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

(11) **EP 2 450 543 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
**09.05.2012 Bulletin 2012/19**

(51) Int Cl.:
***F01N 13/18*** *(2010.01)* ***F01N 13/14*** *(2010.01)*
***F01N 13/10*** *(2010.01)*

(21) Application number: **11188155.3**

(22) Date of filing: **08.11.2011**

(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**
Designated Extension States:
**BA ME**

(30) Priority: **08.11.2010 PCT/IB2010/003156**

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(54) **Exhaust manifold with thin flanges**

(57) An exhaust manifold (1) for an engine (5), the exhaust manifold (1) comprising:
at least one collecting pipe (7) for conveying exhaust gases,
- several exhaust gases inlets (9) in fluid communication with the collecting pipe (7),
- several flanges (11) each defining one of the exhaust gases inlet (9), each flange (11) having an external face (13) adapted to be pressed against a receiving surface (15) of the engine (5),
- several backflanges (17), each backflange (17) being associated to one of the flanges (11) and being adapted to press the corresponding flange (11) against the receiving surface (15).

The flanges (11) are areas of a single plate (33), the plate (33) having a thickness between 0.2 and 2 mm, said areas being continuously connected to one another by other areas (35) of the plate (33), the collecting pipe (7) being not integral with the plate (33), the manifold (1) having leaktight connections (37) connecting the collecting pipe (7) to each of the flange (11).

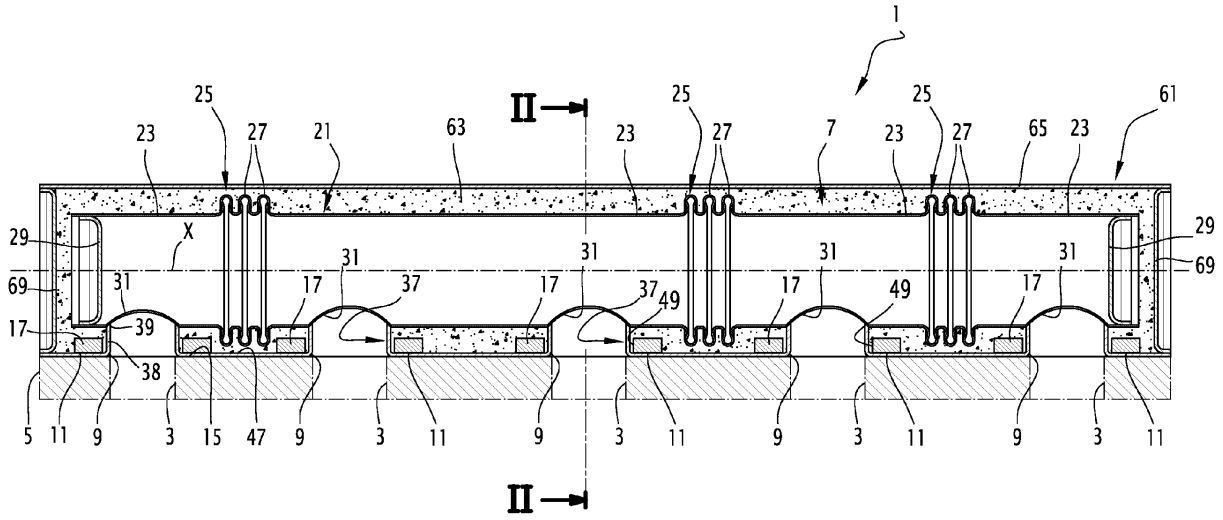


FIG.1

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## Description

**[0001]** The invention relates to a manifold for collecting exhaust gases from an engine, especially an internal combustion engine of an automobile, and for conveying the exhaust gases to an exhaust line.

**[0002]** More specifically, the invention relates to an exhaust manifold of the type comprising:

- at least one collecting pipe for conveying exhaust gases,
- several exhaust gases inlets in fluid communication with the collecting pipe,
- several flanges each defining one of the exhaust gases inlet, each flange having an external face adapted to be pressed against a receiving surface of the engine,
- several backflanges, each backflange being associated to one of the flanges and being intended to press the corresponding flange against the receiving surface.

**[0003]** A manifold of that type is known from FR-2 549 529. Said manifold has a thin inner collecting pipe, an outer casing and a layer of thermal insulation material located between the inner collecting pipe and the outer casing.

**[0004]** When the thermal isolation material is made of fibers, for example metal or ceramic fibers, it is necessary to enclose the fibers in the outer casing, so that the fibers cannot escape during the life of the automobile.

**[0005]** In FR-2 549 529, tubes connect the collecting pipe to the flanges, through the backflanges. The tightness of the outer casing around the tubes is not good.

**[0006]** Accordingly, one of the goal of the invention is to provide a manifold in which the containment of the thermal isolation material can be improved if necessary.

**[0007]** Said goal is achieved by an exhaust manifold of the type above, characterized in that the flanges are areas of a single plate, the plate having a thickness between 0.2 and 2 mm, said areas being continuously connected to one another by other areas of the plate, the collecting pipe being not integral with the plate, the manifold having leaktight connections connecting the collecting pipe to each of the flange.

**[0008]** According to specific embodiments, the manifold comprises one or more of the following features:

- the flanges are integral with one another.
- the collecting pipe has a wall thickness between 0.2 and 2 mm.
- the manifold has an outer casing inside which the collecting pipe is located, and a layer of a thermal insulation material between the collecting pipe and the outer casing, the outer casing being connected to the plate so that the plate and the outer casing define together a closed box for the containment of the thermal insulation material;
- the backflanges are located inside said box;
- the plate has two outer raised edges opposite to one another, raised toward a direction opposite to the engine, the outer casing being connected to the two raised edges of the plate ;
- each backflange has an aperture, the corresponding flange having around the exhaust gas inlet a flanged edge extending into said aperture of the backflange and connected to the collecting pipe by the corresponding connection ;
- the plate comprises slots ;
- the collecting pipe has at least two tubular sections for conveying the exhaust gases, and at least one thermal compensation device integral with the two tubular sections ,
- the thermal compensation device connects respective ends of the two tubular sections to one another and defines internally a passage for conveying the exhaust gases from one tubular section to the other tubular section ;
- at least one of the tubular section has a peripheral wall with a hole connected to one of the flanges by one of the connections and being in fluid communication with the corresponding exhaust gas inlet, said wall having a substantially flat area, the hole having at least a zone extending across the flat area ;
- said exhaust gas inlet has a given surface area, said zone having a surface area between 30% and 50% of the given surface area;
- said zone is separated from an edge of the hole by a gap ;
- the thermal compensation device is a bellow;
- each of the leaktight connections is a tube which is either integral with the corresponding flange and welded or brazed or soldered to the collecting pipe, or integral with the collecting pipe and welded or brazed or soldered to the corresponding flange, or welded or soldered or brazed to both the corresponding flange and the collecting pipe;
- the backflanges each have a thickness between 1.5 and 2.5 mm;
- the exhaust manifold has tie rods adapted to secure the manifold to the engine spacer sleeves through which the tie nods pass, and screws fitted on threaded ends of the tie rods, said screws pressing the backflanges toward the engine, the spacer sleeves being obtained by stamping a metal tube or by folding a sheet of metal.

