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

(11) **EP 3 086 074 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.10.2016 Bulletin 2016/43

(51) Int Cl.:
F28F 9/02 *(2006.01)* ***F25B 39/04*** *(2006.01)*
F28D 1/053 *(2006.01)*

(21) Application number: **15164827.6**

(22) Date of filing: **23.04.2015**

(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
Designated Validation States:
MA

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(54) TUBULAR ELEMENT AND HEAT EXCHANGER

(57) The invention relates to a tubular element (1,101) for a heat exchanger (10,110), especially for a motor vehicle, which is assembled by stacking first tube-shaped segments (2) and second cup-shaped segments (3,103) along the length direction of the tubular element (1,101), wherein the assembled first and second segments (2,3,103) are fluid tight connected, wherein closed upper and lower ends of the tubular element are achieved by using second cup-shaped segments (3,103).

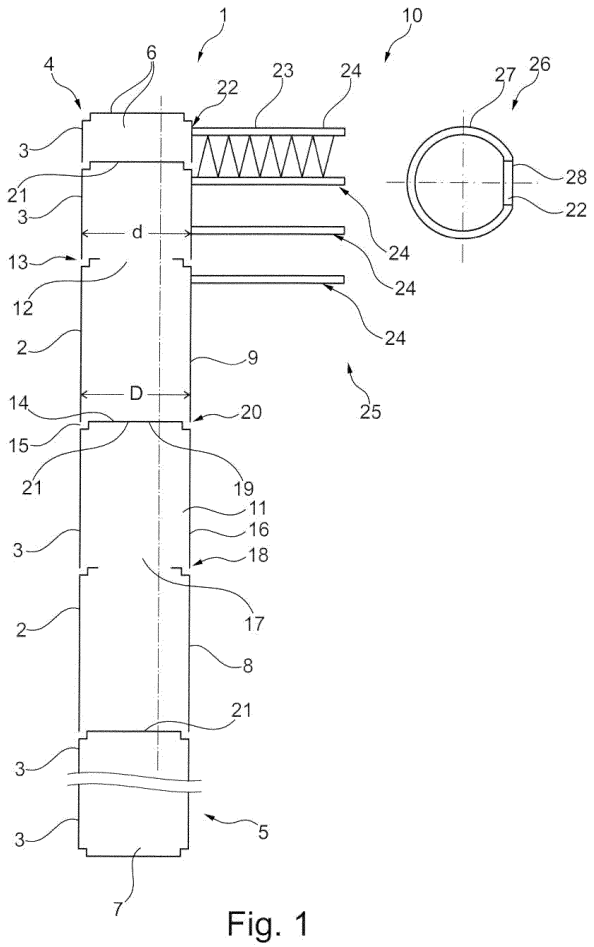

Fig. 1

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Description

Technical area

[0001] The invention refers to a tubular element for a heat exchanger, especially for a condenser for a refrigeration cycle of a motor vehicle, in accordance with the preamble of claim 1. The invention relates additionally to a heat exchanger.

State of the art

[0002] Heat exchanger and especially condenser are well known in the state of the art especially for the use in motor vehicles. Condensers are used as heat exchanger in a refrigerant circuit condensing the refrigerant and usually additionally sub-cooling the liquified refrigerant before it flows to the expansion valve and the evaporator of the refrigerant circuit.

[0003] Usually the condenser provides two separated manifolds and between the manifolds tubes and fins are located, the tubes are usually arranged in a row of tubes between which the respective fins are located. The tubes are fluid connected to the interior of the manifolds since the tubes are fit in openings of the respective tubes. Therefore the refrigerant can flow through the fluid passages of tubes of the row of tubes from one manifold to the other manifold being cooled by way of a heat exchange with the air flow flowing around the tubes. Such condensers are known e.g. by DE 41 30 517 A1, DE 43 30 214 A1 or DE 43 39 952 A1.

[0004] The manifolds are usually produced as a single tube or as a tube in a two part design. The known single-part design uses an extruded tube or a welded or brazed in which openings are provided by punching such that tubes of the row of tubes can be located within the openings and are fluid tight connected by to the manifold by brazing. The known two-part design uses a bottom plate including the openings for fitting the tubes in the openings and a cover plate connected to the bottom plate. The bottom plate and the cover plate are fluid tight connected by brazing. Such a manifold is disclosed by DE 43 39 952 A1.

[0005] Typically the condenser is provided with a number of fluid paths while the refrigerant flows through the different flow paths one after the other. The first flow path usually is a de-heating flow path and the last flow path usually is a sub-cooling flow path, while intermediate flow paths are used as condensation paths. The different flow paths are created by tubes of the row of tubes which are separated by partition walls which are inserted in the manifolds at respective positions within the manifolds. Such a design is well known and disclosed e.g. by DE 43 39 952 A1.

