). The seat of the first flap (6.1) is therefore located directly on the perimetral edge of the tube end-shaped first opening (11.2).

[0055] Another improvement of the second embodiment consists of the bypass conduit (5) in turn being formed by two tubes, an inner tube (5a) and an outer tube (5b). The outer tube (5b) is in contact with the coolant. The inner tube (5a) is where the gas flow circulates when the bypass conduit (5) is open. Given that there is a chamber or space between the inner tube (5a) and the outer tube (5b) having a larger diameter, a thermal barrier reducing the cooling of the gas going through the bypass conduit (5) is established.

[0056] In this embodiment, the outer tube (5b) extends from the first baffle (3) to the second baffle (4), and the inner tube (5a) is prolonged until reaching the stamped sheet metal part (11). In this embodiment, the two ends of the outer tube (5b) are expanded to assure the attachment with the baffles (3, 4).

[0057] The section shown in Figures 7A and 7B shows both the structure of the bypass conduit (5), in turn formed by two tubes (5a, 5b), and the arrangement of the stamped sheet metal part (11) with its two openings (11.1, 11.2).

[0058] These same drawings show the valve with two flaps (6.1, 6.2) formed from the same metal sheet by stamping. The flaps (6.1, 6.2) are positioned 90 degrees with respect to one another about the same rotating shaft (6), such that a 90 degree rotation is established between two end positions; a first position closing the bypass conduit (5) and a second position closing the bundle of tubes (2) by means of closing the first opening (11.1).

[0059] In one embodiment, the two flaps (6.1, 6.2) are independent from one another, both being attached to the rotating shaft (6).

[0060] In one embodiment, the angle according to which the two flaps (6.1, 6.2) are positioned depends on the valve actuation system, and the rotation of the shaft between the two end positions will depend on the angle formed between both (6.1, 6.2). Said angle usually depends on the actuation mechanism and its travel.

[0061] Figure 6 shows a perspective view where only the parts associated with the valve are shown in an exploded view. Particularly, the rotating shaft (6) with the two flaps (6.1, 6.2) attached to said rotating shaft (6) is shown in the intermediate assembly position. In other words, the rotating shaft (6) is installed through the inside of the chamber (C) once all the parts are brazed, particularly the stamped sheet metal part (11) shown towards the back of the outer chamber (Co). The rotating shaft (6) is introduced in the outer sub-chamber (Co), and goes through the perforation (1.2) until it is attached to the support (8) of the rotating shaft (6).

[0062] According to this embodiment, the rotating shaft (6) is also arranged in cantilever fashion, like what has been described in the first embodiment.

[0063] Figures 8 and 9 show a third embodiment. In this third embodiment, a structure such as that described in the second embodiment except for some dimensional changes and the differences highlighted below, is used.

[0064] The most significant difference between the third embodiment and the second embodiment is the substitution of the perforation (1.2) for the passage of the rotating shaft (6) with a groove (1.3) reaching the edge of the end of the sheet metal shell (1) where the chamber (C), also the outer chamber (Co) in this case, is located.

[0065] Although the perforation (1.2) requires assembling the rotating shaft (6) from inside the chamber (C) until reaching the support (8) located outside the sheet metal shell (1), the groove (1.3) allows being able to assemble the rotating shaft (6) first on the support (8), this support (8) in turn being previously placed on the base (7), and to insert the entire assembly from the front. In other words, the assembly of the rotating shaft (6) previously located on the support (8) and the base (7) is carried out by introducing the rotating shaft (6) through the groove (1.3) until it reaches its final position. The base (7) is brazed onto the sheet metal shell (1) in this position.

[0066] The solution of incorporating the rotating shaft (6) through the groove (1.3) is also applicable to other embodiments, for example the first embodiment.

[0067] In addition to facilitating assembly, the configuration according to this embodiment allows positioning the rotating shaft (6) so that the seat or seats of the flaps (6.1, 6.2) is correct and brazing the base (7) in this position once said shaft is positioned.

[0068] Openings (11.1, 11.2) and flaps (6.1, 6.2) with an elongated shape instead of a circular shape have been configured in the third embodiment only as a constructive detail. This embodiment shows both the linear actuator (13) and the actuation rod (12) reaching the connecting rod (6.3) which are not shown in the graphical depictions of other embodiments.

[0069] Likewise, the second fluid communication inlet/outlet (1.6) is again placed in the wall of the sheet metal shell (1) as described in the first embodiment.

Claims

1. A heat exchange device for heat exchange between a first fluid, preferably a gas to be cooled, circulating through a first conduit; and a second fluid, preferably a coolant, circulating through a second conduit, where said device is intended for being intercalated between both conduits and comprises:

   - a sheet metal shell (1) having a tubular configuration,
   - a first sheet metal baffle (3) and a second sheet metal baffle (4) assembled in the sheet metal shell (1) and spaced from one another,
   - a bundle of conduits (2) extending along a longitudinal direction X-X' at least from the first baffle (3) to the second baffle (4),
   - a bypass conduit (5) extending at least from the first baffle (3) to the second baffle (4) and it is parallel to the bundle of conduits (2),
   - a fluid communication inlet and a fluid communication outlet (1.4, 1.5) for the second fluid, both arranged in the sheet metal shell (1) and giving access to the space located between the first baffle (3) and the second baffle (4) for cooling the bundle of conduits (2),
   - a first fluid communication inlet/outlet (10.1) arranged at one of the ends of the bundle of conduits (2) and of the bypass conduit (5), and a second fluid communication inlet/outlet (1.6, 9.1) arranged at the opposite end of the bundle of conduits (2) and of the bypass conduit (5), both the fluid communication inlet/outlet (10.1, 1.6, 9.1) giving access to the first fluid through the bundle of conduits (2), through the bypass conduit (5) or through both (2, 5),

where the tubular sheet metal shell (1) extends longitudinally beyond the second baffle (4) giving rise to a chamber (C) such that said chamber (C) comprises a valve that can be actuated from outside the chamber (C) and is adapted to at least close the bypass conduit (5), and where said valve comprises a shaft (6) attached to the sheet metal shell (1) and capable of rotating with respect to said shell, prolonging into the chamber (C) where said shaft (6) comprises a sheet metal flap (6.1) adapted to sit on the perimetral edge of the end of the bypass conduit (5) for closing same.