**[0009]** The invention will be better understood from a reading of the description below, given purely by way of example and with reference to the drawings, in which:

- Figure 1 is a cross section of an exhaust manifold according to the invention;
- Figure 2 is a cross section taken along line II-II of Figure 1, showing another embodiment of the connection between the flange and the collecting pipe

of the manifold;

- Figure 3 is a perspective view of the plate defining the flanges and of the backflanges of the manifold of Figure 1;
- Figure 4 is another perspective view showing an end of the plate of Figure 1;
- Figure 5 is a partial, perspective view of the plate, the backflanges and the outer casing of the manifold of Figure 1,
- Figure 6 is a cross section the flange, the backflanges and the collecting pipe of the manifold, in a plane perpendicular to the axis of the collecting pipe, showing another aspect of the invention and another embodiment of the connection between the flange and the collecting pipe; and
- Figure 7 is a cross section similar to the section of Figure 6, showing another embodiment of the connection between the flange and the collecting pipe of the manifold.

**[0010]** The manifold 1 shown on figure 1 is intended for collecting the exhaust gases at the outlets 3 of the combustion chambers of the engine 5. The manifold 1 comprises:

- at least one collecting pipe 7 for conveying exhaust gases,
- several exhaust gases inlets 9 in fluid communication with the collecting pipe 7,
- at least one exhaust gases outlet (not shown) in fluid communication with the collecting pipe 7;
- several flanges 11 each defining one of the exhaust gases inlet 9, each flange having an external face 13 (Fig 4) adapted to be pressed against a receiving surface 15 of the engine;
- several backflanges 17, each backflange 17 being associated to one of the flanges 11 and being intended to press the corresponding flange 11 against the receiving surface 15.

**[0011]** In the present description, the thickness of a plate or a wall is the dimension of said plate or wall from one large face to the opposite large face, through the material constituting the plate or the wall, substantially perpendicularly to the two large faces.

**[0012]** The collecting pipe 7 has a thin peripheral wall 21, with a thickness between 0.2 and 2 mm, preferably between 0.2 and 0.8 mm, more preferably between 0.2 and 0.5 mm. Exhaust gases are flowing inside the collecting pipe 7. The wall 21 is in direct contact with the exhaust gases. The peripheral wall is made of a single layer of metal, for example of a stainless steel, such as a ferritic stainless steel or preferably an austenitic stainless steel.

**[0013]** The collecting pipe 7 has a central axis X and extends for example along a straight direction. It may also have a different shape, and include at least a bended portion.

**[0014]** The collecting pipe 7 comprises several tubular sections 23 for conveying the exhaust gases, and several thermal compensation devices 25 integral with the tubular sections.

**[0015]** Each tubular section 23 has two axial ends. Each thermal compensation device 25 connects the respective ends of two neighboring tubular sections 23 to one another and defines internally a passage for conveying the exhaust gases from one tubular section 23 to the other tubular section 23.

**[0016]** As shown on Fig 1, each thermal compensation device 25 is a bellow. The bellow comprises several waves 27, centered on the axis X. The bellows are compressible along axis X.

**[0017]** The central tubular sections 23 have each their both ends connected to neighboring tubular sections by two compensation devices. The tubular sections 23 at the ends of the collecting pipe 7 have one end connected to the neighboring tubular section by a compensation device, the other end being free, and being closed by a dish-like plate 29. The dish-like plate 29 is inserted inside the peripheral wall 21 and connected to the peripheral wall in a leak-tight way, for example by a weld.

**[0018]** Each of the tubular section 23 has at least one hole 31 made in the peripheral wall 21. Each hole 31 is in fluid communication with one of the exhaust gas inlets 9.

**[0019]** A tubular section 23 may comprise more than one hole 31, for example two holes 31 as shown on Figure 1, or more that two holes.

**[0020]** The inlets 9 are located right in front of the outlets 3 of the combustion chambers. Each is in fluid communication with a corresponding outlet 3 of a combustion chamber.

**[0021]** The exhaust gases outlet (not shown) of the manifold 1 is in fluid communication with equipment of the exhaust line located downstream the manifold 1, for example with a turbocharger (not shown). The manifold may include a second exhaust gases outlet, in fluid communication with the inlet manifold feeding fresh air to the engine.

**[0022]** The flanges 11 are areas of a single plate 33. Plate 33 is made of metal, for example a stainless steel, such as a ferritic stainless steel or preferably an austenitic stainless steel. The plate has a thickness between 0.2 and 2 mm, preferably between 0.2 and 0.8 mm, more preferably between 0.2 and 0.5 mm. The plate is substantially flat, and may be parallel to axis X.

**[0023]** The areas defining flanges 11 are continuously connected to one another by other intermediate areas 35 of the plate (Figure 3).

**[0024]** The flanges 11 are integral with one another. They are integral with the intermediate areas 35.

**[0025]** The collecting pipe 7 is not integral with the plate 33. The manifold 1 has leaktight connections 37 connecting the collecting pipe 7 to each of the flange 11. More specifically, each of the leaktight connections 37 has a tube defining internally a passage for the exhaust gases

to flow from the inlet 9 to the corresponding hole 31.

**[0026]** The tube is either integral with the corresponding flange 11 and welded to the collecting pipe 7 (Figure 1 and 2), or welded to both the corresponding flange 11 and the collecting pipe 7 (Figure 6), or integral with the collecting pipe 7 and welded to the corresponding flange 11 (Figure 7).

**[0027]** The welding is a laser welding, an induction welding, or a brazing or a soldering.

**[0028]** In the first case, the flange 11 has around the exhaust gas inlet 9 a flanged edge 38, extending away from the engine, toward the collecting pipe 7. The flanged edge corresponds to the tube of the connection. The end 39 of the flanged edge is welded, brazed or soldered to the collecting pipe, around one of the holes 31.

**[0029]** The end 39 may be parallel or tangential to the peripheral wall 21 (Figure 2). More precisely, when the area of the peripheral wall 21 in which the hole 31 is cut is flat, the end 39 is parallel to said area. When said area is rounded, the end 39 is tangential to said area. The end 39 may be inclined with respect to the peripheral wall 21, for example substantially perpendicular (Figure 1). More precisely, the end 39 may be inclined with respect to the area of the peripheral wall 21 in which the hole 31 is cut. The connection 37 may include a flanged edge (not shown on Figure 1) around the hole 31, extending toward the engine, to which the end 39 is welded, or brazed, or soldered.

