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(54) COOLING DEVICE, IN PARTICULAR FOR AN INTERNAL COMBUSTION ENGINE

(57) The invention relates to a cooling device (1) for an internal combustion engine,
- comprising a heat exchanger (2), preferably a heat exchanger heat exchanger,
- comprising a first container (6a), which is mounted laterally on the heat exchanger (2) and from which a first tubular body (7a) protrudes upwards,
- comprising a second container (6b) which is mounted on the heat exchanger (2) adjacent to the first container (6a) and below the latter and from which a second tubular body (7b) protrudes upwards towards the first container (6a),
characterized in that
the second tubular body (7b) is connected to the first container (6a) in an integrally bonded manner.

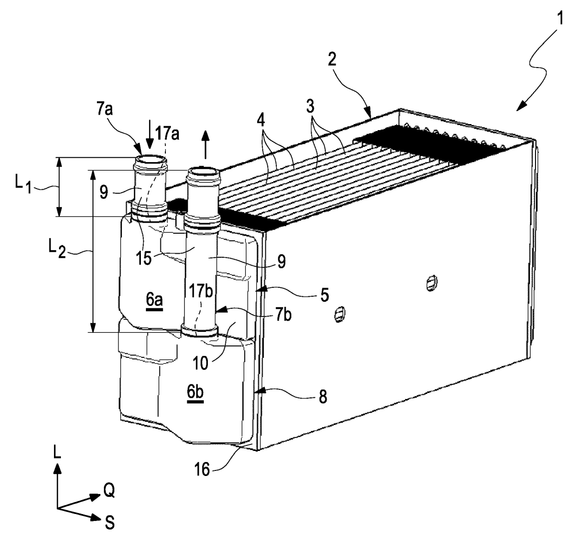


Fig. 1

EP 3 296 537 A1

Description

[0001] The present invention relates to a cooling device, in particular for an internal combustion engine, and to an internal combustion engine with such a cooling device.

[0002] Cooling devices with heat exchangers are used in motor vehicles, for example as charge air coolers, if the charge air to be introduced into the cylinders of the internal combustion engine is intended to be cooled. Said heat exchangers typically comprise a plurality of gas paths through which the gas to be cooled flows and, fluidically separated therefrom, a plurality of gas paths through which a coolant flows. The gas is cooled by transfer of heat from the hot gas to the colder coolant. In order to make the exchange of heat as efficient as possible, the individual gas and coolant paths are generally arranged in an alternating manner next to one another. In this way, the area available for the thermal interaction is maximized. In order to distribute the coolant after introduction into the cooling device to the individual coolant paths and to collect said coolant after it has flowed through the individual coolant paths, a coolant distributor or coolant collector - in each case designed as a container - which communicates fluidically with the individual coolant paths is customarily mounted on the heat exchanger. The coolant can be introduced into the coolant distributor or discharged from the coolant collector via a tubular body mounted on the coolant distributor or collector.

[0003] A cooling device designed in such a manner with a tube-fin heat exchanger is dealt with in EP 1 729 080 A1.

[0004] The present invention is concerned with the problem of specifying, for a cooling device of the type in question, an improved or at least alternative embodiment which is distinguished in particular by improved mechanical rigidity.

[0005] This object is achieved by the subject matter of the independent patent claims. Preferred embodiments are the subject matter of the dependent patent claims.

[0006] The basic concept of the invention is accordingly to connect the tubular body protruding from the coolant distributor or the tubular body protruding from the coolant collector of the cooling device to the coolant collector or coolant distributor in an integrally bonded manner. Said tubular body can thereby be permanently secured on the coolant collector or coolant distributor, which significantly increases the mechanical rigidity of the structure with respect to conventional arrangements.

[0007] A cooling device according to the invention for an internal combustion engine comprises a heat exchanger and a first container, which is mounted laterally on the heat exchanger and from which a first tubular body protrudes upwards. The heat exchanger here is preferably designed as a tube-fin heat exchanger. Furthermore, a second container is arranged adjacent to the heat exchanger and below the first container, from which second container a second tubular body protrudes upwards, i.e. along the same direction as the first tubular body. The terms "at the top" and "below" relate here to an installation position of the cooling device during assembly or to a use position in a motor vehicle. According to the invention, the second tubular body is connected to the first container in an integrally bonded manner.

[0008] In a preferred embodiment, the second tubular body is soldered to the first container at least in sections. Such a soldered connection permits the desired permanent securing of the two components of the cooling device on each other in a simple manner by means of an integrally bonded connection.

