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(54) REINFORCED HEAT EXCHANGER COMPRISING A STACK OF PLATES

(57) The heat exchanger (2) comprises a stack of plates (4) comprising a lower plate (20) onto which the other plates (22) are stacked. The said other plates comprise a base plate (22) immediately adjacent to the lower plate (20).

The heat exchanger (2) also comprises a fixation plate (6) and a reinforcement plate (8) between the fixation plate (6) and the lower plate (20).

The heat exchanger (2) further comprises reinforcing inserts (24) between the base plate (22) and the lower plate (22).

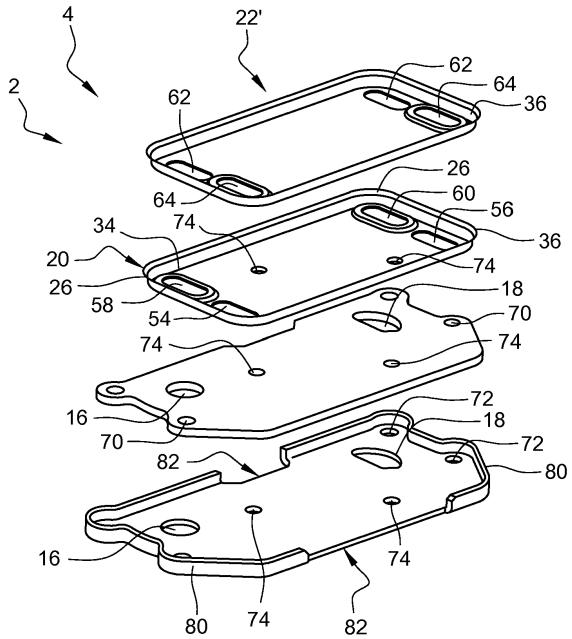

Fig. 3

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Description

[0001] In the field of heat exchangers for automotive vehicles, it is known to use heat exchangers comprising stack of plates for the circulation of two fluids alternately between the adjacent pairs of plates. Such heat exchangers are used for example as oil coolers for the oil of the engine. The oil and coolant circulate along respective sides of each intermediate plate of the stack of plates.

[0002] The heat exchanger may also comprise a fixation plate for fixation of the stack of plates into the automotive vehicle. The stack of plates is for example soldered to the fixation plate which is itself fastened to the vehicle, for example with screws.

[0003] A reinforcement plate between the fixation plate and the stack of plates is also known from US2007084809-A and EP2267390-A.

[0004] However, these designs are costly and may still be improved in terms of mechanical resistance.

[0005] One aspect of the invention relates to a heat exchanger comprising a stack of plates comprising a lower plate onto which the other plates are stacked, the said other plates comprising a base plate immediately adjacent to the lower plate, the heat exchanger also comprising a fixation plate, and a reinforcement plate between the fixation plate and the lower plate, wherein the heat exchanger further comprises reinforcing inserts between the base plate and the lower plate.

[0006] After brazing of the parts together, having reinforcing inserts brings added soldered surface between the top surface of the lower plate and the bottom surface of the said lower plate, thereby reinforcing the heat exchanger.

[0007] It was also found that having reinforcing inserts around only two corners is a good solution.

[0008] In particular embodiments, the heat exchanger may comprise one, several or any combination of the following technical features:

