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(54) A circulating fluidized bed reactor chamber

(57) The invention relates to a fluidized bed reactor chamber made up of peripheral waterwalls (1, 1') constituted by tubes interconnected by fins and having a bottom portion (1A) lined with a layer of refractory material (3A), a top portion (1B), and a zone (1C) referred to as an intermediate zone situated between said bottom and top portions, at least two waterwalls being connected to each other along a substantially vertical edge, and said peripheral waterwalls in said intermediate zone (1C) being bent outwards angularly relative to the vertical plane defined by the top portion (1B) of each peripheral waterwall. According to the invention a horizontal fraction only of each of said peripheral walls is bent in this way, said fractions being disposed on either side of said edge.

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Description

[0001] The invention relates to a circulating fluidized bed reactor chamber.

[0002] More particularly, the invention relates to a fluidized bed reactor chamber made up of peripheral waterwalls constituted by tubes interconnected by fins and having a bottom portion lined with a layer of refractory material, a top portion, and a zone referred to as an intermediate zone situated between said bottom and top portions, at least two waterwalls being connected to each other along a substantially vertical edge, and said peripheral waterwalls in said intermediate zone being bent outwards angularly relative to the vertical plane defined by the top portion of each peripheral waterwall.

[0003] Such a chamber is described in patent document EP 0 457 779.

[0004] According to that prior art document, the intermediate zones of the waterwalls of the chamber are thus bent over their entire width and they have a lining of refractory material.

[0005] The advantage of that arrangement is that it reduces the problem of the high degree of erosion that is caused by the turbulent flow of particles circulating along the walls.

[0006] For chambers of large dimensions suspended from the top, such waterwalls nevertheless present a problem of poor bending strength in the vicinity of said bend, which can lead to damage to the refractory lining and even to the waterwall.

[0007] Furthermore, such waterwalls that present a bend over their entire width are complex to fabricate and require numerous welds to ensure that the walls are leaktight.

[0008] Finally, in such prior art chambers, it is not possible to make internal extension walls of the kind described in patent document EP 0 653 588. The weight of the floor of the chamber would be transferred to the tubes of the extension walls in the proximity of the corresponding peripheral wall, and unfortunately these tubes are of a section that is too small to carry such a load.

[0009] To solve this problem, the invention provides a fluidized bed reactor chamber made up of peripheral waterwalls constituted by tubes interconnected by fins and having a bottom portion lined with a layer of refractory material, a top portion, and a so-called intermediate zone situated between said bottom and top portions, at least two waterwalls being connected to each other along a substantially vertical edge, and said peripheral waterwalls in said intermediate zone being bent outwards angularly relative to the vertical plane defined by the top portion of each peripheral waterwall, which chamber is characterized in that a horizontal fraction only of each of said peripheral walls is bent in this way, said fractions being disposed on either side of said edge.

[0010] The invention presents the advantage of presenting such bends in limited fractions only of the periphery of chamber, and thus of substantially reducing the problem of the bending strength of such a suspended chamber of large size.

[0011] Furthermore, the fractions are situated at the location where two waterwalls are connected to each other along a substantially vertical edge, so the erosion caused by the flow of particles is particularly great at that location.

[0012] Preferably, these locations are the corners of a chamber having a cross-section that is polygonal, often square or rectangular, with the two walls then being two of the walls defining the chamber.

[0013] Under such circumstances, said fraction of each of said peripheral walls advantageously extends over a width lying in the range 0.3 meters (m) to 0.8 m.

[0014] These locations may also be at a junction between a peripheral wall and an internal extension wall connected thereto, generally perpendicularly thereto. Said two walls are then a chamber-defining wall chamber and an internal extension wall.

[0015] Under such circumstances, said fraction of said peripheral wall is advantageously of a width lying in the range 0.4 m to 1.2 m.

[0016] In a preferred embodiment of the invention, said intermediate zone also has a shoulder of refractory material of thickness greater than the thickness of said layer of refractory material in said bottom zone.