**[0030]** In the second case, the flange 11 also has around the exhaust gas inlet 9 a flanged edge 38, extending away from the engine, toward the collecting pipe 7. However, the flanged edge is shorter than in the first case. The tube 41 is welded, or brazed, or soldered by one end to the flanged edge 38, and by its opposite end to the collecting pipe, around one of the holes 31. The collecting pipe may include a flanged edge (not shown on Figure 6) around the hole 31, extending toward the engine, to which said opposite end of the tube 41 is welded, or brazed, or soldered. The tube 41 may have enlarged ends, for accommodating the flanged edges of the plate and of the collecting pipe.

**[0031]** In the third case, the collecting pipe 7 includes a flanged edge 43 around the hole 31, extending toward the engine. The flanged edge 43 corresponds to the tube of the connection. The end 45 of the flanged edge 43 is welded to the flange 11, around inlet 9. The flange 11 may include around the exhaust gas inlet 9 a flanged edge 38, shorter than in the first case.

**[0032]** In any case, the tube length is sufficient so that the waves 27 of the thermal compensation device can be accommodated between the wall 21 and the plate 33.

**[0033]** The backflanges 17 have a thickness between 1.5 and 10 mm, preferably between 1.5 and 4 mm. The backflanges, in one embodiment, are thick pieces of metal, having a thickness much larger than the thickness of the plate 33, typically between 3 and 4 mm. In another embodiment, the backflanges are stamped pieces of metal, having a thickness close to the thickness of plate 33 to reduce the weight of the exhaust manifold. In that case, the backflanges have a thickness between 1.5 and 2.5 mm. Such backflanges may have raised edges, to increase the rigidity of the backflanges.

**[0034]** The blackflanges are bearing against an inner surface 47 of the plate 33, opposite to the external faces 13 of the flanges. The inner surface 47 is oriented toward the collecting pipe 7.

**[0035]** Each backflange 17 has a central aperture 49 and two lateral apertures 51 (Figures 2 and 3). The central aperture 49 is located in front of and around the corresponding exhaust gases inlet 9. The connection 37 extends through the central aperture. When the plate 33 includes a flanged edge 38 around the inlet, said flanged edge extends in the central aperture 49.

**[0036]** The two lateral apertures 51 are located in front of corresponding apertures 53 made through the flange 11. Tie rods 55 secured to the engine extends through both the lateral aperture 51 of the backflange and the corresponding apertures 53 of the flange 11, for securing the manifold to the engine, as explained farther away.

**[0037]** The plate 33 comprises slots 57. The slots 57 are cut in the areas 35, intermediate between the flanges. They are not covered by the backflanges. The slots are parallel to one another. They extend substantially perpendicularly to axis X. A member of slots are closed at an inner end, toward the center of the plate, and are opened at their outer ends, at the level of the raided edges 59 of the plate. A number of other slots are closed at their two opposite ends (Figure 4). The width of the slots is for example between 1 and 4 mm.

**[0038]** The plate 33 comprises two raised edges 59, parallel and opposite to one another. The raised edges 59 for example are substantially parallel to the axis X. Each edge 59 is cut by several slots 57. The raised edges 59 extend away from the engine, toward the collecting pipe 7.

**[0039]** The manifold 1 has an outer casing 61 inside which the collecting pipe7 is located, and a layer 63 of a thermal insulation material between the collecting pipe 7 and the outer casing 61 (Figures1 and 2).

**[0040]** The outer casing 61 is connected to the plate 33 so that the plate 33 and the outer casing 61 define together a closed box for the containment of the thermal insulation material.

**[0041]** The backflanges 17 are located inside said box.

**[0042]** The outer casing 61 has a sheet 65 enveloping the collecting tube. As shown on Figure 5, the sheet 65 has two opposite edges 67 welded or brazed or soldered to the raised edges 59 of the plate 33. The sheet 65 and the plate 33 define together a tubular structure whose axial ends are closed by dish-like plates 69 (Figure 1).

**[0043]** The thermal insulation material is made for example of ceramic or metal fibers. The fibers, when new, are not volatile. However, after repeated heating, the fibers tend to disintegrate. The free fibers and the dust resulting from said disintegration is contained in the closed box.

**[0044]** As clearly shown on Figures 2 and 5, the sheet 65 comprises openings 71 for accommodating the threaded end 73 of the tie rods 55. Spacer sleeves 75 are located inside the closed box. Each spacer sleeve 75 has a central bore 77 through which the tie rod passes. The threaded end 73 of the tie rod protrudes out of the bore, a screw 79 being fitted on said threaded end. The screw 79 bears against one end of the spacer sleeve 75, and presses the spacer sleeve toward the engine. The other end of the spacer sleeve bears against the backflange 17 and presses said backflange 17 against the flange 11. Said flange is in turn pressed against the receiving surface 15 of the engine.

**[0045]** As can be seen on Figure 2, the tie rod and the screw have substantially the same section as the opening 71, and extend across the opening. The tie rod together with the screw close the opening with sufficient tightness to prevent fibers from the thermal insulation material to escape through the opening.

**[0046]** The spacer sleeves can be manufactured by machining a cylinder of metal, or by stamping a tube of metal as described in DE 103 43 149. Each spacer sleeves can be obtained as well by folding a plate of metal in a U form. The two free edges bear against plate 33 and the center part of the U has a hole for receiving the tie rod. A spacer sleeve made of a stamped tube or made of a folded plate is much lighter than a spacer sleeve made of a machined cylinder. The tube and the sheet typically have a thickness between 1.5 and 2.5 mm.

**[0047]** According to another aspect of the invention, the peripheral wall 21 has a substantially flat area 81, as shown on Figure 6.

**[0048]** Each hole 31 has at least a zone 83 extending across the flat area 81. Said zone 83 corresponds to the intersection between the flat area 81 and the hole 31. Said zone 83 preferably has a surface area between 30% and 50% of the surface area of the exhaust gas inlet corresponding to the hole 31.

**[0049]** Said zone 83 is separated from an edge 85 of the hole 31 by a gap 87 cut through a region of the wall 21 which is not flat.

**[0050]** The flat area 81 makes much easier forming a flanged edge around the hole 31, such as the flanged edge shown on figure 7. It makes much easier fitting and welding a tubular connection around the hole 31, as shown on Figures 1, 2 and 6.

**[0051]** Said flat area 81 may extend along the full axial length of the collecting pipe 7, or only along a part of the axial length of the collecting pipe.

**[0052]** In order to include said flat area 81, the collecting pipe 7 may have many different types of section. It may have a square, rectangular, triangular or trapezoidal cross section, with slightly rounded corners. It may have an oval or ovoid section, with a very large radius of curvature at the level of the area 81 so that said area 81 is substantially flat.