- the reinforcing inserts are frame parts;
- the reinforcing inserts have an arcuate shape;
- the reinforcing inserts extend along from 45° to 90° of a corner of the lower plate, preferably from 70° to 90°, preferably 90°;
- the reinforcing inserts extend around more than 90 degrees, the reinforcing inserts having straight portions at the end of the arcuate portions;
- the reinforcing inserts have a rectangular cross section;
- the reinforcing inserts have a round cross section;
- the reinforcing inserts extend along a peripheral edge of the lower plate;
- the reinforcing inserts are in contact with the peripheral edge of the lower plate;
- the reinforcing inserts are in contact with an internal surface of the peripheral edge of the lower plate;
- the reinforcing inserts have a bottom surface in contact with a top surface of the lower plate;
- the reinforcing inserts have a top surface in contact with a bottom surface of the lower plate;
- the reinforcing inserts are sandwiched between a top surface of the lower plate and a bottom surface of the lower plate;
- the reinforcing inserts extend between a top surface of the lower plate and a bottom surface of the said lower plate;
- the reinforcing inserts are only along one or more corners of the lower plate, preferably along only two corners of the lower plate;
- the reinforcing inserts are continuous along the respective corners of the lower plate;
- for each reinforced corner, there is only one reinforcing insert;
- the reinforcement plate is a substantially planar plate;
- the reinforcement plate is a planar plate;
- the reinforcement plate has two holes for the circulation of fluid, the reinforcing inserts being at proximity of the two holes;
- the two holes are respectively for the inlet and outlet of a fluid, in particular oil;
- the lower plate has corresponding holes in regards of the two holes for the circulation of fluid of the reinforcement plate, the two holes of the lower plate being respectively in the two corners of the lower plate that are reinforced by the reinforcing inserts;
- the fixation plate has a planar surface receiving the reinforcement plate and a protrusion around the reinforcement plate;
- the protrusion is a peripheral edge of the fixation plate;
- the peripheral edge is present along at least 50% of the contour of the reinforcement plate;
- the fixation plate has two holes for the circulation of fluid in regards of the corresponding holes of the reinforcement plate;
- the fixation plate has holes for fixation of the heat exchanger into an automotive vehicle;
- the reinforcement plate has holes for fixation in regards of the corresponding holes of the reinforcement plate;
- the stack of plates define two circuits for two respective fluids, the circuits being configured so that the two fluids circulate alternately between the adjacent pairs of plates;
- each circuit flows along a respective side of each intermediate plate of the stack of plates;
- each intermediate plate of the stack of plates has holes for the circulation of two fluids through each intermediate plate;
- the top end plate opposite to the lower plate in the stack of plates, has two holes respectively for the inlet and outlet of the second of the two fluids, in particular coolant;
- the heat exchanger is an oil cooler.

[0009] Embodiments of the invention will now be described, by way of example, with reference to the following drawings, in which:

- Figure 1 is a perspective view of a heat exchanger according to an embodiment of the invention, comprising a stack of plates, a fixation plate and a reinforcement plate between the fixation plate and the stack of plates;
- Figure 2 is a top view of the lower plate present in the heat exchanger of Figure 1, with reinforcing inserts on top of the lower plate;
- Figure 3 is a perspective view showing the fixation plate, the reinforcement plate and the lower plate of the stack of plates present in the heat exchanger of Figure 1, as well as on top of the lower plate, the first base plate of the stack of base plates;
- Figure 4 is a perspective of a reinforcing insert;
- Figure 5 is a section view of the fixation plate, reinforcement plate, lower plate, said base plate and said reinforcing insert.

[0010] Figure 1 shows a heat exchanger 2 typically used for oil cooling. The heat exchanger comprises a stack of plates 4, a fixation plate 6 and a reinforcement plate 8 between the fixation plate 6 and the stack of plates 4.

[0011] The heat exchanger comprises a coolant inlet 10 and coolant outlet 12 going through the top end plate 14 of the stack of plates. The coolant is for example a water and glycol based liquid commonly used for engine cooling. On figures 2 & 3, an oil inlet 16 and an oil outlet 18 can also be seen through the lower plate 20 of the stack of plates 4, through the reinforcement plate 8 and through the fixation plate 6. The heat exchanger 2 is thus intended to be used as an oil cooler, for example for cooling the oil of the engine of the automotive vehicle. However, the heat exchanger could also be used for heat exchange between other fluids, such as for example between water and glycol based liquid and a refrigerant fluid such as for example 1234yf.