[0009] The second tubular body can expediently have a circumferential wall which extends along a longitudinal direction and, in a cross section perpendicular to the longitudinal direction, has a round, preferably a circular, geometry.

[0010] In an advantageous development, an outer side of the first container, which outer side faces the second tubular body, is soldered to the second tubular body, in particular to the circumferential wall of the second tubular body.

[0011] A mechanically particularly stable fastening of the first container to the second tubular body can be achieved in a further advantageous embodiment, in which the first container, in particular the outer side thereof facing the second tubular body, has a surface contour which is complementary to the circumferential wall of the second tubular body, at least in that region in which said container is connected to the second tubular body in an integrally bonded manner.

[0012] Even better securing of the second tubular body on the first container is achieved if the first container lies flat against the second tubular body at least in that region in which said container is connected to the second tubular body in an integrally bonded manner.

[0013] In a further advantageous development, the outer side of the first container comprises a lower region which merges upwards into an upper region which is at a greater distance from the heat exchanger than the lower region. In this variant, the second tubular body is connected to the upper region of the first container in an integrally bonded manner. Reduced manufacturing costs are associated with such a connection which is integrally bonded only in regions.

[0014] The upper region particularly preferably extends along at least one third of an entire height of the first container.

[0015] In an advantageous development, the lower region of the first container is arranged at a distance from the second tubular body. Undesirable thermomechanical stresses between the second tubular body and the first container can thereby be kept small.

[0016] In a further preferred embodiment, in a longitudinal section along a longitudinal direction of the second tubular body, the outer side of the first container and the second tubular body, in particular an outer side of the circumferential wall thereof, lie against each other at least along the first region. This permits the realization of a flat integrally bonded connection, in particular if the latter is a soldered connection.

[0017] The second tubular body can expediently have a second tube length which is measured along the longitudinal direction and is greater than a first tube length of the first tubular body, which first tube length is measured along the longitudinal direction. The effect which can be achieved by this is that the openings of the two tubular bodies, which openings face away from the containers, are arranged at the same height.

[0018] A further preferred embodiment in which the first tubular body and the first container are formed in two parts has proven particularly simple to fit. In this variant, the design of first container and first tubular body is realized in such a manner that the first tubular body can be inserted along the first direction into a first container opening present on the first container.

[0019] A further preferred embodiment in which the second tubular body and the second container are formed in two parts has likewise proven particularly simple to fit. In this variant, the design of second container and second tubular body is realized in such a manner that the second tubular body can be inserted along the first direction into a second container opening present on the second container.

[0020] The invention furthermore relates to an internal combustion engine with an exhaust system and with a cooling device presented above. The above-explained advantages of the cooling device according to the invention are therefore also transferred to the internal combustion engine.

[0021] Further important features and advantages of the invention emerge from the dependent claims, from the drawings and from the associated description of the figures with reference to the drawings.

[0022] It goes without saying that the features mentioned above and those which have yet to be explained below are usable not only in the respectively stated combination, but also in different combinations or on their own without departing from the scope of the present invention.

[0023] Preferred exemplary embodiments of the invention are illustrated in the drawings and are explained in more detail in the description below.

[0024] In the drawings, in each case schematically:

Fig. 1 shows an example of a cooling device according to the invention in a perspective illustration,

Fig. 2 shows the cooling device of Figure 1 in a longitudinal section,

Fig. 3 shows the cooling device of Figure 1 in a cross section.

[0025] Figure 1 shows an example of a cooling device 1 according to the invention for an internal combustion engine in a perspective view. The cooling device 1 comprises a heat exchanger 2 which can be designed as a tube-fin heat exchanger or a stacked plate heat exchanger. The heat exchanger 2 or heat exchanger heat exchanger comprises in a customary manner a plurality of gas and coolant paths 3, 4 which are arranged in an alternating manner on one another along a stacking direction S, run in a fluidically separated manner from one another in the heat exchanger 2, but nevertheless are thermally coupled to one another. By means of an exchange of heat between the gas and the coolant, heat is extracted from the gas to be cooled and is supplied to the coolant, as a result of which the desired cooling of the gas is achieved.

[0026] In order to supply the coolant for cooling the gas to the individual coolant paths 4, a coolant distributor 5 is provided on the heat exchanger 2. The coolant distributor 5 comprises a first container 6a, which is mounted laterally with respect to the stacking direction S on the heat exchanger 2 and from which a first tubular body 7a protrudes upwards. The coolant can be introduced via the first tubular body 7a into the first container 6a and distributed by the latter to the individual coolant paths 4. For this purpose, the first container 6a communicates with the coolant paths 4 of the heat exchanger 2.