2. The device according to claim 1, where the shaft (6) is attached to the sheet metal shell (1) by means of the interposition of a support (8) with the shaft (6) going through same, such that said support (8) is integral with the sheet metal shell (1), and where the support (8) allows rotation of the shaft (6).

3. The device according to claim 2, where the support (8) is integral with the sheet metal shell (1) by means of the interposition of a base (7) such that the base (7) is attached to the sheet metal shell (1) and the support (8) of the shaft (6) is arranged on the base (7).

4. The device according to claim 3, where an extension of the base (7) is the support of an actuator (13) for operating the shaft (6).

5. The device according to any of claims 1 to 4, where the sheet metal shell (1) having a tubular configuration shows an expansion step (1.1) intended for housing the second sheet metal baffle (4).

6. The device according to any of the preceding claims, where the bypass conduit (5) comprises a first outer tube (5b) and a second inner tube (5a) forming between them a thermal insulation chamber.

7. The device according to any of the preceding claims, where the chamber (C) is closed by means of a sheet metal cover (9).

8. The device according to any of the preceding claims, where the chamber (C) comprises a stamped sheet metal part (11) dividing the chamber (C) into an inner sub-chamber (Ci) in communication with the inside of the tubes of the bundle of conduits (2) and an outer sub-chamber (Co), and where said stamped sheet metal part (11) comprises a first opening (11.1) and a second opening (11.2) such that:

- the stamped sheet metal part (11) establishes a perimetral closure with the shell (1),
- the first opening (11.1) establishes fluid communication between the inner sub-chamber (Ci) and the outer sub-chamber (Co),
- the second opening (11.2) perimetrically surrounds the bypass conduit (5); and
- the second fluid communication inlet/outlet (1.6, 9.1) is in direct communication with the outer sub-chamber (Co).

9. The device according to claim 8, where the first opening (11.1) and the second opening (11.2) of the stamped sheet metal part (11) comprise a valve seat.

10. The device according to claim 9, where the seat of the second opening (11.2) is either:

- in a tube end-shaped termination of said second opening (11.2);
- or on the perimetral edge of the end of the bypass conduit (5) where this bypass conduit (5) axially goes beyond the position of said second opening (11.2).

11. The device according to claim 9 or 10, where the shaft (6) of the valve comprises a second flap (6.2) such that:

- the first flap (6.1) is adapted to close on the seat of the second opening (11.2),
- the second flap (6.2) is adapted to close on the seat of the first opening (11.1) of the stamped sheet metal part (11); and
- where the first flap (6.1) and the second flap (6.2) are configured for adopting at least two end positions, a first end position where the first flap (6.1) establishes the closure of the bypass conduit (5) in a first angular position of the shaft (6); and a second end position where the second flap (6.2) establishes the closure of the second opening (11.2) in a second angular position of the same shaft (6).

12. The device according to any of the preceding claims, where the flap or flaps (6.1, 6.2) have a concave protuberance (6.1.1) adapted to enter the cavity on which the seat of said flap is located for making it stiff in the event of temperature changes.

13. The device according to any of the preceding claims and particularly to claim 2, where the sheet metal shell (1) comprises a perforation (1.2) for the passage of the rotating shaft (6), and where the support (8) of the shaft (6) and said shaft (6) are adapted to allow mutual coupling by inserting the shaft (6) from inside the chamber (C) through the perforation (1.2).

14. The device according to any of claims 1 to 13 and particularly to claims 2 and 3, where the sheet metal shell (1) comprises an open groove (1.3) for the passage of the rotating shaft (6) extending to the end where the chamber (C) is located, and where said groove is configured such that the assembly formed by the support (8) of the shaft (6) and said shaft (6) as well as the base (7) allows inserting the shaft (6) through the open groove (1.3) to the final position of the base (7) on the sheet metal shell (1).