[0006] Further to the general design of a condenser so called condenser modules are known which additionally provide a receiver and/or dryer tube in parallel with one of the manifolds. Such condenser modules have the advantage that the sub-cooling is advanced since the sub-cooling path is usually completely filled with liquid refrigerant which is additionally cooled by the air flowing around the tubes and fins of the sub-cooling flow path. Such condenser modules are known from DE 42 38 853 C2.

[0007] All the above mentioned manifolds and receivers have in common that they are produced by way of a single tube or by way of a bottom plate and a cover plate extending in the direction of the hight of the condenser including the partition walls and being fluid tight connected by brazing. Therefore almost every condenser has its own dimensions due to different available space in the vehicle. Therefore the hight of the manifold, the location and the number of the tubes and the respective openings vary from condenser to condenser and therefore different tools for manufacturing are needed.

Embodiment of the invention, problem, solution, advantages

[0008] The problem addressed with regard to this invention is to create a heat exchanger, especially for a motor vehicle, which allows a less expensive manufacture.

[0009] This is achieved by a heat exchanger according to the features of claim 1.

[0010] A preferred embodiment relates to a tubular element for a heat exchanger, especially for a motor vehicle, which is assembled by stacking first tube-shaped segments and second cup-shaped segments along the length direction of the tubular element, wherein the assembled first and second segments are fluid tight connected, wherein closed upper and lower ends of the tubular element are achieved by using second cup-shaped segments. Therefore the tubular element can be assembled using an amount of first and/or second segments such that the respective design can be achieved using almost only generally designed segments and the amount of especially designed segments is reduced. This leads to a cost effective manufacture of a tubular element.

[0011] According to the inventive concept it is of advantage that at least one partition wall or partition walls which are located within the tubular element is or are created by using at least one second cup-shaped segment.

[0012] Furthermore it is of advantage that a first tube-shaped segment has a tube wall and a first opening at a first end of the tube wall and a second opening at a second end of the tube wall. Therefore partition walls can easily be integrated within the tubular element by using cup-shaped segments which otherwise can be used e. g. as closure at the upper or lower end of the tubular element.

[0013] An embodiment of the tubular element is designed such that a second cup-shaped segment has a tube wall and a first opening at a first end of the tube wall and a closing wall at a second end of the tube wall. There-

fore the cup-shaped segment provides a tube body with one opening and with one closure at one of their respective ends.

[0014] Furthermore it is of advantage that the tube wall of a first segment and/or of a second segment has a reduced outer diameter at one of the first end or the second end, such that an outer diameter of the end with the reduced diameter is smaller than an inner diameter of the end without a reduced diameter or with a smaller reduction in diameter. This leads to an easy and tight connection of segments if an end with reduced diameter is fitted in an end without reduced diameter.

[0015] According to an embodiment of the inventive concept it is of advantage that openings are provided in first tube-shaped segments and/or second cup-shaped segments, wherein the openings are provided to receive tube ends of tubes of a tube block of a heat exchanger. Accordingly a fluid tight connection of a tube block can be achieved if the tube ends are located in openings of

[0016] A further embodiment is of a tubular element is designed such that openings are provided in first tube-shaped segments and/or second cup-shaped segments, wherein the openings are provided as liquid transfer openings through which a fluid is transferrable between different devices. Therefore the tubular element can be used as receiver of a condenser or a condenser module or the like.

[0017] According to an embodiment of tubular element a design is preferred wherein the tube wall has a circular cross-section or a circular cross-section having a flattened portion. Therefore the flattened portion or a part of a circular portion can be used as location for an opening which can be created e.g. by punching. Furthermore the tubular element can be designed such that it is of advantage that the openings are provided in the tube wall in an area having the circular cross-section or in an area of the flattened portion.

[0018] According to another aspect of an embodiment, the tubular element is a manifold of a heat exchanger, especially of a condenser. Therefore the tubular element can be designed and assembled as manifold without or with partition walls. Such partition walls maybe used as guiding elements to direct a fluid flow and to divide a tube block in different flow paths.

[0019] According to another aspect of the inventive concept the tubular element is a receiver of a heat exchanger, especially of a condenser module having a condenser and a receiver.

[0020] The object of the invention may be achieved by a heat exchanger with at least one manifold, especially with two manifolds and with a tube block with tubes which are fluid-tight connected to the at least one manifold, wherein the at least one manifold is an inventive manifold.