[0012] The stack of plates 4 of the heat exchanger is designed so that the two fluids circulate alternately between the adjacent pairs of plates. That is to say, each fluid circulates along respective sides of each intermediate plate 22 (also called "base plates") of the stack of plates. The base plates 22 have holes for the circulation of the two fluids through each base plate. On figures 3 and 5 is shown the first base plate 22' of the stack of plates 4, starting from the side of the lower plate 20.

[0013] This type of stack of base plates 4 is commonly used and known to the person skilled in the art.

[0014] The heat exchanger comprises reinforcing inserts 23 (Figure 2, Figure 4 & Figure 5) between the lower plate 20 and the base plate 22'.

[0015] The reinforcing inserts 23 are frame parts, for example of rectangular cross section. Alternatively, the reinforcing inserts 23 are inserts of any adapted cross section, for example a round cross section.

[0016] The reinforcing inserts 23 extend internally along two corners 26 of the lower plate 20. More generally, the reinforcing inserts 23 extend along only one or more corners of the lower plate. To this end, the reinforcing inserts have an arcuate shape, more precisely a quarter circular shape. More generally, the reinforcing inserts 23 extend along between 45° and 90° of the reinforced corners, preferably 90°.

[0017] The reinforcing insert 23 are sandwiched between the top main planar surface 24 of the lower plate 20 and the bottom main planar surface 26 of the lower plate 22'. The top surface 28 of the reinforcing inserts 23 is thus in contact with the bottom surface 26 of the lower plate 22' and the bottom surface 30 of the reinforcing inserts is in contact with the top surface 24 of the lower plate 20.

[0018] Importantly also, the reinforcing elements have a radial external surface 32 in contact with an internal surface 34 of the peripheral edge 36 of the lower plate 20.

[0019] For each of the two reinforced corners of the lower plate 20, there is preferably only one continuous reinforcing insert 23.

[0020] Preferably also, the reinforcing inserts 23 are in one part (or "continuous") around their respective corners 26. That is to say that each corner 26 is reinforced by only one reinforcing insert 23. It was found a more reliable reinforcement compared to having several reinforcing inserts around a specific corner.

[0021] Preferably again, the reinforced corners are the one at proximity of the holes for fluid communication 16 and 18 for oil. If the inlet and outlet of water and glycol based coolant were also designed through the reinforcement plate 8 and fixation plate 6, which is also a possible alternative, then the reinforcing inserts would be at proximity of the inlet & outlet for oil, and there would be no reinforcing inserts at proximity of the inlet & outlet for water & glycol based coolant.

[0022] The base plates 22,22' are all identical. They have holes 62 for the circulation of oil and holes 64 for the circulation of coolant.

[0023] Also, each base plate is turned 180 degrees in respect of the adjacent base plates. In this way, it is not necessary to make two different kinds of plates, as commonly known.

[0024] A first group of base plates are intended for the circulation of oil above the base plates 22. The holes 62 for the circulation of oil are in the same plane as the main planar surfaces of these plates and the holes 66 for the circulation of coolant are elevated so that they make a tight contact with the bottom planar surface of the base plate above, which is turned 180 degrees.

[0025] The second half of the base plates 22 of the stack of plates have holes 64 for coolant in the plane of the main planar surfaces of these base plates 22 and the holes for the circulation of oil 62 are elevated so that they make a tight contact with the bottom surface of the plates above. Coolant will circulate on the top side of this second

type of base plate.

[0026] Importantly, each base plate 22 of the stack of plates 4, the lower plate 20 and the upper plate (not shown) having a peripheral edge 36 of an identical shape. The peripheral edge 36 of each plate receives the external surface of the peripheral edge 36 of the plate above in a tight manner. This design is also called a "tub" design wherein each tub plate receives the tub plate above in a tight manner along the peripheral edges 36.