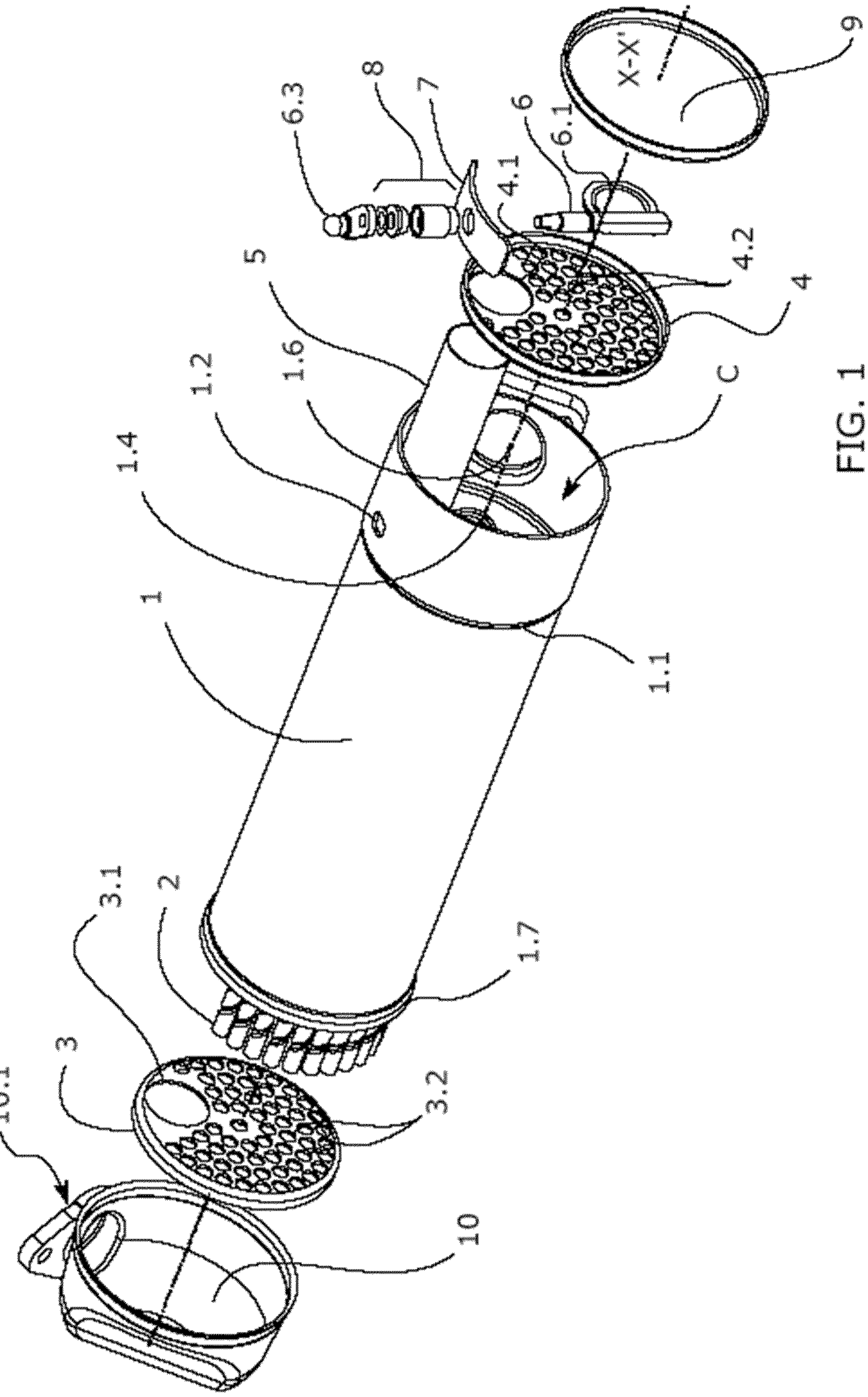

FIG. 1

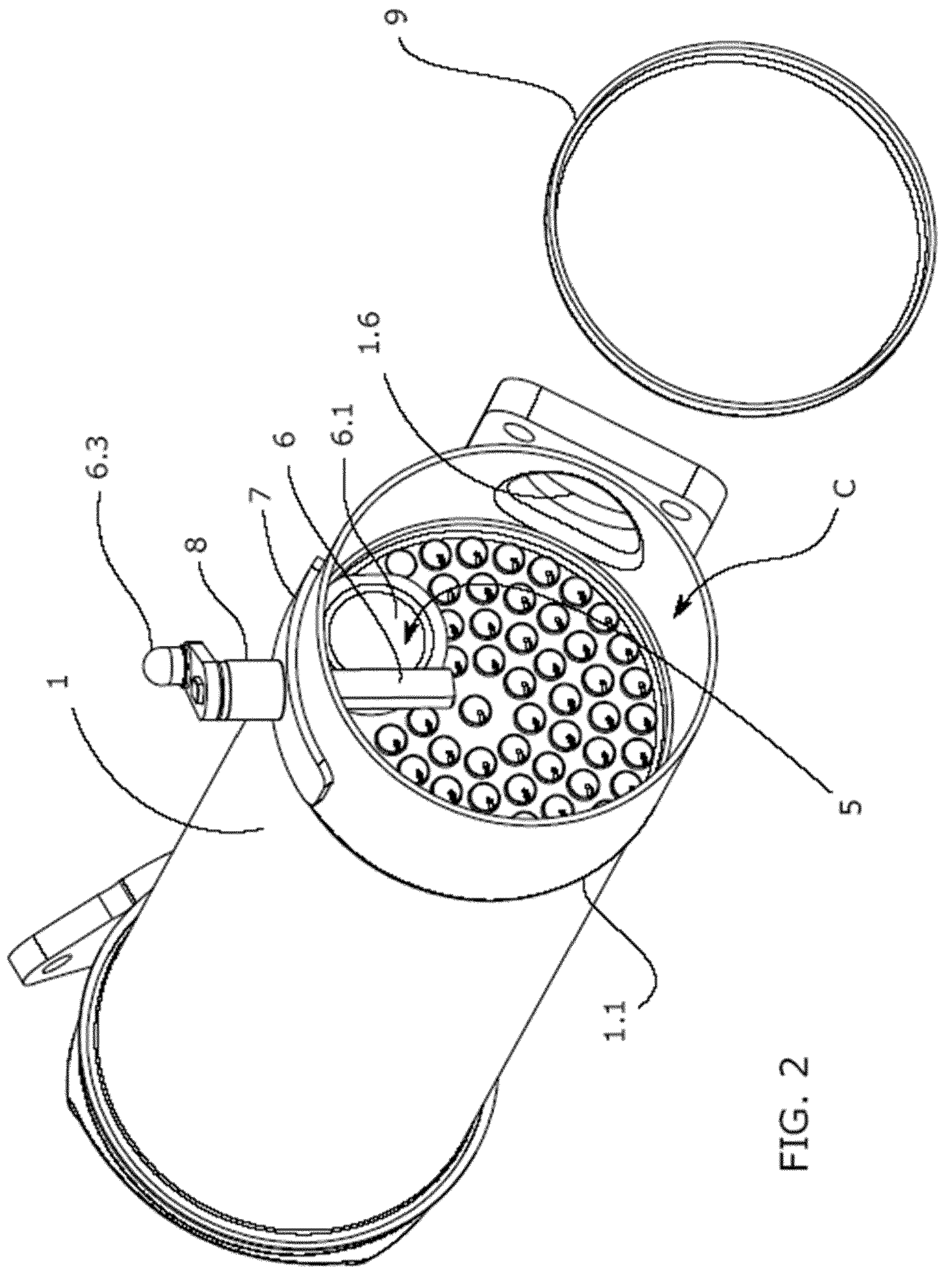

FIG. 2