[0021] The object of the invention may additionally be achieved by a heat exchanger with at least one manifold, especially with two manifolds and with a tube block with tubes which are fluid-tight connected to the at least one manifold, with a receiver fluid tight connected to a manifold, wherein the receiver is an inventive receiver.

[0022] Further advantageous embodiments are described in the following description of the figures and in the depending claims.

Short description of drawings

[0023] Hereafter the invention is described in more detail based on at least one embodiment shown in the following drawings. It shows:

Fig. 1 a first embodiment of a tubular element as manifold for a heat exchanger,

Fig. 2 a further embodiment of tubular element as a receiver of a heat exchanger,

Fig. 3 a detailed view of a connecting portion of two segments, and

Fig. 4 a detailed view of another embodiment of a connecting portion of two segments.

Preferred embodiment

[0024] Figure 1 shows a part of a heat exchanger 10 with a first embodiment of a tubular element 1, which may be used as manifold 11 of the heat exchanger 10. Such a heat exchanger 10 is may be manufactured as a condenser or as a radiator or the like.

[0025] The tubular element 1 comprises a plurality of first segments 2 and/or second segments 3, which are stacked and connected in length direction of the tubular element 1. Figure 1 shows an upper part 4 of the tubular element 1 with four second segments 3 and two first segments 2, while the lower part 5 may comprise at least one second segment 3 as can be seen.

[0026] The upper segment 6 and the lower segment 7 are made as second segments 3 while intermediate segments are made as first segments 2 or second segments 3 respectively.

[0027] The first segments 2 are made as tube-shaped segments. The tube-shaped segments comprise a tubular wall 9 with a first opening 12 at a first end 13 and with a second opening 14 at a second end 15. Therefore a fluid may flow through the both openings 12, 14 and through the tube which is defined by the tubular wall 9.

[0028] It is possible to use second segments with a predetermined length such that are pre-manufactured and selected from a system of second segments. Otherwise at least one second segment can be manufactured with a certain length to fit to the overall length of the tubular element 1.

[0029] The second segments 3 are made as cup-shaped segments. The cup-shaped segments comprise a tubular wall 16 with a first opening 17 at a first end 18 and with a closing wall 19 at a second end 20. Therefore a fluid may flow through the one first opening 17 into the

tube made by the tube wall but can not flow through the complete tube since the closing wall 19 limits the flow at the second end 20.

[0030] Therefore the closing wall 19 of the second segment 3 might be used as closure wall at the upper and lower end of the tubular element and e.g. as partition wall 21 within the tubular element 1.

[0031] As can be seen in Figure 1, the tubular wall 9 or 16 of the first segment or of the second segment has a reduced outer diameter d at one of the first end or the second end, such that an outer diameter of the end with the reduced diameter d is smaller than an inner diameter of the end without a reduced diameter having a diameter D. This leads to a good connection between two segments since the end with reduced diameter of one segment can be fitted into the end without reduced diameter of the adjacent located other segment. This connection will be fluid tight connected such as brazed.

[0032] The tubular element 1 is designed as manifold and comprises openings 22 which are provided in first tube-shaped segments 2 and in the second cup-shaped segments 3. The openings 22 are located such the tube ends 23 of tubes 24 of a tube block 25 might be located in the openings 22. Therefore the tubes 24 can communicate with the inner space of the manifold.

[0033] As can be seen from the upper right drawing of Figure 1, the cross section 26 of a first and/or of a second segment or the respective tubbular wall 9, 16 has a circular cross-section 27 having a flattened portion 28. The flattened portion 28 is preferred to place the openings 22 and e.g. punch the openings in the tube wall.

[0034] Figure 2 shows a part of a second embodiment of a tubular element 101, which may be used as receiver 111 of the heat exchanger 110. Such a heat exchanger 110 is may be manufactured as a condenser or as a radiator or the like.

[0035] The tubular element 101 comprises a plurality of first segments and/or second segments 103, which are stacked and connected in length direction of the tubular element 101.

[0036] Figure 2 shows an upper part 104 of the tubular element 101 with five second segments 103, while the lower part may comprise at least one first segment or one second segment.

[0037] The upper segment 106 and the not shown lower segment are made as second segments 103 while intermediate segments 108 are made as first segments or second segments respectively.

[0038] The first segments are made as tube-shaped segments. The tube-shaped segments comprise a tubular wall with a first opening at a first end and with a second opening at a second end, as can be seen from Figure 1. Therefore a fluid may flow through the both openings and through the tube which is defined by the tubular wall of the first segment. It is possible to use second segments with a predetermined length such that are pre-manufactured and selected from a system of second segments. Otherwise at least one second segment can be manufactured with a certain length to fit to the overall length of the tubular element 1.