**[0053]** The pipe may as well have any type of cross section, with at least one flat area.

**[0054]** In a less preferred embodiment, the peripheral wall 21 does not have flat areas such as areas 81, and has a round section. The holes 31 are cut in completely convex areas.

**[0055]** One of the advantages of the manifold is that a single seal (not shown) is sufficient to ensure the tightness to the exhaust gases between the manifold and the engine. The seal is between the plate 33 and the engine.

**[0056]** Because the flanges are areas of a single plate, the plate having a thickness between 0.2 and 2 mm, it is easy to weld a collecting pipe having a thin wall to the flanges.

**[0057]** Furthermore, since all the flanges are part of the same plate and are continuously connected to one another by other areas of the plate, it is easy to position and secure the flanges to the engine.

**[0058]** In case the exhaust manifold includes an outer casing for containing the thermal insulation material, the shape of the plate can be designed so that the plate can be used to close the outer casing toward the engine. The plate in that case has two functions: defining the flanges for each exhaust gases inlet, and closing the outer casing.

**[0059]** Since the collecting pipe is not integral with the plate, the manifold having leaktight connections connecting the collecting pipe to each of the flange, it is easy to assemble the plate, the backflanges and the collecting pipe.

**[0060]** Using a collecting pipe with a thin wall has the advantage that the thermal inertia of the collecting pipe is low. The weight of the manifold is very low with respect to a cast iron manifold.

**[0061]** Since the backflanges are located inside the box made by the plate and the outer casing, the shape of the outer casing is simple.

**[0062]** The slots in the plate allow the thermal expansion of the areas of the plate located between the backflanges.

**[0063]** The thermal stress in the collecting pipe is limited, because the tubular sections of the collecting pipe are connected to one another by thermal compensation devices. When the collecting pipe has a thin wall, it is particularly advantageous to make the compensation devices integral with the tubular sections. The collecting pipe is thus completely tight to the exhaust gases. The risk that a fiber of the thermal insulation material is drawn by the exhaust gases into the turbocharger is significantly reduced.

**[0064]** The structure of the manifold is very simple. It is not necessary to implement sliding joints between the tubular sections of the collecting pipe. The manufacturing of the collecting pipe is easy, since it is not necessary to weld the tubular sections to one another.

**[0065]** The weight of the different parts of the manifold bears directly on the tie rods secured to the engine, and generates very little stress in the collecting pipe or the outer casing.

**[0066]** The flat area of the collecting pipe makes much

easier forming a flanged edge around the holes of the collecting pipe, or fitting and welding tubular connections around said holes.

**[0067]** The tubular connections between the collecting pipe and the flanges are such that there is sufficient clearance between the collecting pipe and the plate to accommodate the thermal expansion devices which protrude with respect of the wall of the collecting tube.

**[0068]** The manifold may not have an outer casing and a layer of thermal isolation material. It may have an outer casing separated from the collecting pipe by an air gap without thermal insulation material. In the least case, the air gap ensures the thermal isolation.

**[0069]** The manifold may include more than one collecting pipe, for example two, three, four or more than four collecting pipe. The collecting pipes do not have fluid communications between them inside the manifold.

**[0070]** The plate 33 defining the flanges may be integral. It may be made of several pieces as well, said pieces being secured to one another, for example by weld lines.

**[0071]** According to another independent aspect, the invention is directed to an exhaust manifold for an engine, the exhaust manifold comprising:

- at least one collecting pipe for conveying exhaust gases,
- several exhaust gases inlets in fluid communication with the collecting pipe,
- one or several flanges defining the exhaust gases inlet, the or each flange having an external face adapted to be pressed against a receiving surface of the engine,

characterized in that the collecting pipe has at least two tubular sections for conveying the exhaust gases and a thermal compensation device integral with the two tubular sections, the collecting pipe having a peripheral wall with at least one hole in fluid communication with a corresponding exhaust gas inlet, said wall having a thickness between 0.2 and 2 mm, preferably between 0.4 and 0.8 mm, said wall having a substantially flat area, the hole having at least a zone extending across the flat area.

**[0072]** In this case, the flanges may be separated from one another, and may not be areas of a single plate. The flanges may be rather thicker, between 0.2 and 4 mm, preferably between 0.2 and 1.5 mm. The manifold may not include backflanges, the spacer sleeve bearing directly against the flanges when the flanges have sufficient thickness.

**[0073]** The process for manufacturing the exhaust manifold described above will now be detailed. The process includes the following steps.

**[0074]** The collecting pipe 7 is manufactured starting from a preform.

**[0075]** Said preform is a tube having the same section all along its axial length. Said section is typically round or oval.

**[0076]** The tube is first shaped by hydroforming, heat forming, or by mechanical pressure forming. The initial shape of the tube is modified to create flat areas and/or recesses. The recesses may be convex toward the inside of the tube, or toward the outside. The flat areas are for example intended to become the areas 81, or the areas where the holes 31 will be cut. The recesses are for example annular and extend each all around a circumference of the tube. The recesses are intended to become the bellows 27.

**[0077]** The bellows 27 are then formed, typically using a so-called compressive hydrobuckling method. The tube is brought into the cavity of a mold. The cavity has a wall with annular hollows having substantially the shape of the bellows 27. A fluid, typically a liquid, is injected into the internal volume of the tube so that the peripheral wall of the tube is pushed against the wall of the cavity and stretched. At the same time, a pressure is applied axially to the two axial ends of the tube. The pressure pushes the two axial ends of the tube axially one toward the other. The annular recesses are located right in front of the hollows of the cavity. The wall of the tube, in the area of the recesses, is stretched and expands outwardly into the hollows. They take the shape of the bellows 27.

**[0078]** If necessary, a step of mechanical shaping can be applied after the expansion of the recesses, to slightly modify the shape of the expanded recesses and force them into the shape of the bellows 27. The mechanical shaping can be carried out using fingers, that pinch the bottom part of each bellow and restrict its width.

**[0079]** Next the holes 31 are cut in the wall of the tube, and the raised edges 43 are created, if any. The raised edges are created by stretching the edges of the holes, using for example a flow turning process. The dish-like plates 29 are then inserted at both axial end of the tube, and welded or brazed to the tube in a leak tight manner.

**[0080]** The forming of the exhaust gas outlet of the manifold will not be described here.

**[0081]** The plate 33 is formed starting from a flat, rectangular piece of metal. The inlets 9, the raised edges 59 and the slots 57 are typically created by stamping. Then the raised edges 38 around the inlets 9 are created by flow turning.

**[0082]** The backflanges 17 are then positioned on the plate 33, and the holes 31 are leak tightly connected to the inlets 9. In the embodiment of figure 2, the ends 39 are welded or brazed or soldered to the edges of the holes 31. In the embodiment of figure 6, the tubes 41 are welded or brazed or soldered to the edges of the holes 31 and to the raised edges 38 of the inlets. In the embodiment of figure 7, the raised edges 43 are welded or brazed or soldered to the raised edges 38 of the inlets.