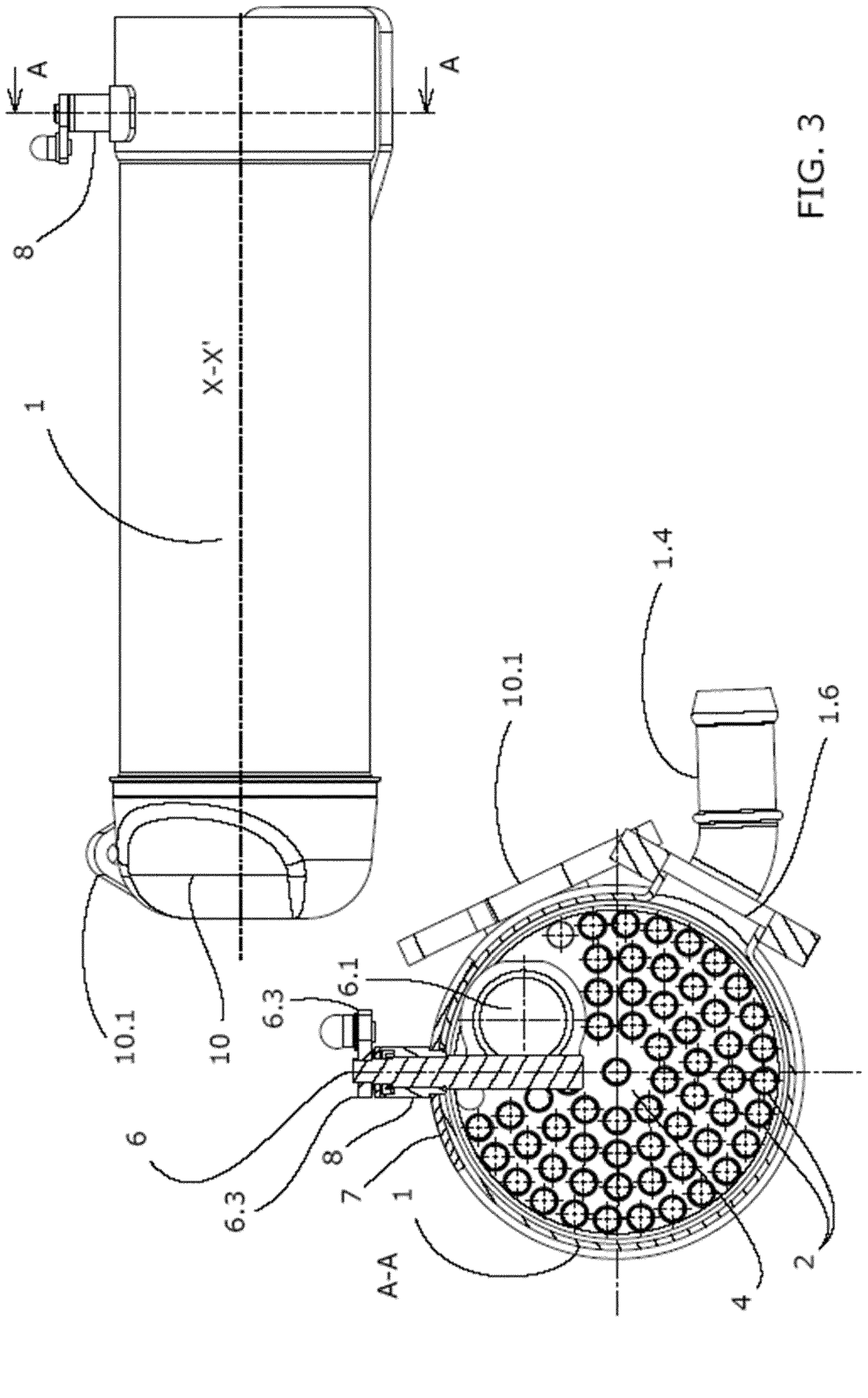

FIG. 3

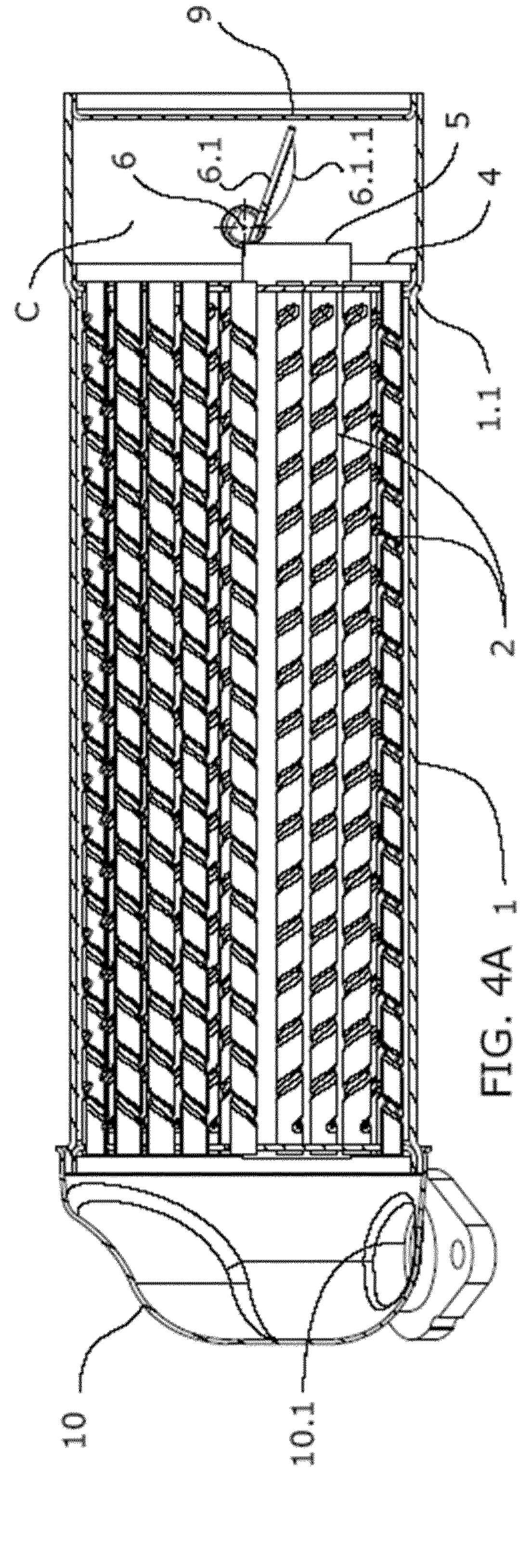

FIG. 4A

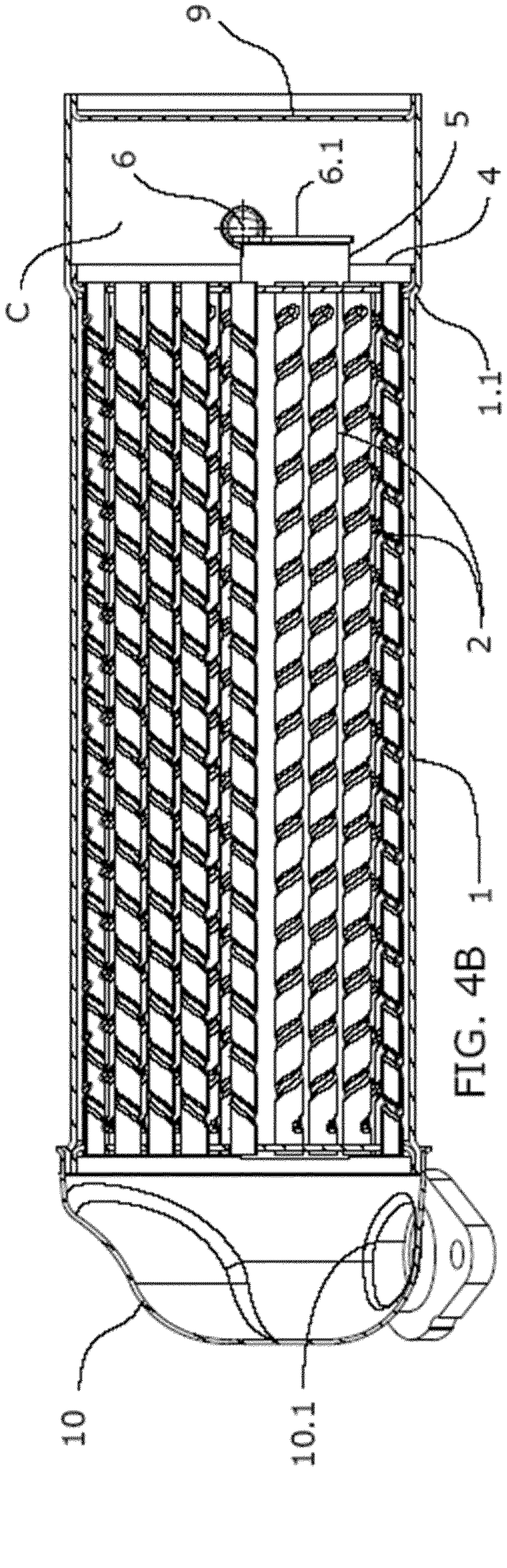