[0017] Preferably, the angle at the inside edge of the shoulder between the surface of said shoulder and a line passing through the outer edge of the bend is greater than or equal to 35°.

[0018] In a first variant, said intermediate zone has a lining of refractory material situated above a said shoulder on said fraction.

[0019] The surface of said lining may lie in the same vertical plane as the fins of said top portion, or it may form a surface that slopes downwards and inwards, beginning from the plane of said fins of said top portion.

[0020] Under such circumstances, said surface lies in the same vertical plane as the fins of the top portion in the top of said intermediate zone, and then the surface slopes downwards from a height that is defined by a line sloping up from the inside edge of the shoulder at an angle to the surface of the shoulder that is greater than or equal to 40°.

[0021] Said surface may then be inclined at an angle that is less than or equal to 7° relative to a vertical plane.

[0022] Advantageously, said peripheral waterwalls are also bent inwards over said fraction, below the outward first bend.

[0023] The invention is described below in greater detail with the help of figures that merely show preferred embodiments of the invention.

[0024] Figures 1 to 3 are vertical section views of a peripheral waterwall at its junction with an inner extension wall connected thereto using first, second, and third embodiments of the invention.

[0025] Figure 4 is a horizontal section view on plane IV-IV of Figure 3.

[0026] Figures 5 to 8 are vertical section views of a peripheral waterwall at its junction with another peripheral waterwall connected thereto using first, second, third, and fourth embodiments of the invention.

[0027] Figure 9 is a horizontal section view on plane IX-IX of Figure 5.

[0028] Figure 10 is a vertical section view of a waterwall in accordance with the invention showing a first parameter.

[0029] Figure 11 is a vertical section view of a waterwall in accordance with the invention showing other parameters.

[0030] Figure 12 is a horizontal section view on plane XII-XII of Figure 8, showing a final parameter.

[0031] In a fluidized bed reactor chamber made up of peripheral waterwalls 1 constituted by tubes interconnected by fins, a bottom portion 1A is lined with a layer of refractory material 3A, a top portion 1B has no refractory material, and a zone situated between the bottom portion and the top portion is referred to as an intermediate zone 1C.

[0032] In the invention, this chamber is suspended via its ceiling, and in the intermediate portion, the weight of the floor is taken up by straight tubes that constitute at least 50% of the tubes.

[0033] Figures 1 to 4 show the junction between an inner extension waterwall 2 connected to a peripheral waterwall 1, in general in perpendicular manner. The two walls shown are then a chamber-defining wall and an inner extension wall, and they are connected to each other by welding along an edge that is substantially vertical.

[0034] Like the peripheral wall 1, the extension wall 2 has a bottom portion 2A lined with a layer of refractory material and a top portion 2B having no refractory material.

[0035] The peripheral waterwall 1 is bent outwards at an angle relative to the vertical plane defined by the top portion 1B of the peripheral waterwall, over a horizontal fraction only, said fractions being disposed on either side of the edge. This outward bend is of an amplitude d that is not less than the diameter of the tubes (see Figure 4).

[0036] Over the entire width of the peripheral waterwall 1, this intermediate zone 1C also has a shoulder 4 of refractory material of thickness greater than of the layer of the refractory material 3A in the bottom zone.

[0037] This shoulder 4 is as described in patent document EP 0 384 500 and its thickness is not less than 1.5 times the thickness of the layer of refractory material 3A in the bottom zone.

[0038] As shown in Figure 10, the thickness of this shoulder 4 is dimensioned as a function of the outside edge of the outward bend defining the intermediate zone C. The angle at the inside edge of the shoulder between the surface of the shoulder and a line passing through the outer edge of the bend is greater than or equal to 35°.

[0039] The peripheral waterwall 1 is also bent inwards over the same fraction, beneath the outward first bend. This inward bend is of the same amplitude d as the above amplitude and it is placed in such a manner that the horizontal surface of the shoulder 4 is situated thereabove.