**[0083]** Next, spacer sleeves 75 are mounted on the backflanges 17. Each spacer sleeve 75 has a lower end 91 having a restricted diameter. Said end has a shape adapted to fit into one of the holes 51 of the backflanges (fig 2). The spacer sleeves are force fitted into holes 51.The spacer sleeves have each a recess 93, having a shape corresponding to the shape of the collecting pipe

7. The recess 93 is cut in the outer surface of the sleeve. The recess 93 makes possible to have the tie rods 55 closer to the collecting pipe 7. Only one orientation of the spacer sleeves with respect to the collecting pipe is allowed.

**[0084]** Then, the outer casing 61 and the layer of thermal insulation material 63 are mounted around the collecting pipe 7. The tie rods are inserted into the spacer sleeves 75 and screws 75 are tightened on the tie rods. The edges 67 of the outer casing are welded or brazed or soldered to the raised edges 59 of the plate 33. The dish like plates 69 are inserted between the sheet 65 of the casing and the plate 33 and leak tightly secured to the sheet and the plate, for example by welding or brazing or soldering.

## Claims

1. An exhaust manifold (1) for an engine (5), the exhaust manifold (1) comprising:

   - at least one collecting pipe (7) for conveying exhaust gases,
   - several exhaust gases inlets (9) in fluid communication with the collecting pipe (7),
   - several flanges (11) each defining one of the exhaust gases inlets (9), each flange (11) having an external face (13) adapted to be pressed against a receiving surface (15) of the engine (5),
   - several backflanges (17), each backflange (17) being associated to one of the flanges (11) and being adapted to press the corresponding flange (11) against the receiving surface (15),

   **characterized in that** the flanges (11) are areas of a single plate (33), the plate (33) having a thickness between 0.2 and 2 mm, said areas being continuously connected to one another by other areas (35) of the plate (33), the collecting pipe (7) being not integral with the plate (33), the manifold (1) having leaktight connections (37) connecting the collecting pipe (7) to each of the flange (11).

2. The exhaust manifold of claim 1, **characterized in that** the flanges (11) are integral with one another.

3. The exhaust manifold of anyone of the preceding claims, **characterized in that** the collecting pipe (7) has a wall thickness between 0.2 and 2 mm.

4. The exhaust manifold of anyone of the preceding claims, **characterized in that** the manifold (1) has an outer casing (61) inside which the collecting pipe (7) is located, and a layer (63) of a thermal insulation material between the collecting pipe (7) and the outer casing (61), the outer casing (61) being connected to the plate (33) so that the plate (33) and the outer casing (61) define together a closed box for the containment of the thermal insulation material (63).

5. The exhaust manifold of claim 4, **characterized in that** the backflanges (17) are located inside said box.

6. The exhaust manifold of claim 4 or 5, **characterized in that** the plate (33) has two outer raised edges (59) opposite to one another, raised toward a direction opposite to the engine (5), the outer casing (61) being connected to the two raised edges (59) of the plate (33).

7. The exhaust manifold of anyone of the preceding claims, **characterized in that** each backflange (17) has an aperture (49), the corresponding flange (11) having around the exhaust gas inlet (9) a flanged edge (38) extending into said aperture (49) of the backflange (17) and connected to the collecting pipe (7) by the corresponding connection (37).

8. The exhaust manifold of anyone of the preceding claims, **characterized in that** the plate (33) comprises slots (57).

9. The exhaust manifold of anyone of the preceding claims, **characterized in that** the collecting pipe (7) has at least two tubular sections (23) for conveying the exhaust gases, and at least one thermal compensation device (25) integral with the two tubular sections (23).

10. The exhaust manifold of claim 9, **characterized in that** the thermal compensation device (25) connects respective ends of the two tubular sections (23) to one another and defines internally a passage for conveying the exhaust gases from one tubular section (23) to the other tubular section (23).

11. The exhaust manifold of anyone of claims 9 to 10, **characterized in that** at least one of the tubular section (23) has a peripheral wall with a hole (31) connected to one of the flanges (11) by one of the connections (37) and being in fluid communication with the corresponding exhaust gas inlet (9), said wall having a substantially flat area (81), the hole (31) having at least a zone (83) extending across the flat area (81).

12. The exhaust manifold of claim 11, **characterized in that** said exhaust gas inlet (9) has a given surface area, said zone (83) having a surface area between 30% and 50% of the given surface area.

13. The exhaust manifold of claim 11 or 12, **characterized in that** said zone (83) is separated from an edge (85) of the hole (31) by a gap (87).

**14.** The exhaust manifold of anyone of claims 9 to 13, **characterized in that** the thermal compensation device (25) is a bellow.

**15.** The exhaust manifold of anyone of the preceding claims, **characterized in that** each of the leaktight connections (37) is a tube which is either integral with the corresponding flange (11) and welded or brazed or soldered to the collecting pipe (7), or integral with the collecting pipe (7) and welded or brazed or soldered to the corresponding flange (11), or welded or soldered or brazed to both the corresponding flange (11) and the collecting pipe (7).

**16.** The exhaust manifold of anyone of the preceding claims, **characterized in that** the backflanges (17) each have a thickness between 1.5 and 2.5 mm.

**17.** The exhaust manifold of anyone of the preceding claims, **characterized in that** it has tie rods (55) adapted to secure the manifold (1) to the engine (5), spacer sleeves (75) through which the tie rods (55) pass, and screws (79) fitted on threaded ends of the tie rods (55), said screws (79) pressing the backflanges (17) toward the engine (5), the spacer sleeves (75) being obtained by stamping a metal tube or by folding a sheet of metal.