[0039] The second segments 103 are made as cup-shaped segments. The cup-shaped segments comprise a tubular 116 wall with a first opening 117 at a first end 118 and with a closing wall 119 at a second end 120. Therefore a fluid may flow through the one opening 117 into the tube made by the tube wall but can not flow through the complete tube since the closing wall 119 limits the flow at the second end 120.

[0040] In case the closing wall 119 is perforated by means of holes 150 a fluid flow through the provided holes 150 and through the respective partition wall 119 is possible.

[0041] Therefore the closing wall 119 of the second segment 103 might be used as closure wall at the upper and lower end of the tubular element and e.g. as partition wall within the tubular element 101.

[0042] A perforated closing wall 119 allowing a through flow and therefore only named as perforated wall 119 can be used to locate a dryer material between two of such perforated walls 119. On the other hand such a perforated wall 119 might be used as filter in case the holes 150 are small in diameter such that particles might be filtered out of the fluid flow by means of the perforated wall 119. As can be seen from Figure 2, the wall 151 is used as filter and the walls 152 and 153 are used to define the space for a dryer material between them.

[0043] As can be seen in Figure 2, the tube wall 116 of a first segment or of the shown second segment 103 has a reduced outer diameter d at one of the first end or the second end, such that an outer diameter of the end with the reduced diameter d is smaller than an inner diameter of the end without a reduced diameter having a diameter D. This leads to a good connection between two segments since the end with reduced diameter of one segment can be fitted into the end without reduced diameter of the adjacent located other segment. This connection will be fluid tight connected such as brazed.

[0044] The tubular element 101 is designed as receiver and comprises openings 122, 123 which are provided in two second segments 103. The openings 122 and 123 allow an inflow 124 and an outflow 125 of a fluid into the receiver or out of the receiver.

[0045] As can be seen from the upper right drawing of Figure 2, the cross section 126 of a first and/or of a second segment or the respective tube wall 116 has a circular cross-section. Other shapes are possible too.

[0046] The Figures 3 and 4 show different embodiments of a connection between two segments of a first segment and/or a second segment.

[0047] Figure 3 shows a segment 201 and a segment 202 wherein the segment 201 maybe a first or second segment and segment 202 maybe a first segment or a second segment. Only a part of the two segments are shown to explain the connection between the two segments 201, 202.

[0048] Both segments have a tubular wall 203, 204,

while segment 201 has an end 205 with a reduced diameter d and segment 202 has an end 206 without a reduced diameter having the diameter D with D > d. This means that the outer diameter of the end 205 is smaller than the inner diameter of the end 206 such that the end 205 fits in the inner space of the end 206. Additionally between the wall of the end 205 and the wall of the end 206 remains a space 207 in which a brazing material 208 like a brazing ring might be located to fluid tightly braze and connect the two walls 203 and 204 at their ends 205, 206. In the axial direction a functional gap 209 remains between the both ends of the segments 201 and 202. According to this connection concept a secure and fluid tight connection can be achieved.

[0049] Figure 3 shows that the diameter reduction of the end 205 of segment 201 is realised by a step to reduce the diameter from the diameter of the tubular wall 203 to the diameter of the end 205. This might be realised by deep drawing or other deformation of the wall or the like.

[0050] Figure 4 shows a segment 301 and a segment 302 wherein the segment 301 maybe a first or second segment and segment 302 maybe a first segment or a second segment. Only a part of the two segments 301 and 302 are shown to explain the connection concept to connect the two segments 301, 302.

[0051] Both segments 301, 302 have a tubular wall 303, 304, while segment 301 has an end 205 with a reduced diameter d and segment 302 has an end 306 without such a reduced diameter having the diameter D with D > d.

[0052] This means that the outer diameter of the end 305 is smaller than the inner diameter of the end 306 such that the end 305 fits in the inner space of the end 306.

[0053] Figure 4 shows that the diameter reduction of the end 305 of segment 301 is realised by a s-shaped step to reduce the diameter from the diameter of the tubular wall 303 to the diameter of the end 305. Between the two diameters a ring-shaped space 307 is provided to receive the end 306 of the other segment 302. The end 306 shows a reduction in diameter to fit in the space 307. Additionally between the wall of the end 305 and the wall of the end 306 remains a space 308 in which a brazing material 309 like a brazing ring might be located to fluid tightly braze and connect the two walls 303 and 304 at their ends 305, 306. A functional gap 310 remains in the axial direction between the both ends 305, 306 of the segments 301 and 302. According to this connection concept a secure and fluid tight connection can be achieved.