FIG. 4B

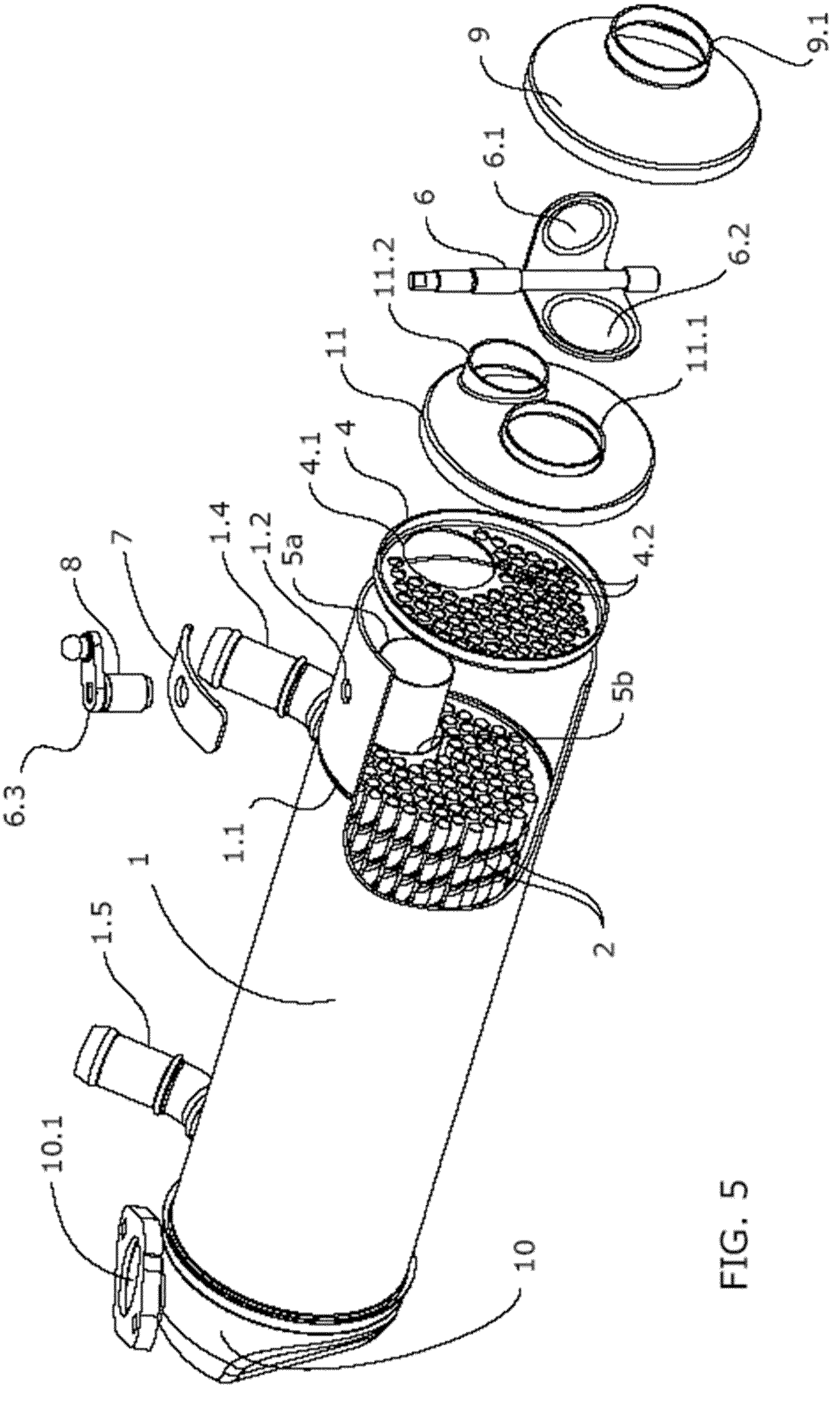

FIG. 5

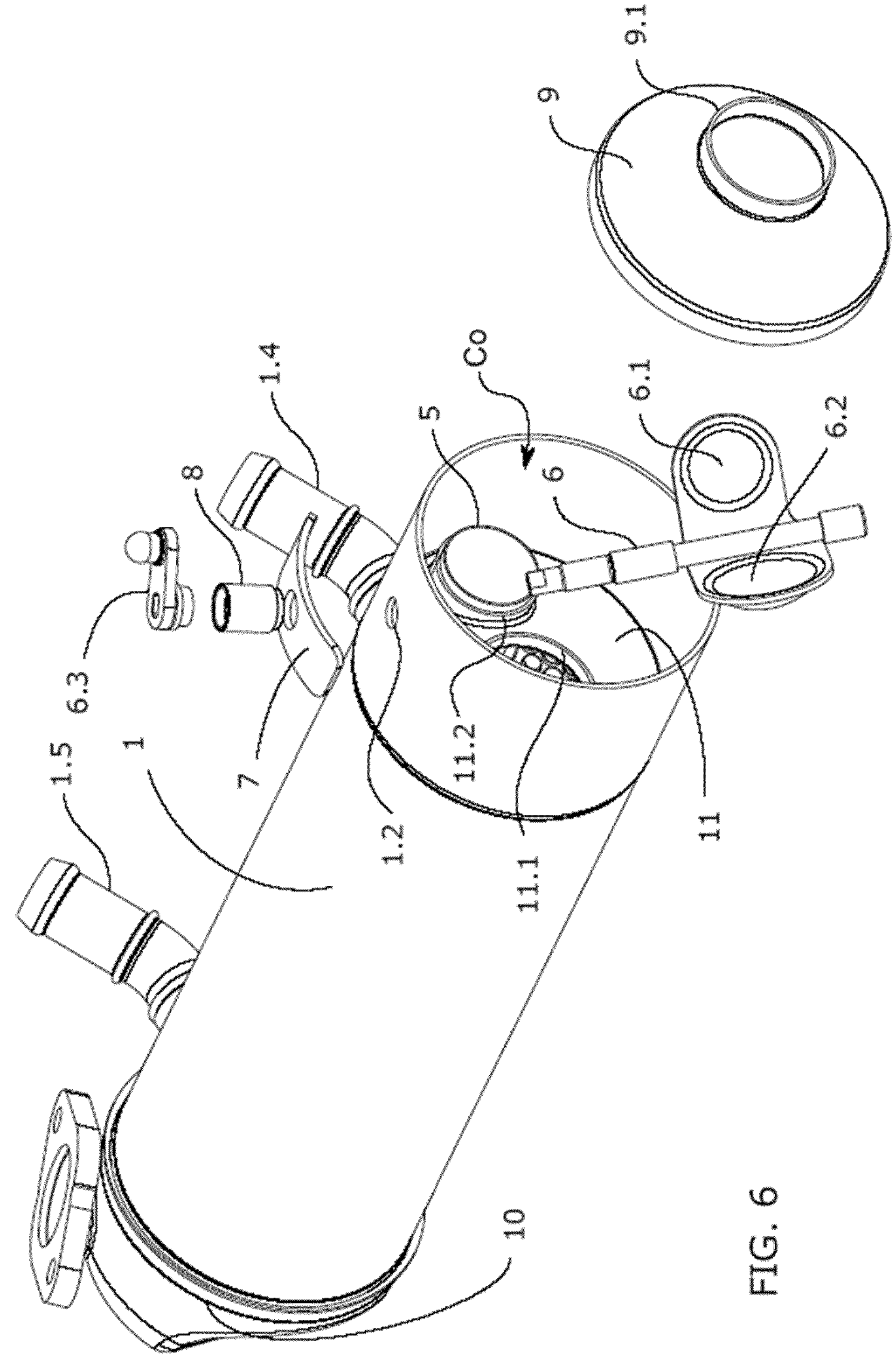

FIG. 6