[0040] In the variant shown in Figure 1, the intermediate zone 1C does not have any lining of refractory material situated above this shoulder 4.

[0041] In the variant shown in Figure 2, the intermediate zone 1C has a lining 3C of refractory material situated above the shoulder 4. The surface of the lining 3C lies in the same vertical plane as the fins of the top portion 1B.

[0042] In the variant shown in Figure 3, the intermediate zone 1C has a lining 3C of refractory material situated above the shoulder 4. The surface of this lining 3C forms a surface that slopes downwards and inwards beginning from the plane of the fins of the top portion 1B.

[0043] Figure 11 shows parameters for dimensioning this inside surface of the lining of refractory material 3C.

[0044] At the top of the intermediate zone 1C, this surface lies in the same vertical plane as the fins of the top portion 1B, and then the surface is inclined downwards at an angle γ relative to a vertical plane from a height that is defined by a line sloping up from the inside end of the shoulder at an angle β relative to the surface of the shoulder 4, after which the surface is again vertical.

[0045] The angle β is selected to be greater than or equal to 40°, and the angle γ is substantially less than or equal to 7°.

[0046] In Figure 4, which is in horizontal section, there can be seen the junction at right angles between the lining of refractory material 3C that is connected to the last non-bent tubes of the wall and to the first tube of the extension wall.

[0047] The fraction of the peripheral wall 1 in question has a width L lying in the range 0.4 m to 1.2 m.

[0048] Figures 5 to 11 show corners of a chamber that is polygonal in cross-section, often square or rectangular, the two walls then being two peripheral waterwalls 1, 1' defining the chamber and connected to each other by welding along an edge that is substantially vertical.

[0049] The peripheral waterwalls 1, 1' are bent outwards identically at an angle relative to the vertical plane defined by the top portions of the peripheral waterwall in the intermediate zone over a horizontal fraction only, said fractions being disposed on either side of the edge. This outward bend is of an amplitude d that is not less than the value of the diameter of the tubes (see Figure 9).

[0050] In Figures 5 to 8 there are shown only two peripheral waterwalls.

[0051] Over the entire width of the peripheral waterwall 1, the intermediate zone 1C also has a shoulder 4 of refractory material of thickness greater than that of the layer of refractory material 3A in the bottom zone.

[0052] This shoulder 4 is as described in patent document EP 0 385 500 and its thickness is not less than 1.5 times the thickness of the layer of refractory material 3A in the bottom zone. The angle formed by the surface of the shoulder, centered on the inside edge thereof and passing via the outside edge of the bend is greater than

or equal to 35°.

[0053] The peripheral waterwall 1 is also bent inwards over the same fraction, below the outward first bend. This inward bend is of the same amplitude d as above and it is disposed in such a manner that the horizontal surface of the shoulder 4 is situated thereabove.

[0054] In the variant shown in Figure 5, the intermediate zone 1C does not have any lining of refractory material situated above the shoulder 4.

[0055] In the variant shown in Figure 6, the intermediate zone 1C has a lining 3C of refractory material situated above the shoulder 4.

[0056] In the variant shown in Figure 7, the intermediate zone 1C has a lining 3C of refractory material situated above the shoulder 4. The surface of the lining 3C is in the same vertical plane as the fins of the top portion 1B.

[0057] In the variant shown in Figure 8, the intermediate zone 2C has a lining 3C of refractory material situated above the shoulder 4. The surface to this lining 3C forms a surface that slopes downwards and inwards starting from the plane of the fins of the top portion 1B. Its dimensioning parameters are identical to those defined above with reference to Figure 11.

[0058] In the horizontal section of Figure 9, there can be seen the structure of the two waterwalls 1, 1' where they join at the corner of the chamber. The bent fraction of each of said peripheral walls is advantageously of a width L' lying in the range 0.3 m to 0.8 m.