[0027] The top end plate only has holes 66 & 68 for receiving the inlet & outlet of coolant. Alternatively, as explained above, the inlet & outlet of coolant could also be on the side of the fixation plate 6, in which case, there would be not circulation holes in the top end plate 14.

[0028] The reinforcement plate 8 shown more specifically on Figure 3, is a planar plate having a relatively high thickness.

[0029] The reinforcement plate 8 has fixation holes 70 in regards of corresponding fixation holes 72 of the fixation plate 6, in order to receive for example fixation screws intended to fasten the heat exchanger into the automotive vehicle. Alternatively, the reinforcement plate has no fixation hole and the fixation plate 6 is fastened to the automotive by holes that are external to the reinforcement plate.

[0030] The reinforcement plate 8 also has positioning protrusions 74, or more generally positioning elements, that cooperate with corresponding positioning elements 74 of the lower plate 20. In this specific example, the positioning elements 74 of the lower plate 20, the reinforcement plate 8 and the fixation plate 6, are protruding plots, the protruding plots of each of the plates 20, 6 and 8 being respectively identical.

[0031] The fixation plate 6 shown on figures 1 3 & 5 is intended to receive the reinforcement plate and to fasten the heat exchanger 2 to the automotive vehicle thanks to fixation holes 72 in regards of the fixation holes 70 of the reinforcement plate 8. Fixation can be done with fixation screws or any other adapted fixation insert such as bolts.

[0032] The fixation plate 6 has top planar surface 76 (Figure 5) receiving the bottom planar surface 78 of the reinforcement plate 8, the two surfaces 76,78 being in contact with each other. Alternatively, the fixation plate 6 and reinforcement plate 8 could have any other adapted geometry.

[0033] The fixation plate 6 has a peripheral edge 80 (Figures 1 & 3) around the reinforcement plate 8 and in contact with the external peripheral surface 62 (Figure 4) of the reinforcement plate 8.

[0034] Preferably the peripheral edge 80 extends along substantially the whole contour of the reinforcement plate 6. In the figures, there is only one small region 82 where the peripheral edge 80 is not present, but the peripheral edge 80 is still present around at least 50% of the contour of the reinforcement plate 8.

Claims

1. Heat exchanger (2) comprising a stack of plates (4) comprising a lower plate (20) onto which the other plates (22) are stacked, the said other plates comprising a base plate (22') immediately adjacent to the lower plate (20), the heat exchanger (2) also comprising a fixation plate (6) , and a reinforcement plate (8) between the fixation plate (6) and the lower plate (20), wherein the heat exchanger (2) further comprises reinforcing inserts (23) between the base plate (22') and the lower plate (22).

2. Heat exchanger (2) according to claim 1, wherein the reinforcing inserts (23) are frame parts.

3. Heat exchanger (2) according to claim 1 or 2, wherein the reinforcing inserts (23) have an arcuate shape.

4. Heat exchanger (2) according to the preceding claim, wherein the reinforcing inserts (23) extend along from 45° to 90° of a corner (26) of the lower plate (20), preferably from 70° to 90°, preferably 90°.

5. Heat exchanger (2) according to any of the preceding claims, wherein the reinforcing inserts (23) have a rectangular cross section.

6. Heat exchanger (2) according to any of the preceding claims, wherein the reinforcing inserts (23) extend along a peripheral edge (36) of the lower plate (20).

7. Heat exchanger (2) according to the preceding claim, wherein the reinforcing inserts (23) are in contact with the peripheral edge (36) of the lower plate (20).

8. Heat exchanger (2) according to any of the preceding claims, wherein the reinforcing inserts (23) extend between a top surface (24) of the lower plate (20) and a bottom surface (26)of the said base plate (22').

9. Heat exchanger (2) according to any of the preceding claims, wherein the reinforcing inserts (23) are only along one or more corners (26) of the lower plate (20), preferably along only two corners (26) of the lower plate (20).