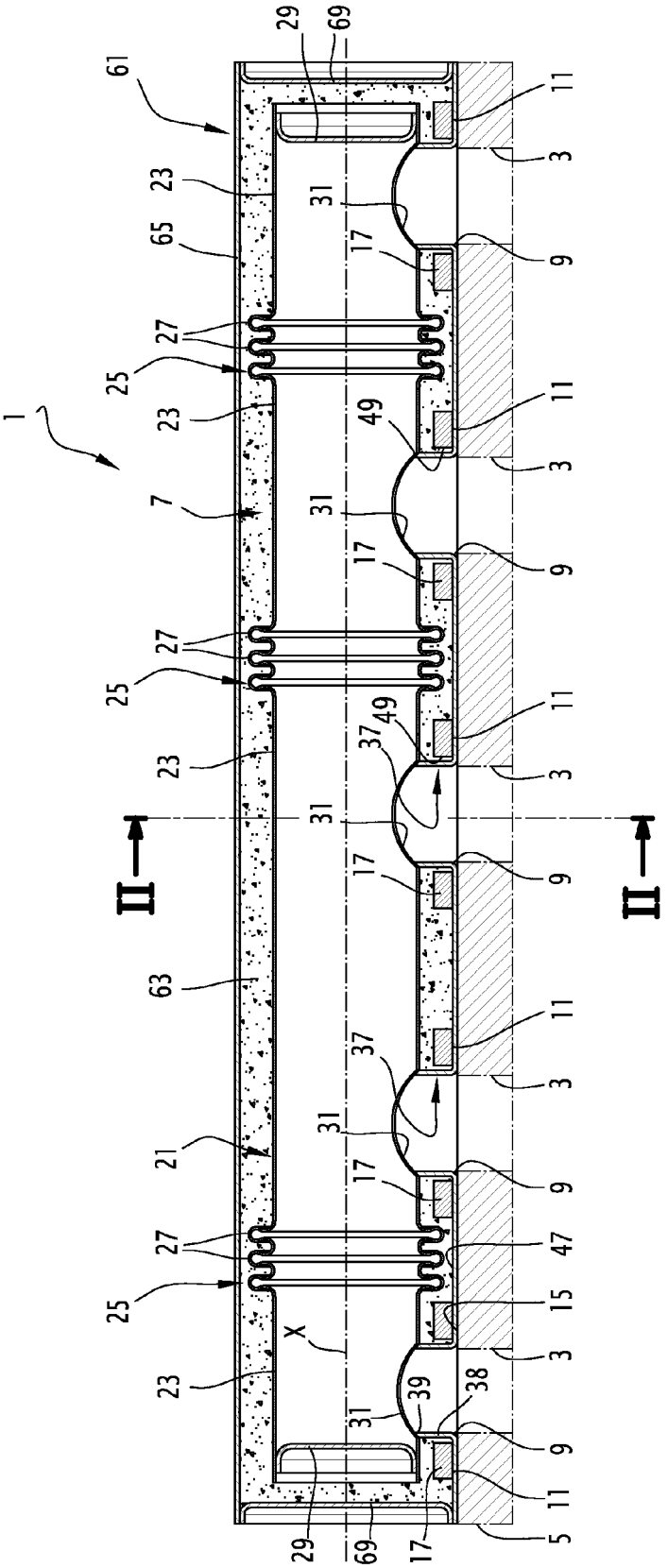


FIG.1

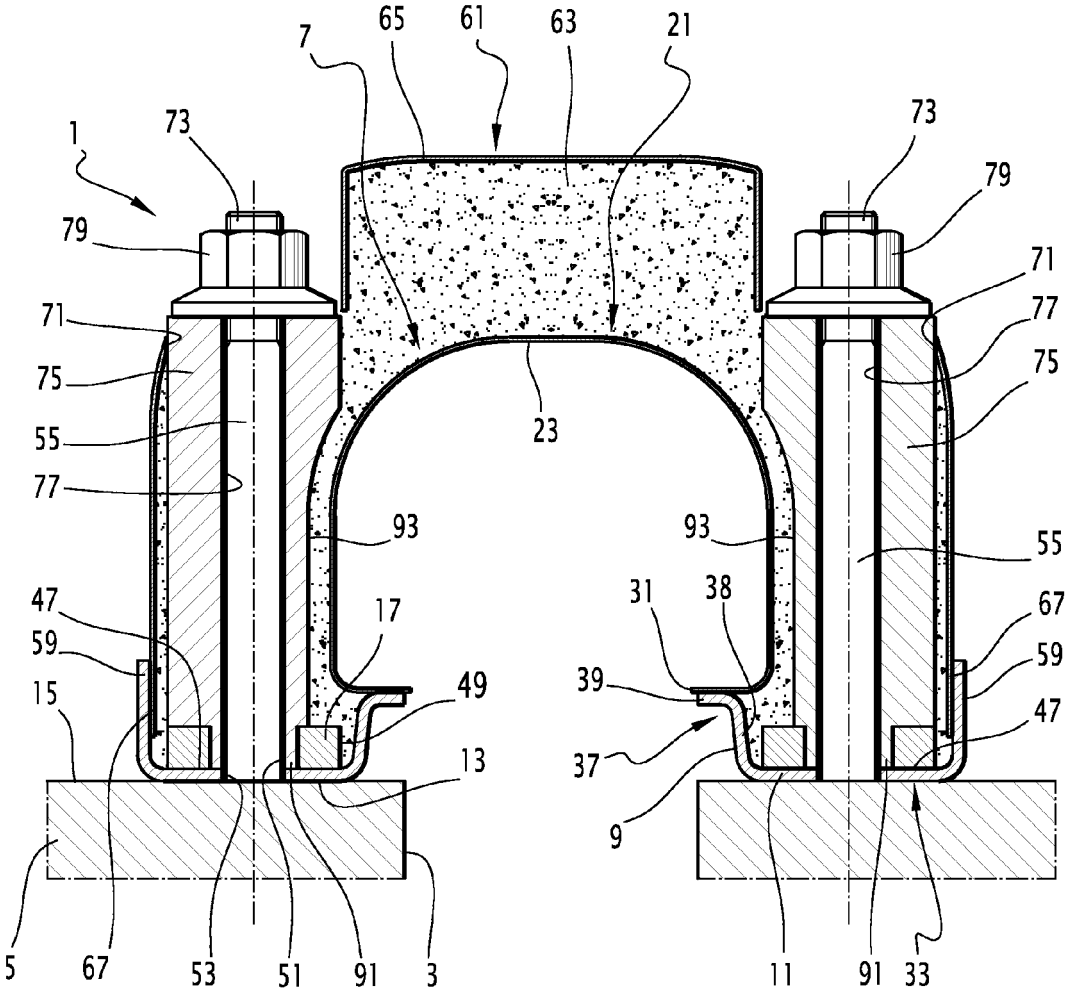
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FIG.2