[0027] In order to collect the coolant again after it has flowed through the individual coolant paths 4 and to discharge said coolant from the cooling device 1, a coolant collector 8 which likewise communicates with the coolant paths 4 is provided on the heat exchanger 2. The coolant collector 8 furthermore comprises a second container 6b which is mounted on the heat exchanger 2 below the first container 6a and adjacent thereto. A second tubular body 7b protrudes upwards from the second container 6b.

[0028] The terms "at the top", "at the bottom", "above" and "below" used above and below preferably relate to an installation position of the cooling device 1 during assembly or to a use position of the cooling device 1, in particular in a motor vehicle.

[0029] In the example scenario, the two tubular bodies 7a, 7b both extend along a common longitudinal direction L in each case perpendicularly to the stacking direction S. The two containers 6a, 6b are arranged one above the other on the same side of the heat exchanger 2, specifically on a side wall 16 of the heat exchanger 2. In a variant of the example, coolant distributor 5 and coolant distributor 8 may be interchanged. The second tubular body 6b has a second tube length l2 which is measured along the longitudinal direction L and is greater than a first tube length l1 measured along the longitudinal direction L. The first tubular body 7a and the first container 6a can be formed in two parts, and therefore the first tubular body 7a can be inserted into a first container opening 17a present on the first container 6a. In an analogous manner, the second tubular body 7b and the second container 6b can also be formed in two parts, and therefore the second tubular body 7b can be inserted into a second container opening 17b present on the second container

6b.

[0030] The second tubular body 7b comprises a circumferential wall 9 which extends along the longitudinal direction L and, in a cross section perpendicular to the longitudinal direction, has a round, preferably a circular, geometry. The longitudinal direction L runs here perpendicularly to the stacking direction S. This can be gathered from Figure 3 which shows the cooling device 1 of Figure 1 in such a cross section. As shown in the figures, the first tubular body 7a can be formed with regard to its geometrical shaping in an identical manner to the second tubular body 7b.

[0031] Figure 2 shows the cooling device 1 of Figure 1 in a longitudinal section along the common longitudinal direction L of the two tubular bodies 7a, 7b. According to Figure 2, an outer side 10 of the first container 6a, which outer side faces the second tubular body 7b, is soldered to the circumferential wall 9 of the second tubular body 7b. The second tubular body 7b is therefore soldered to the first container 6a at least in sections. In this way, the second tubular body 7b is connected to the first container 6a in an integrally bonded manner.

[0032] Figure 3 shows the cooling device 1 of Figure 1 in a cross section perpendicular to the longitudinal direction L of the two tubular bodies 7a, 7b. As Figure 3 clearly proves, the outer side 10 of the first container 6a, which outer side faces the second tubular body 7b, has a surface contour which is complementary to the circumferential wall 9 of the second tubular body 7b in that region 11 in which said outer side is connected to the second tubular body 7b in an integrally bonded manner. The first container 6a lies flat against the second tubular body 7b in the region 11 in which said container is connected to the second tubular body 7b in an integrally bonded manner.

[0033] It can be gathered from the longitudinal section of Figure 2 that the outer side 10 of the first container 6a comprises a lower region 12 which merges upwards, along the longitudinal direction L, into an upper region 13. The upper region 13 is at a distance a1 along a transverse direction Q from the heat exchanger 2 or from the side wall 16 thereof. The lower region 12 is at a distance a2 along the transverse direction Q from the heat exchanger 2, which distance is smaller than the distance a1. The transverse direction Q runs perpendicularly here both to the stacking direction S and to the longitudinal direction L.

[0034] According to Figure 2, the upper region 13 extends along the longitudinal direction L along at least a third of an entire height H of the first container 6a. By contrast, the lower region 12 of the first container 6a is arranged at a distance from the second tubular body 7b. The two regions 12, 13 can merge into each other by means of a radial step 14. In the longitudinal section along the longitudinal direction L of the second tubular body 7b according to Figure 2, the outer side 10 of the first container 6a and an outer side 15 of the circumferential wall 9 of the second tubular body 7b lie against each other along the lower region 12. The second tubular body 7b is soldered, i.e. connected in an integrally bonded manner, to the upper region 13 of the first container 6a.