Claims

1. Tubular element (1, 101) for a heat exchanger (10,110), especially for a motor vehicle, which is assembled by stacking first tube-shaped segments (2) and second cup-shaped segments (3,103) along the length direction of the tubular element (1,101), wherein the assembled first and second segments (2,3,103) are fluid tight connected, wherein closed upper and lower ends of the tubular element are achieved by using second cup-shaped segments (3,103).

2. Tubular element (1,101) according to claim 1, wherein at least one partition wall or partition walls (21) is or are created by using at least one second cup-shaped segment (3, 103).

3. Tubular element (1, 101) according to one of the claims 1 or 2, wherein a first tube-shaped segment (2) has a tube wall (8) and a first opening (12) at a first end (13) of the tube wall (8) and a second opening (14) at a second end (15) of the tube wall (8).

4. Tubular element (1,101) according to one of the claims 1, 2 or 3, wherein a second cup-shaped segment (3,103) has a tube wall (9) and a first opening (17) at a first end (18) of the tube wall (9) and a closing wall (19) at a second end (20) of the tube wall (9).

5. Tubular element (1,101) according to one of the preceding claims, wherein the tube wall (8,9) has a reduced outer diameter (d) at one of the first end (13,18) or the second end (15,20), such that an outer diameter (d) of the end with the reduced diameter is smaller than an inner diameter (D) of the end without a reduced diameter or with a smaller reduction in diameter.

6. Tubular element (1,101) according to one of the preceding claims, wherein openings (22) are provided in first tube-shaped segments (2) and/or second cup-shaped segments (3), wherein the openings (22) are provided to receive tube ends (23) of tubes (24) of a tube block (25) of a heat exchanger (10).

7. Tubular element (1,101) according to one of the preceding claims, wherein openings (122,123) are provided in first tube-shaped segments and/or second cup-shaped segments (103), wherein the openings (122,123) are provided as liquid transfer openings through which a fluid is transferrable between different devices.

8. Tubular element (1, 101) according to one of the preceding claims, wherein the tube wall (8,9) has a circular cross-section (26,27,126) or a circular cross-section (26,27) having a flattened portion (28).

9. Tubular element (1,101) according to one of the preceding claims, wherein the openings (22,122,123) are provided in the tube wall (8,9,116) in an area having the circular cross-section or in an area of the

flattened portion.

10. Tubular element (1) according to one of the preceding claims, wherein the tubular element (1) is a manifold (11) of a heat exchanger (10), especially of a condenser.

11. Tubular element (101) according to one of the preceding claims 1 to 9, wherein the tubular element (101) is a receiver (111) of a heat exchanger (110), especially of a condenser module having a condenser and a receiver.

12. Heat exchanger (10,110) with at least one manifold (11), especially with two manifolds (10) and with a tube block (25) with tubes (24) which are fluid-tight connected to the at least one manifold (11), wherein the at least one manifold (11) is a manifold according to at least one of the preceding claims 1 to 10.

13. Heat exchanger (10,110) with at least one manifold (11), especially with two manifolds (11) and with a tube block (25) with tubes (24) which are fluid-tight connected to the at least one manifold (11), with a receiver (111) fluid tight connected to a manifold (11), wherein the receiver is a receiver according to at least one of the preceding claims 1 to 9 or 11.