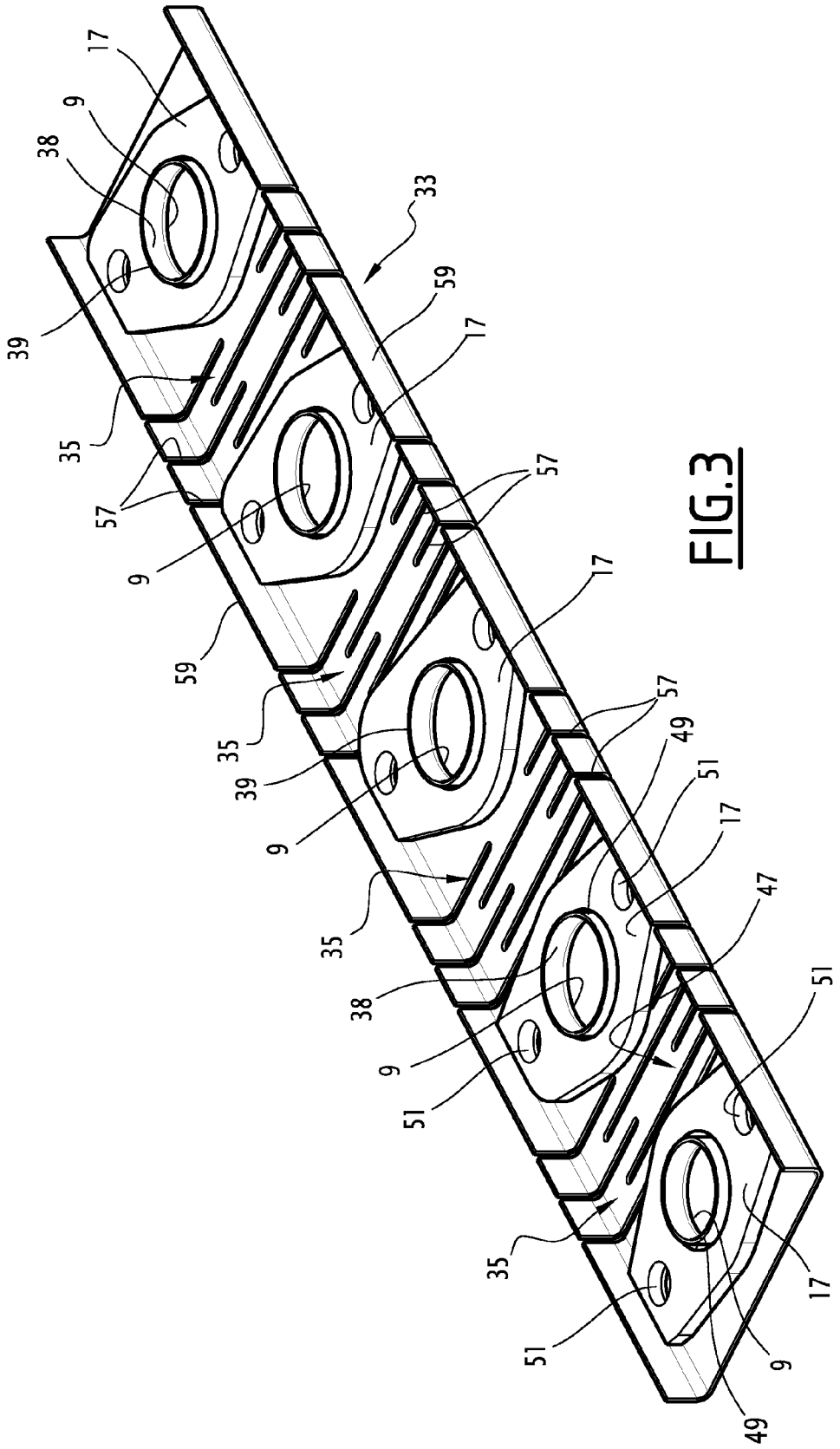
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FIG.3

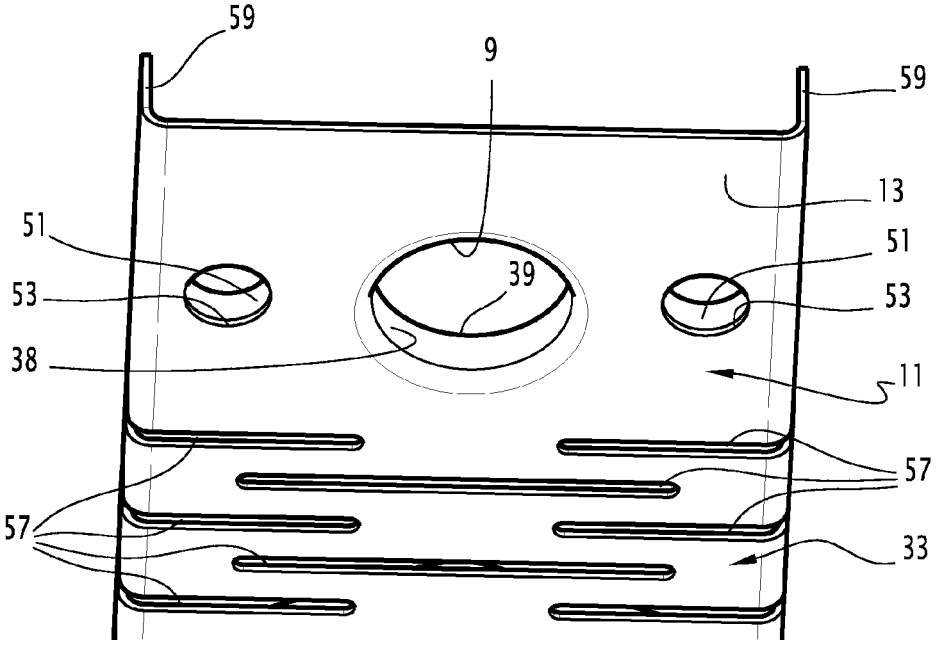
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FIG.4

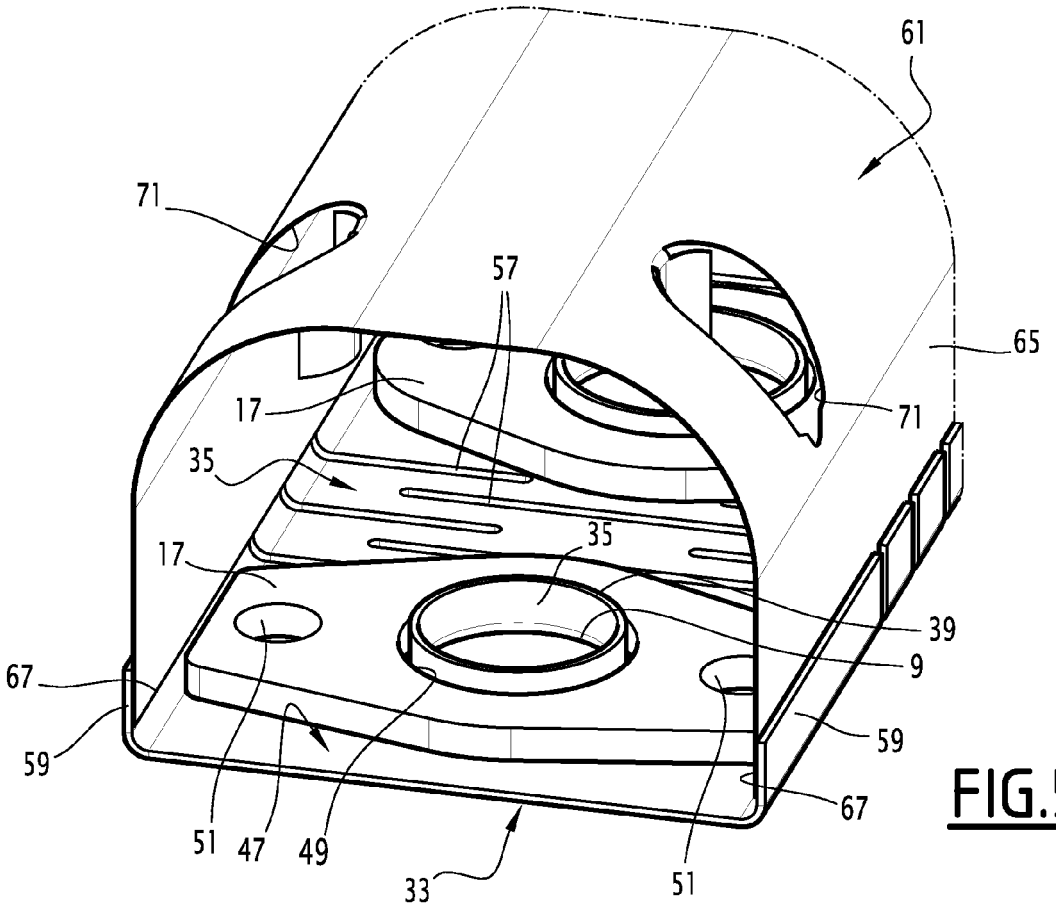
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FIG.5