[0059] Figure 12 is a section on plane XII-XII of Figure 8, showing a lining of refractory material 3C placed in the intermediate zone above the shoulder 4 over the fraction presenting the bend. This lining is of a thickness such that its junction with the surface of the shoulder 4 intersects the first adjacent tube of the corresponding peripheral waterwall 1, 1' on a line forming an angle θ that is greater than or equal to 40° equal to the angle at the center of said first tube, having one side in the same plane as the fins of the corresponding waterwall and its other side passing via said line.

Claims

1. A fluidized bed reactor chamber made up of peripheral waterwalls (1, 1') constituted by tubes interconnected by fins and having a bottom portion (1A) lined with a layer of refractory material (3A), a top portion (1B), and a zone (1C) referred to as an intermediate zone situated between said bottom and top portions, at least two waterwalls being connected to each other along a substantially vertical edge, and said peripheral waterwalls in said intermediate zone (1C) being bent outwards angularly relative to the vertical plane defined by the top portion (1B) of each peripheral waterwall, which chamber is **characterized in that** a horizontal fraction only of each of said peripheral walls is bent in this way, said fractions being disposed on either side of said edge.

2. A chamber according to claim 1, **characterized in that** said intermediate zone (1C) also has a shoulder (4) of refractory material of thickness greater than that of said layer of refractory material (3A) in said bottom zone.

3. A chamber according to the preceding claim, **characterized in that** the angle (α) at the inside edge of said shoulder (4) between the surface of said shoulder and a line passing through the outer edge of the bend is greater than or equal to 35°.

4. A chamber according to any preceding claim, **characterized in that** said intermediate zone (1C) has a lining of refractory material (3C) situated above a said shoulder (4) on said fraction.

5. A chamber according to claim 4, **characterized in that** the surface of said lining lies in the same vertical plane as the fins of said top portion (1B).

6. A chamber according to claim 4, **characterized in that** said lining of refractory material forms a surface that slopes downwards and inwards starting from the plane of the fins of said top portion (1B).

7. A chamber according to the preceding claim, **characterized in that** over the height of said intermediate zone said surface lies in the same vertical plane as the fins of the top portion, and then the surface slopes downwards from a height that is defined by a line sloping from the inside edge of the shoulder (4) at an angle (β) relative to the surface of the shoulder that is greater than or equal to 40°.

8. A chamber according to the preceding claim, **characterized in that** said surface is inclined at an angle (γ) less than or equal to 7° relative to a vertical plane.

9. A chamber according to any preceding claim, **characterized in that** said peripheral waterwalls are also bent inwards over said fraction, below the outward first bend.

10. A chamber according to any preceding claim, **characterized in that** said two walls are two walls (1, 1') defining the chamber.

11. A chamber according to the preceding claim, **characterized in that** said fraction of each of said peripheral walls has a width (L') lying in the range 0.3 m to 0.8 m.

12. A chamber according to any one of claims 1 to 9, **characterized in that** said two walls are a wall defining the chamber (1) and an internal extension wall (2).

13. A chamber according to the preceding claim, **characterized in that** said fraction of said peripheral wall has a width (L) lying in the range 0.4 m to 1.2 m.