Claims

1. Cooling device (1) for an internal combustion engine,

- comprising a heat exchanger (2), preferably a tube-fin heat exchanger,
- comprising a first container (6a), which is mounted laterally on the heat exchanger (2) and from which a first tubular body (7a) protrudes upwards,
- comprising a second container (6b) which is mounted on the heat exchanger (2) adjacent to the first container (6a) and below the latter and from which a second tubular body (7b) protrudes upwards towards the first container (6a),

characterized in that
the second tubular body (7b) is connected to the first container (6a) in an integrally bonded manner.

2. Cooling device according to Claim 1,
characterized in that
the second tubular body (7b) is soldered at least in sections to the first container (6a).

3. Cooling device according to Claim 1 or 2,
characterized in that
the second tubular body (7b) has a circumferential wall (9) which extends along a longitudinal direction (L) and, in a cross section perpendicular to the longitudinal direction (L), has a round, preferably a circular, geometry.

4. Cooling device according to one of Claims 1 to 3,
characterized in that
an outer side (10) of the first container (6a), which outer side faces the second tubular body (7b), is soldered to the second tubular body (7b), in particular to the circumferential wall (9) of the second tubular body (7b).

5. Cooling device according to Claim 3 or 4,
characterized in that
the first container (6a), in particular the outer side (10) thereof facing the second tubular body (7b), has a surface contour which is complementary to the circumferential wall (9) of the second tubular body (7b), at least **in that** region (11) in which said container is connected to the second tubular body (7b) in an integrally bonded manner.

6. Cooling device according to one of the preceding claims,

characterized in that
the first container (6a) lies flat against the second tubular body (7b) at least **in that** region (11) in which said container is connected to the second tubular body (7b) in an integrally bonded manner.

7. Cooling device according to one of Claims 4 to 6,
characterized in that
the outer side (10) of the first container (6a) comprises a lower region (12) which merges upward into an upper region (13) which is at a greater distance from the heat exchanger (2) than the lower region (12), wherein the second tubular body (7b) is connected to the upper region (13) of the first container (6a) in an integrally bonded manner.

8. Cooling device according to Claim 7,
characterized in that
the upper region (13) extends along at least one third of a height (H) of the first container (6a).

9. Cooling device according to Claim 7 or 8,
characterized in that
the lower region (12) of the first container (6a) is arranged at a distance from the second tubular body (7b).

10. Cooling device according to one of Claims 4 to 9,
characterized in that,
in a longitudinal section along the longitudinal direction (L) of the second tubular body (7b), the outer side (10) of the first container (6a) and the second tubular body (7b), in particular an outer side (15) of the circumferential wall (9) thereof, lie against each other at least along the first region (12).

11. Cooling device according to one of the preceding claims,
characterized in that
the second tubular body (6b) has a second tube length (l2) which is measured along the longitudinal direction (L) and is greater than a first tube length (l1) of the first tubular body, which first tube length is measured along the longitudinal direction (L).

12. Cooling device according to one of the preceding claims,
characterized in that
the first tubular body (7a) and the first container (6a) are formed in two parts in such a manner that the first tubular body (6a) can be inserted into a first container opening (17a) present on the first container (6a).

13. Cooling device according to one of the preceding claims,
characterized in that
the second tubular body (7b) and the second container (6b) are formed in two parts in such a manner that the second tubular body (7b) can be inserted into a second container opening (17b) present on the second container (6b).