10. Heat exchanger (2) according to any of the preceding claims, wherein the reinforcement plate (8) has two holes (16, 18) for the circulation of fluid, the reinforcing inserts (23) being at proximity of the two holes (16, 18).

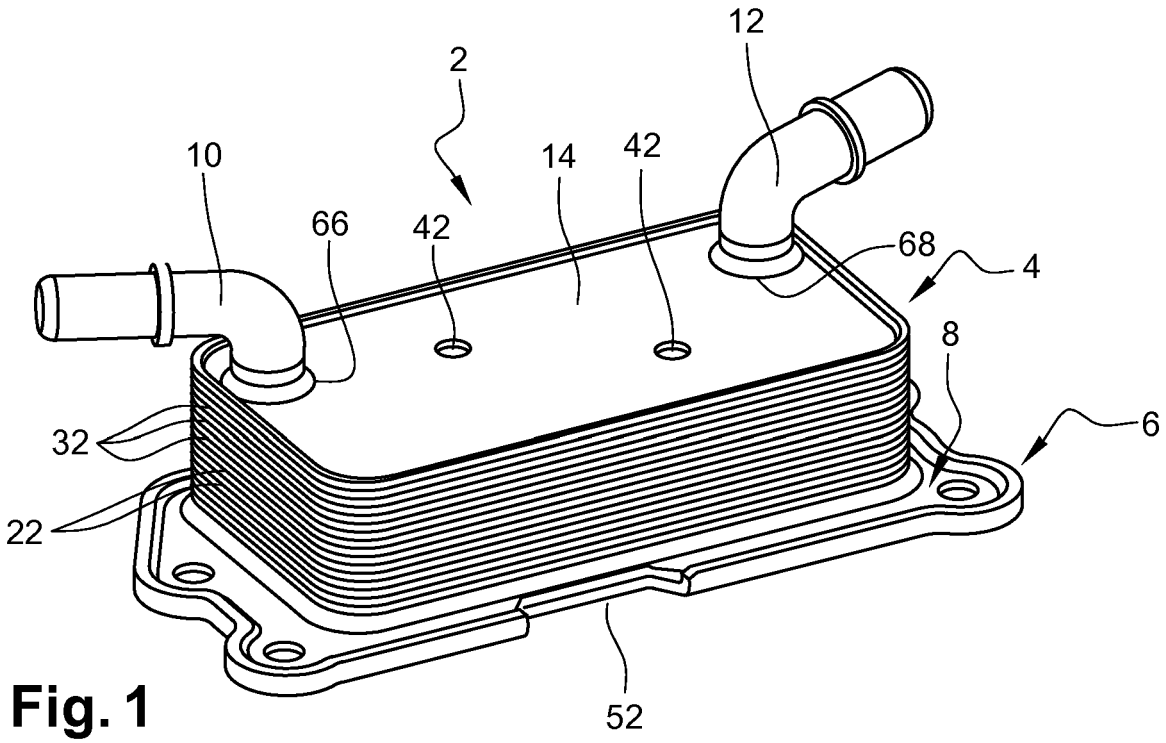
11. Heat exchanger (2) according to the preceding claim, wherein the lower plate (20) has corresponding holes (58, 60) in regards of the two holes (16, 18) for the circulation of fluid of the reinforcement plate (8), the two holes (16, 18) of the lower plate (20) being re-

spectively in the two corners (26) of the lower plate (20) that are reinforced by the reinforcing inserts (23).

12. Heat exchanger (2) according to any of the preceding claims, wherein the fixation plate (6) has a planar surface receiving the reinforcement plate (8) and a protrusion (80) around the reinforcement plate (8).

13. Heat exchanger (2) according to the preceding claim, wherein the protrusion (80) is a peripheral edge of the fixation plate (6).

14. Heat exchanger (2) according to any of the preceding claims, wherein the stack of plates (4) defines two circuits for two respective fluids, the circuits being configured so that the two fluids circulate alternately between the adjacent pairs of plates (22).