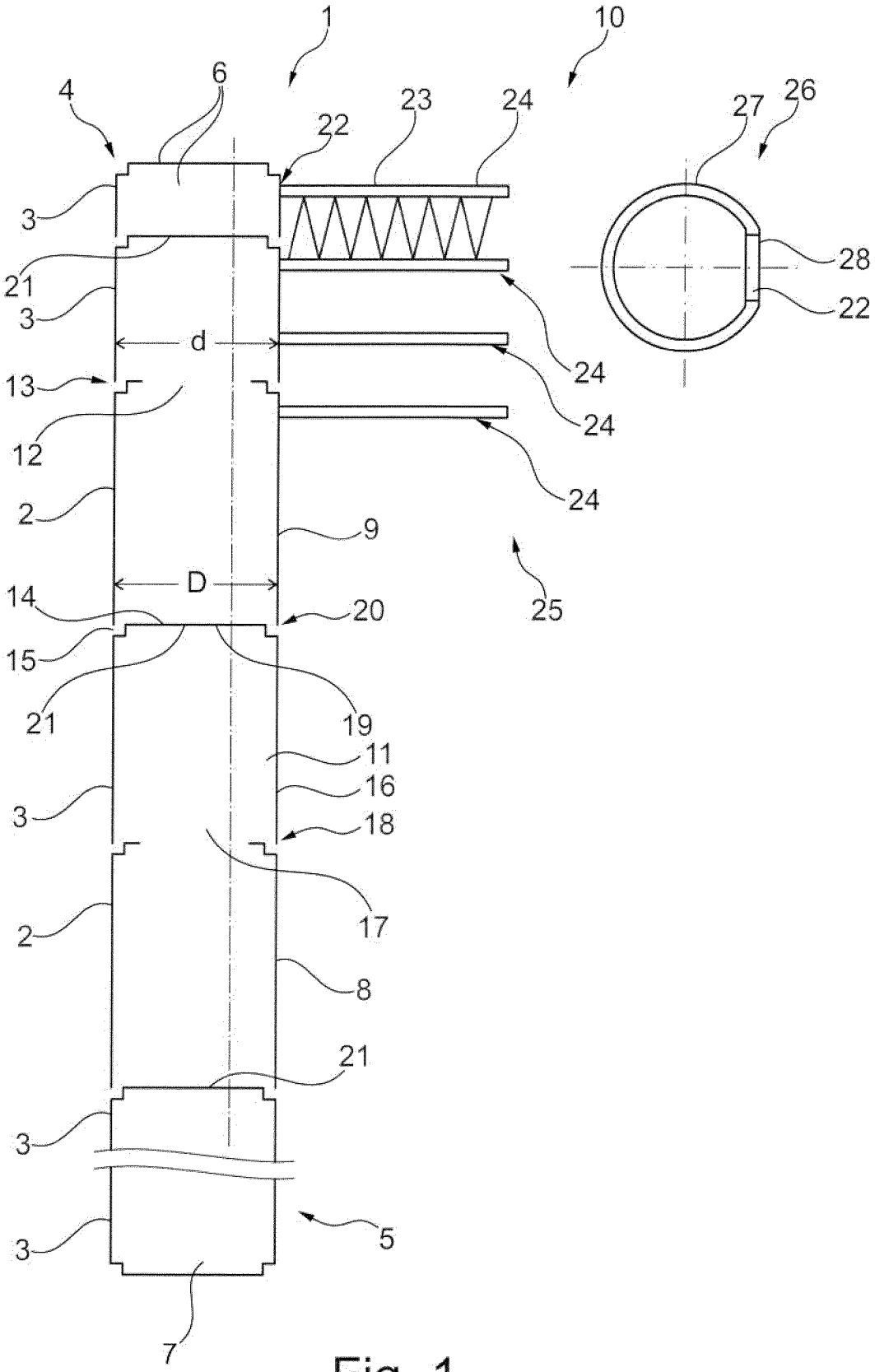
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Fig. 1