14. Internal combustion engine with a cooling device (1) according to one of the preceding claims.

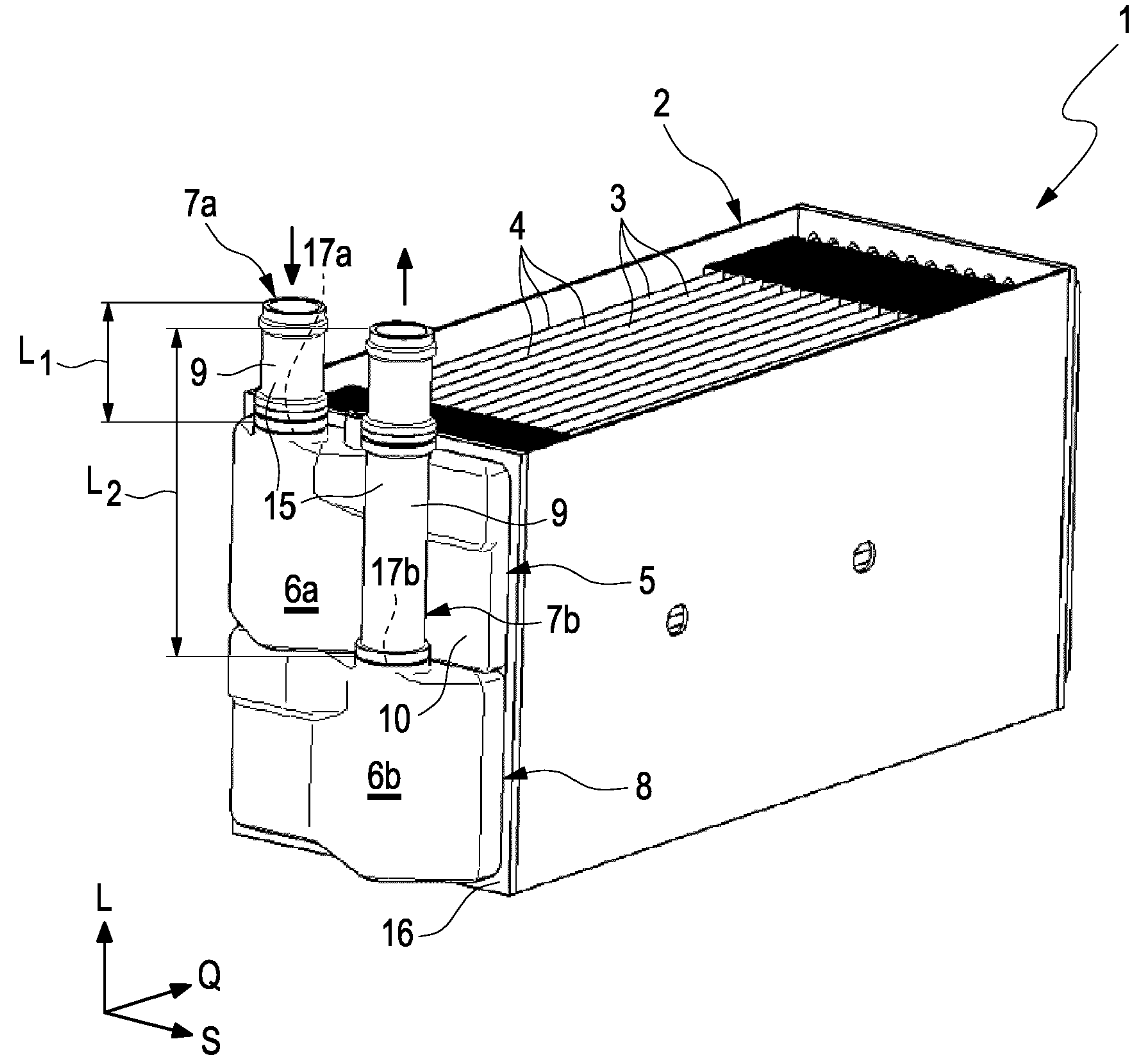


Fig. 1

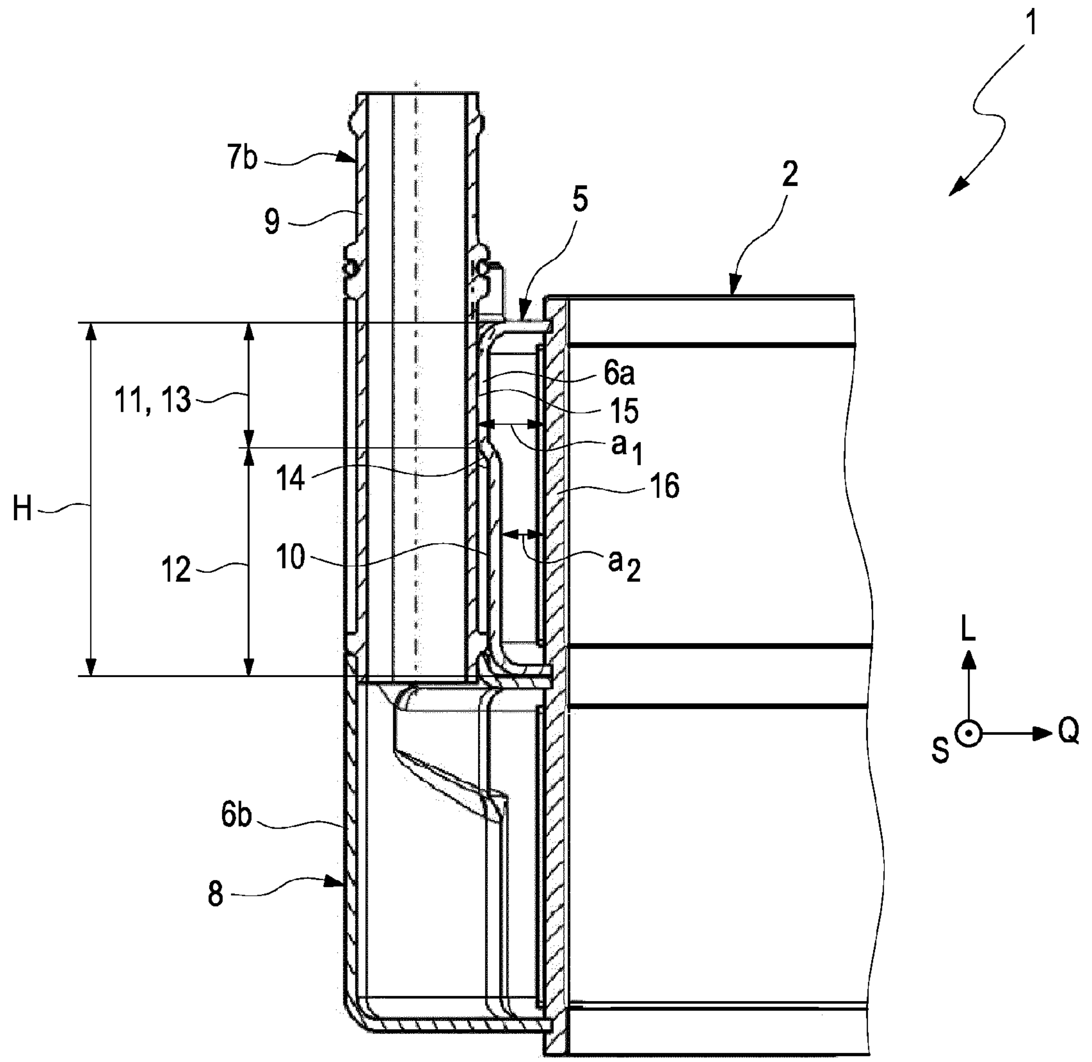
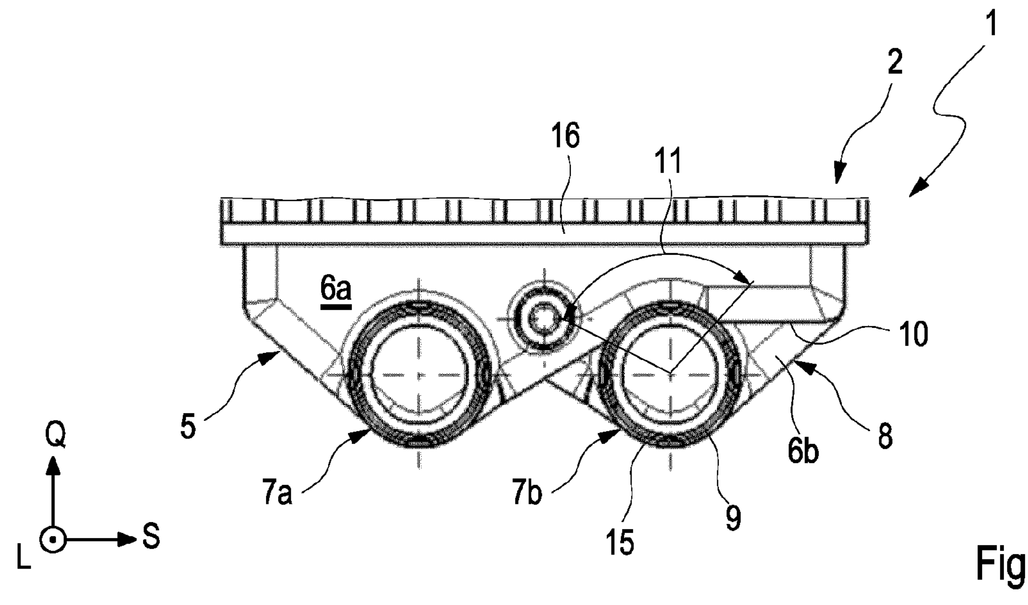

1
2
5
7b
9
6a
15
11, 13
a1
14
16
H
12
10
a2
L
S
Q
6b
8

Fig. 2


1
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6a
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Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 8774

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TECHNICAL FIELDS SEARCHED (IPC)

F01P
F02B
F28F
F28D

The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	7 February 2017	Schwaller, Vincent

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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