12
2
10
14
42
66
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68
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6
32
22
52

Fig. 1

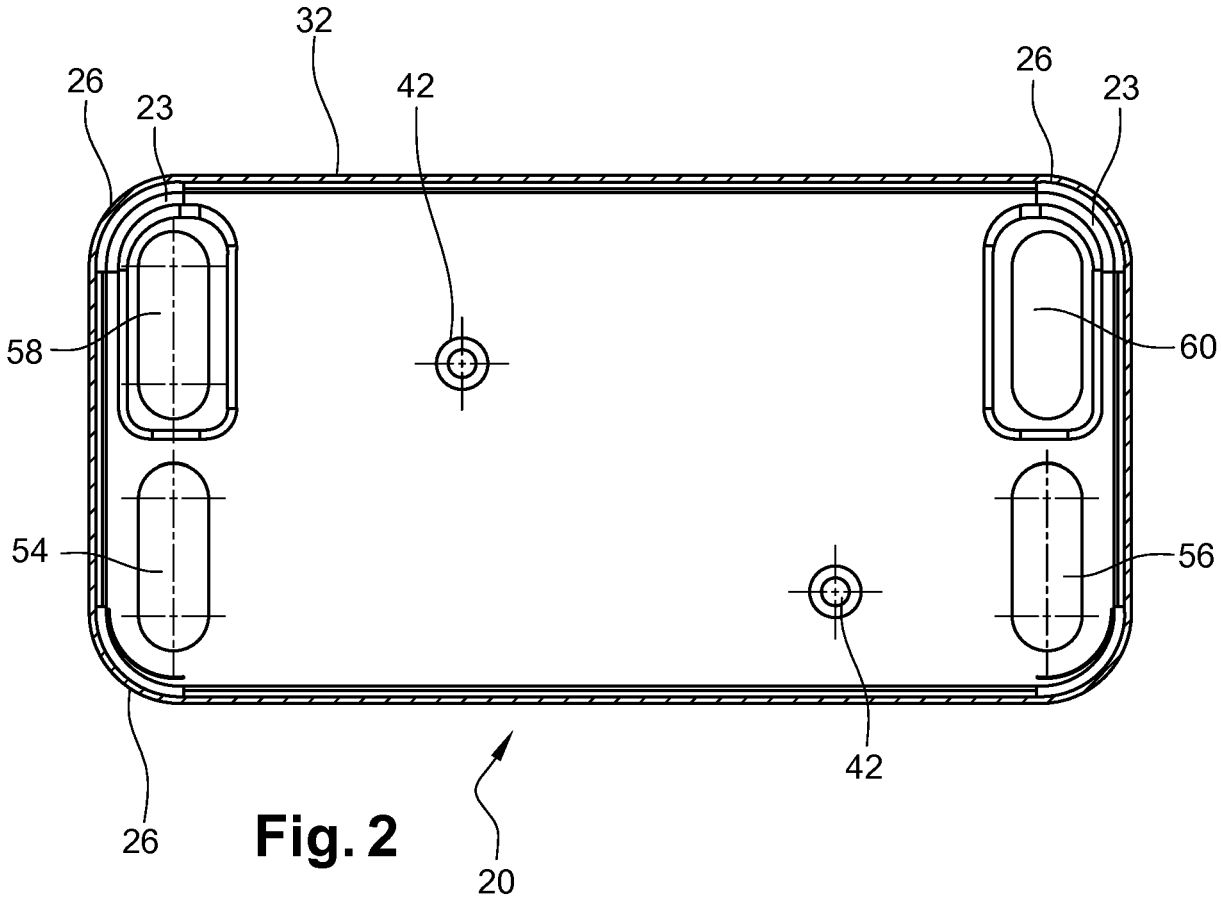
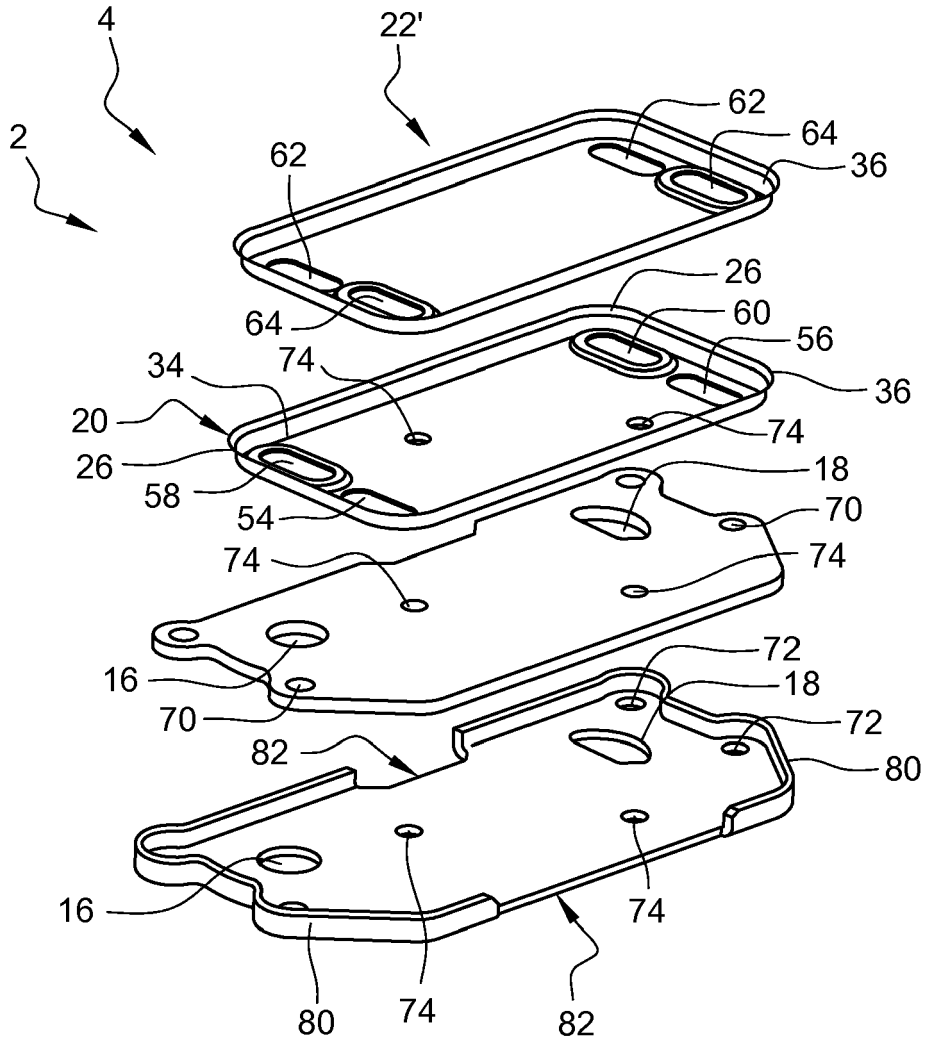