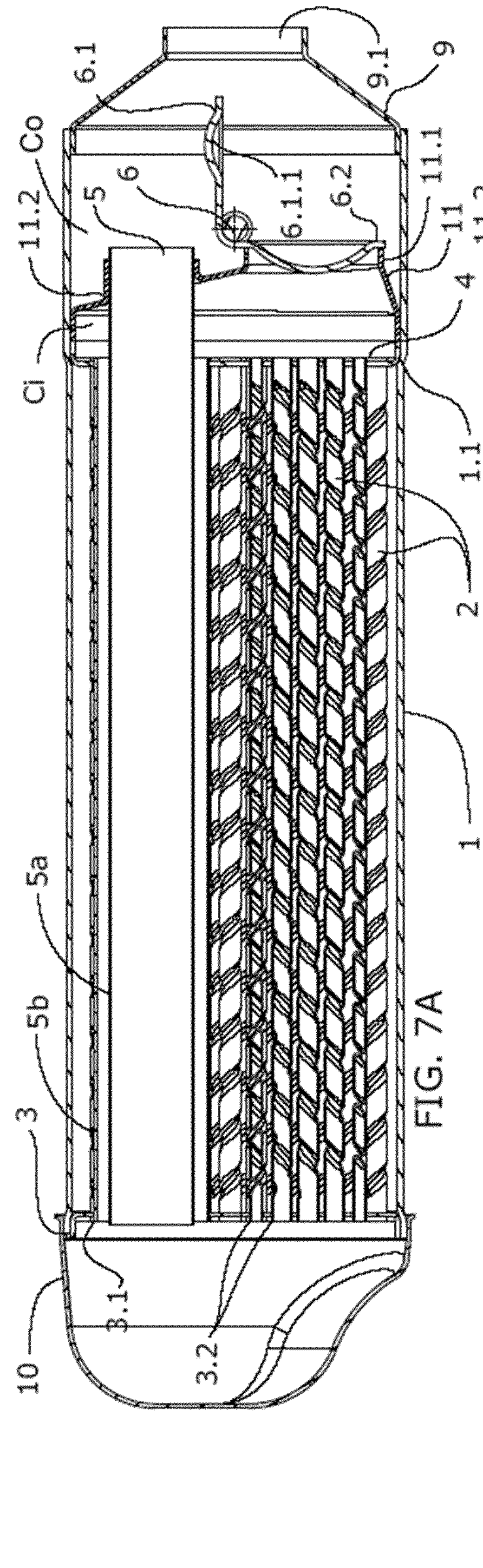
6.1
Co
11.2
5
6
6.1.1
6.2
11.1
11
9.1
9
4
Ci
1.1
2
1
5a
5b
3
3.1
3.2
10