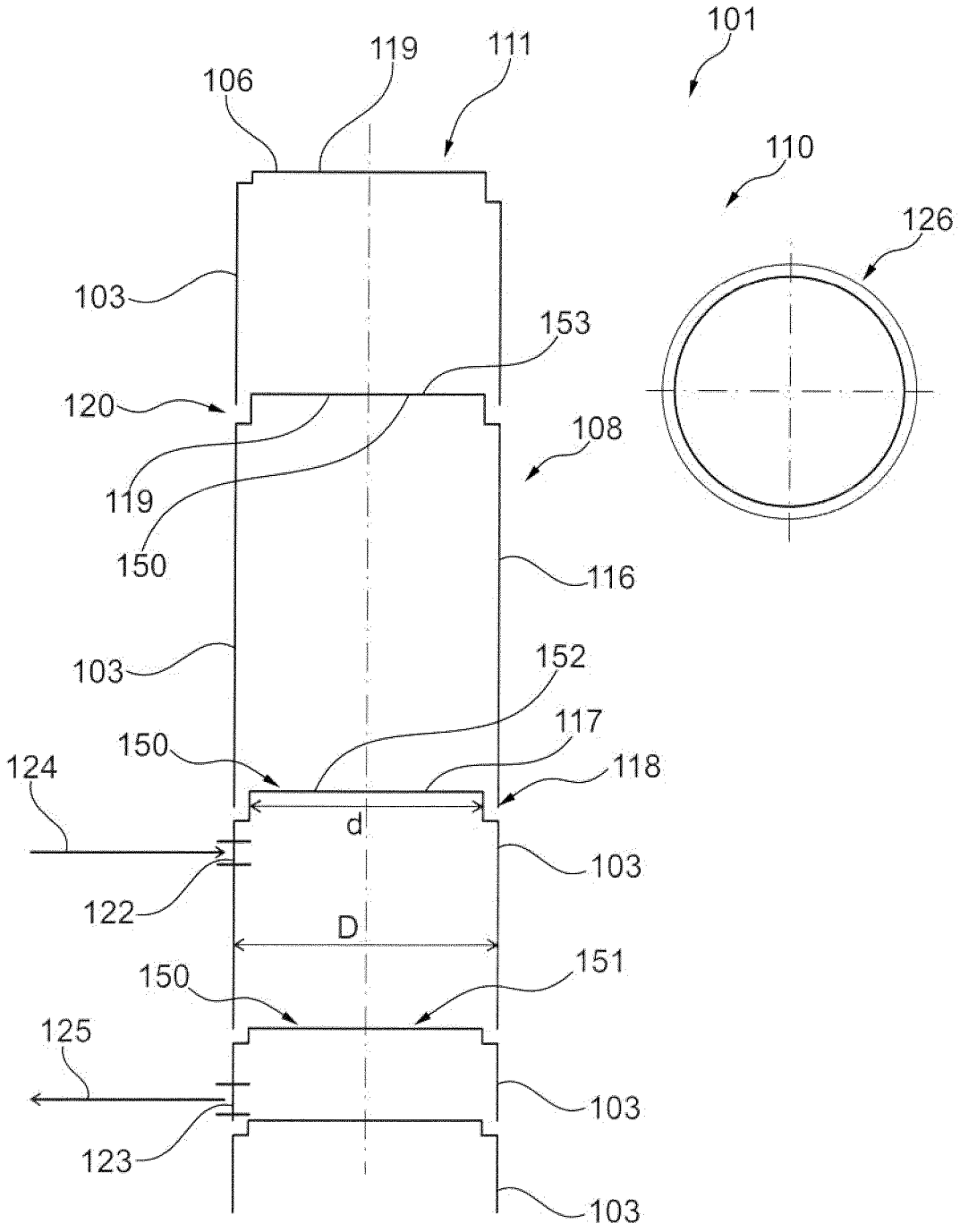
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Fig. 2