32
26
23
42
26
23
58
60
54
56
42
26
20

Fig. 2


4
22'
2
62
64
36
62
26
64
60
56
34
74
36
20
74
26
18
58
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70
74
74
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72
82
80
16
74
80
74
82

Fig. 3

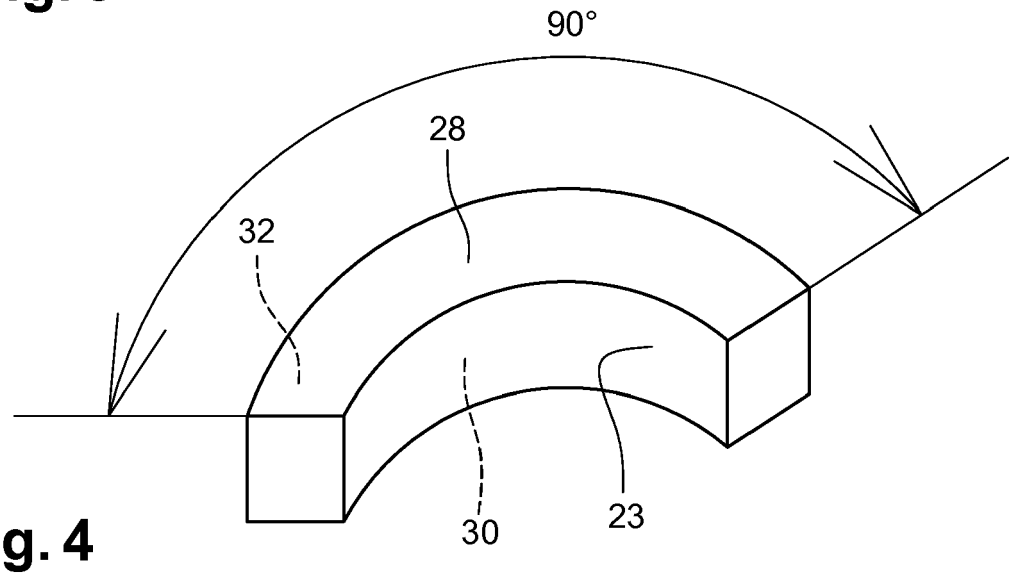
90°
28
32
30
23

Fig. 4

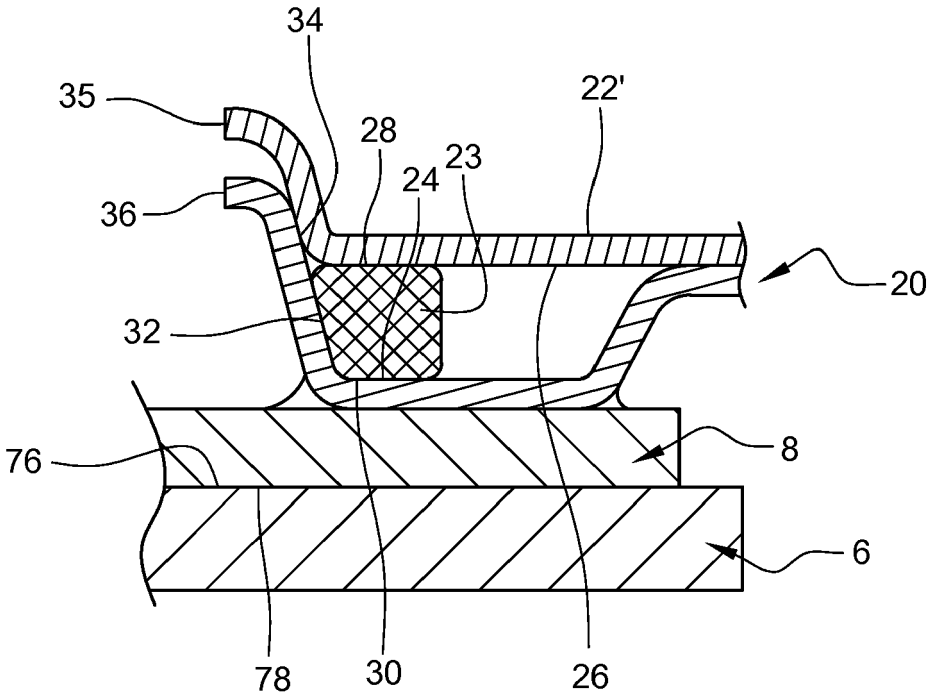

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 4546

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TECHNICAL FIELDS SEARCHED (IPC)

F28D
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 January 2019	Jessen, Flemming

CATEGORY OF CITED DOCUMENTS

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