FIG.6

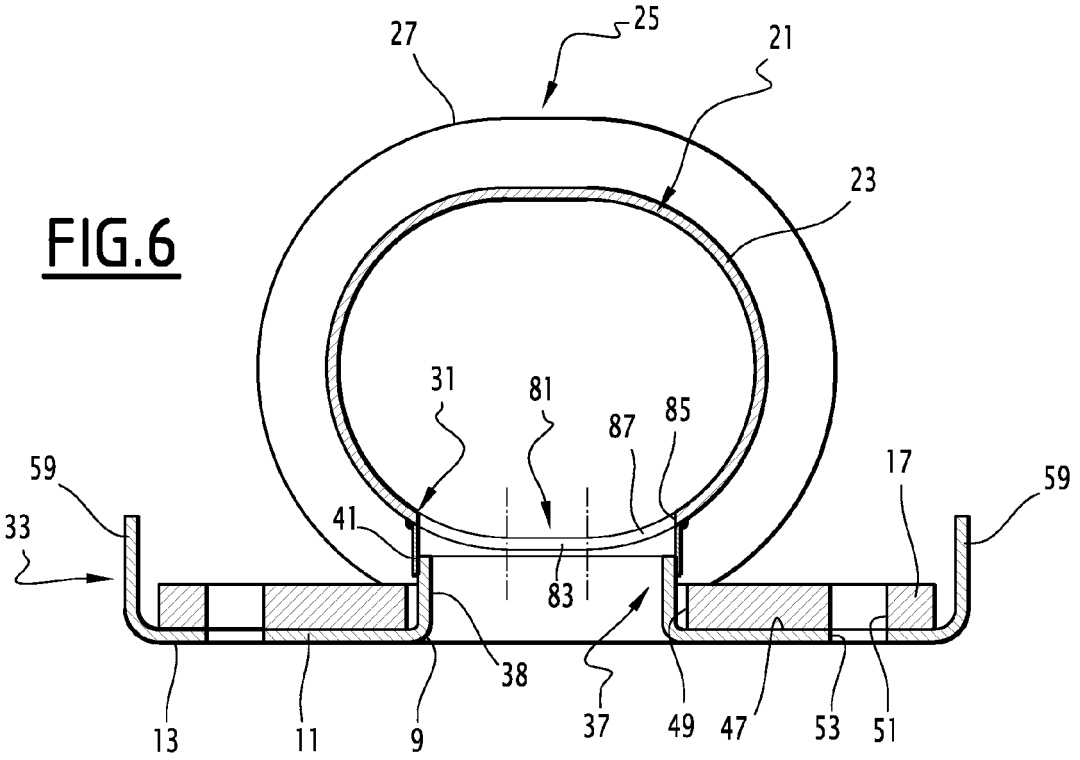
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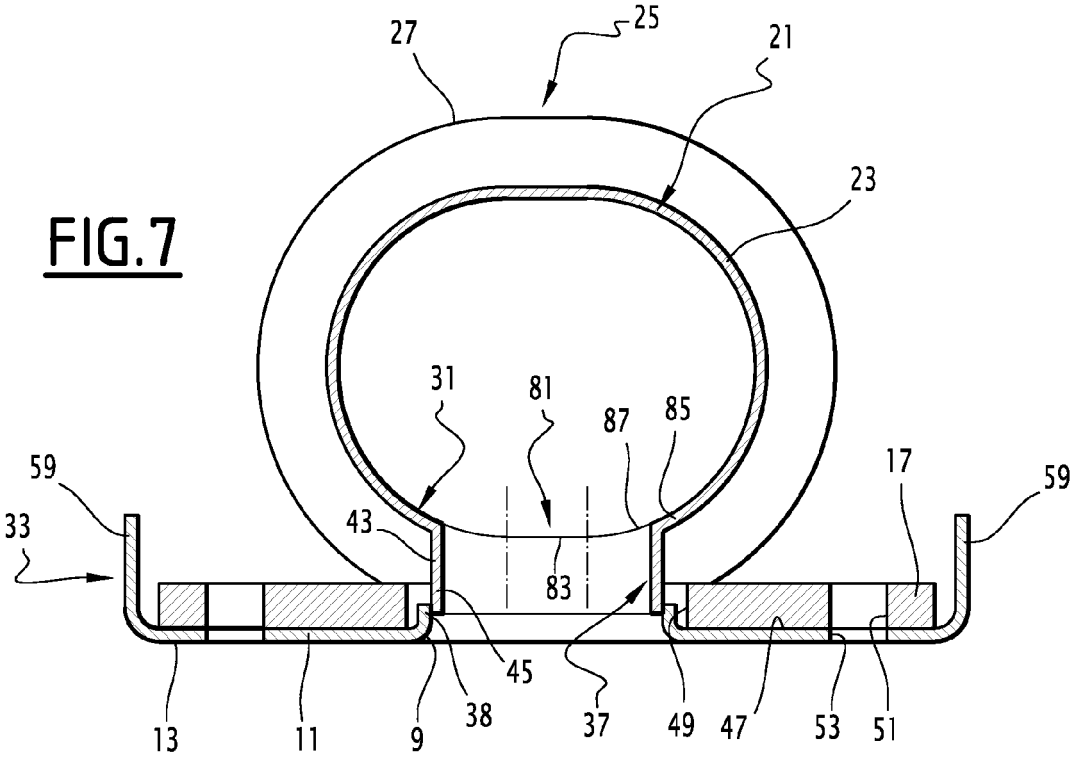
FIG.7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# EUROPEAN SEARCH REPORT

Application Number
EP 11 18 8155

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| F01N |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 28 November 2011 | Hermens, Sjoerd |

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1

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28-11-2011

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