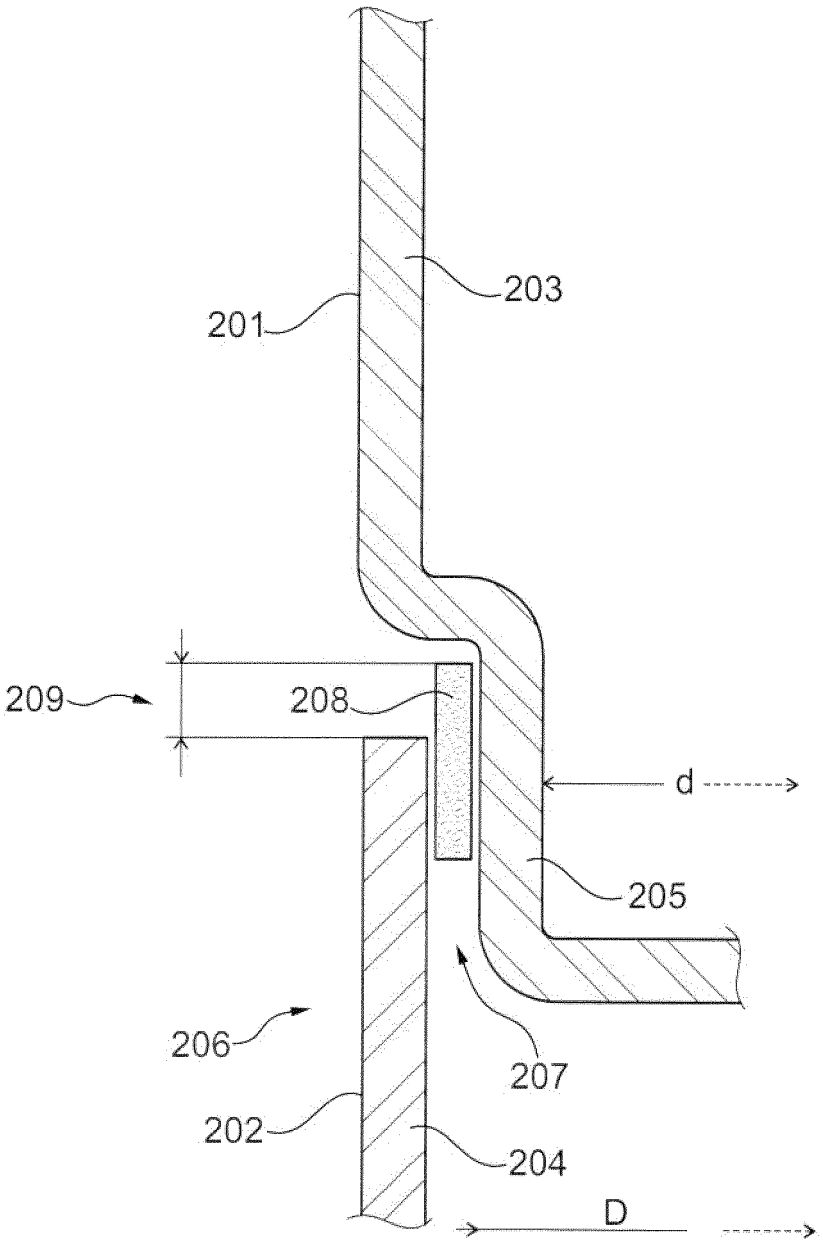

Fig. 3

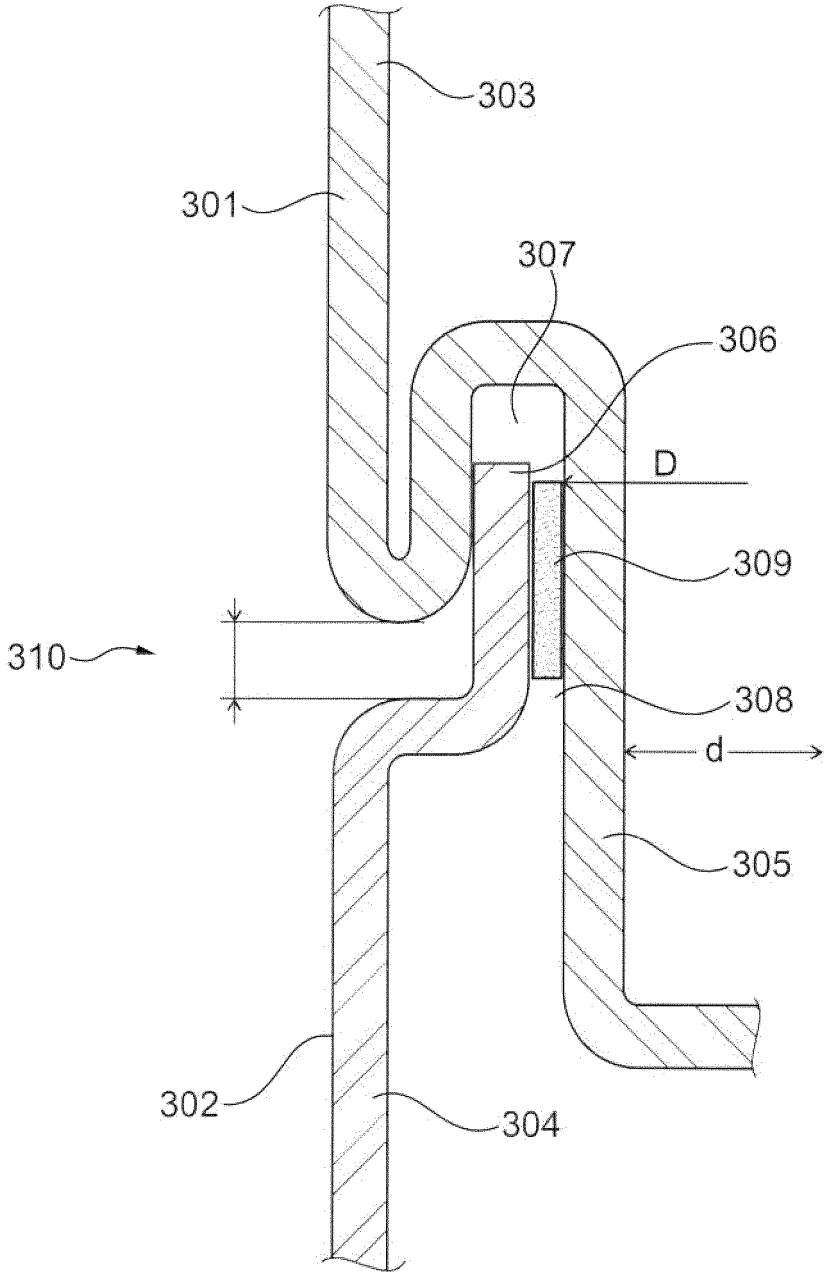

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 4827

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F28F
F25B
F28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 November 2015	Mellado Ramirez, J

CATEGORY OF CITED DOCUMENTS

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