FIG. 7A

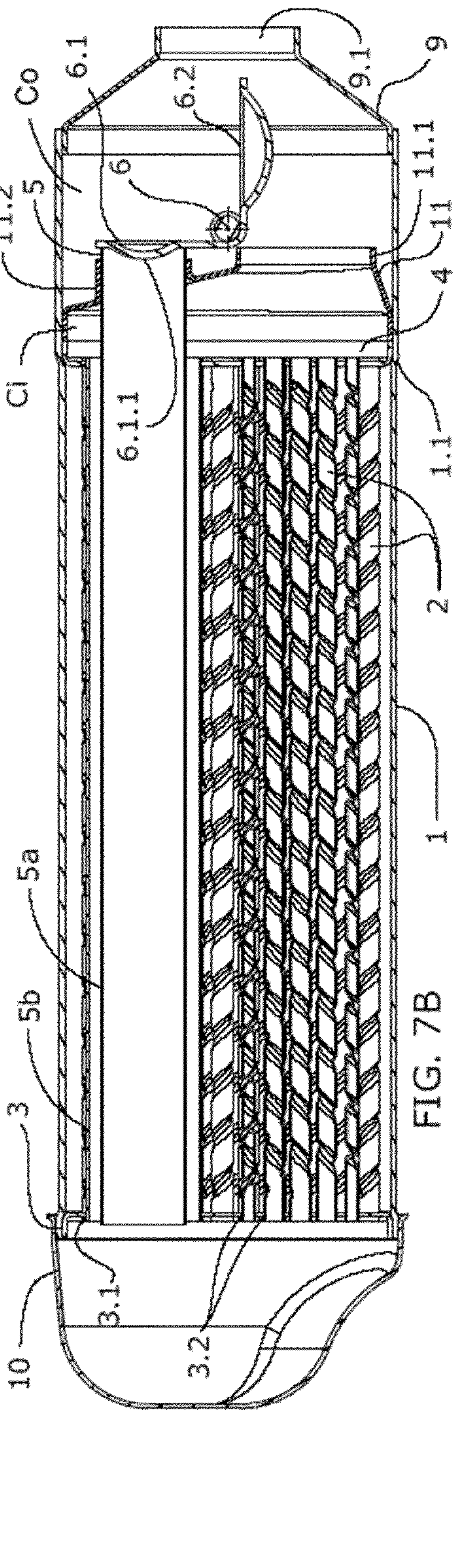
Co
6.1
6.2
6
5
11.2
11.1
11
9.1
9
4
Ci
6.1.1
1.1
2
1
5a
5b
3
3.1
3.2
10

FIG. 7B

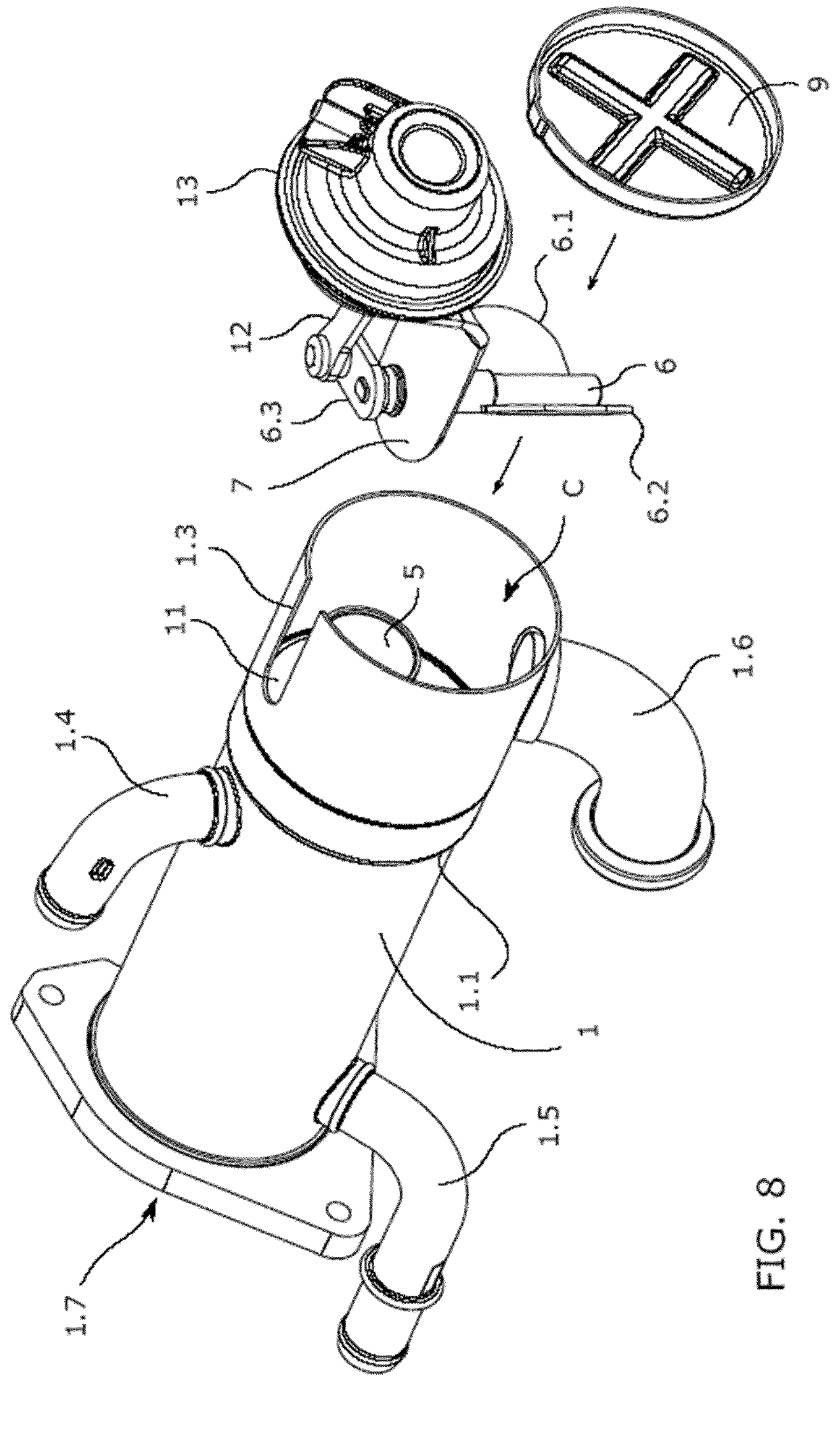

FIG. 8

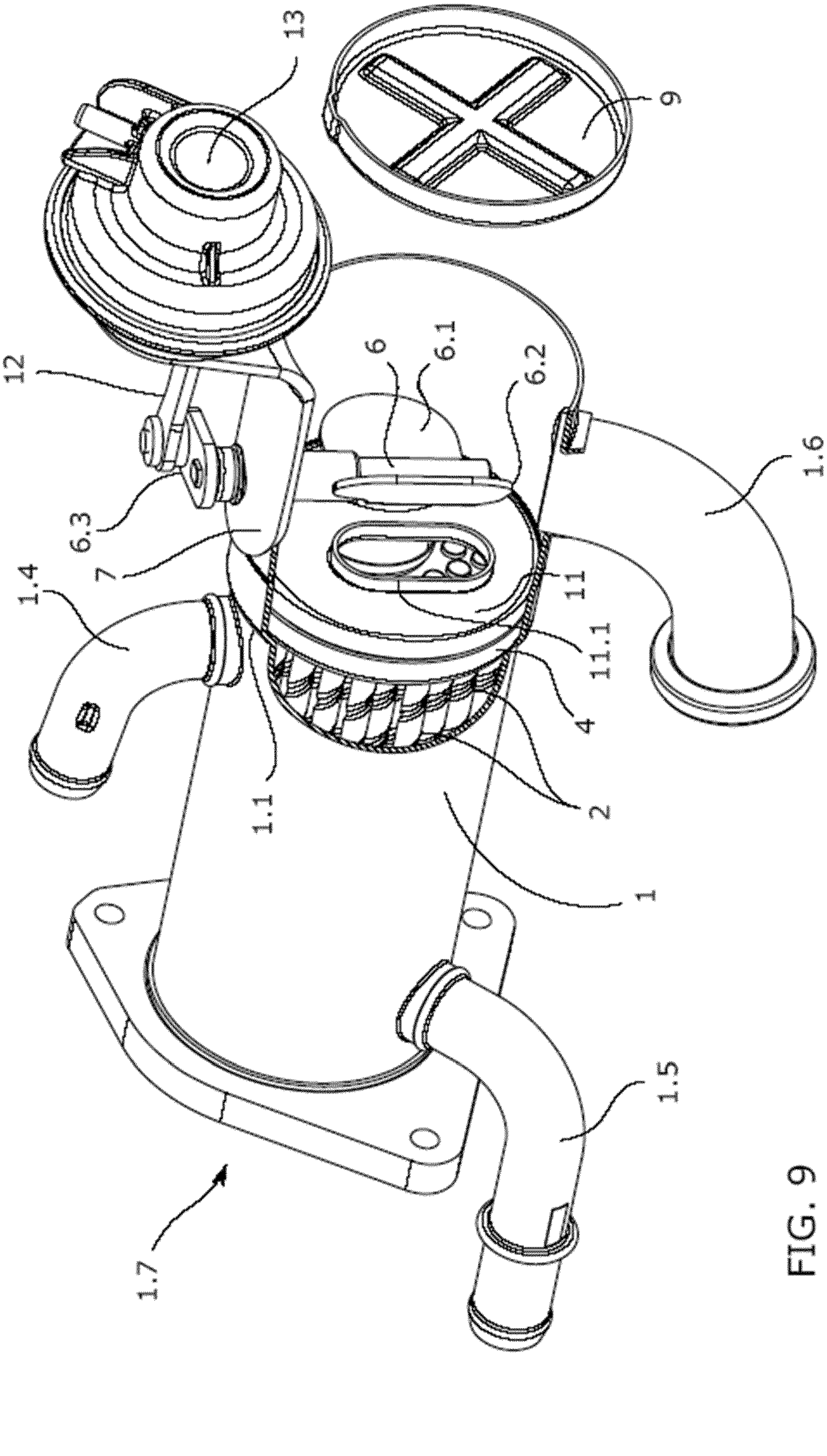

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 14 38 2172

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 2 312 252 A1 (LURGI GMBH [DE]) 20 April 2011 (2011-04-20) * paragraphs [0003], [0005], [0010]; figure 1 *	1-14 8	INV. F28F27/02 F02M25/07 F28D7/16 F28D21/00
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Y	EP 1 367 253 A1 (ESTAMPACIONES NOROESTE S A [ES] DAYCO ENSA SL [ES]) 3 December 2003 (2003-12-03) * the whole document *	8	

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F28F
F02M
F28D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 October 2014	Martínez Rico, Celia

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20-10-2014

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