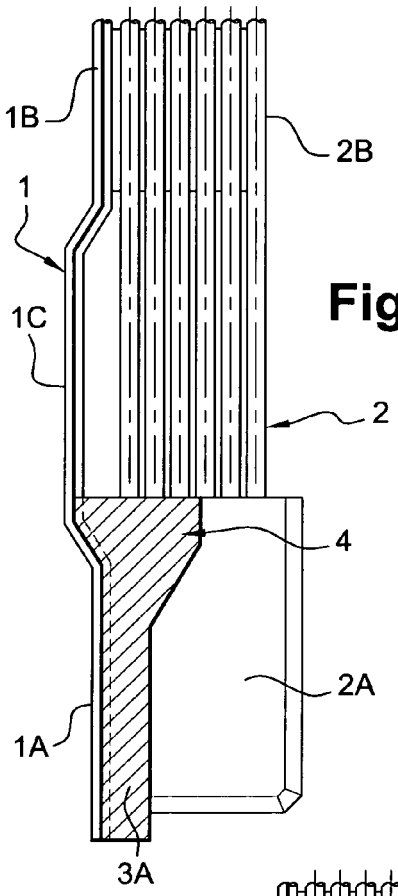

Fig. 1

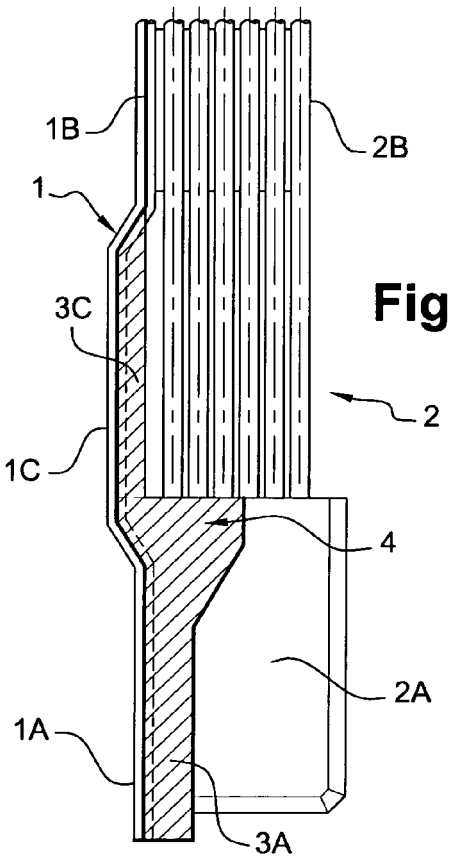

Fig. 2

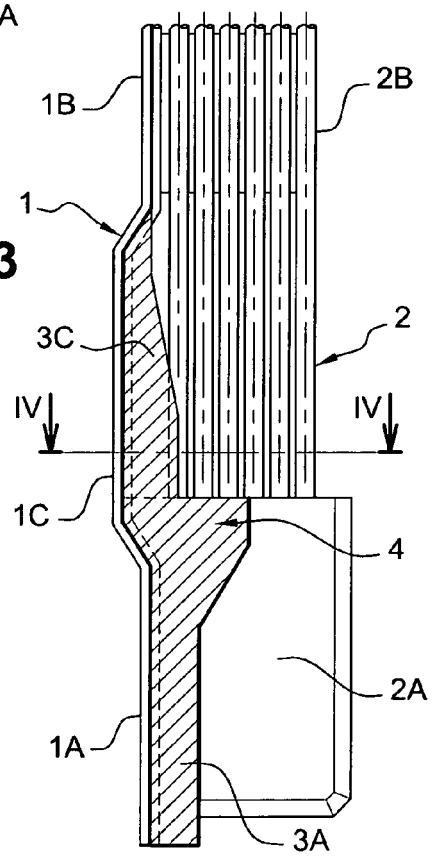

Fig. 3

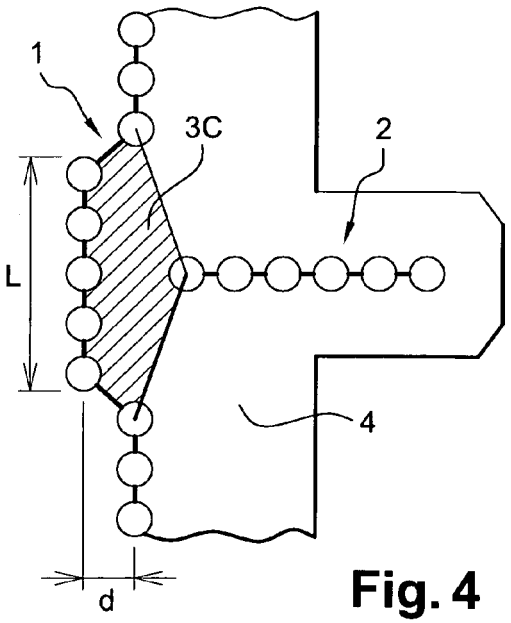

Fig. 4

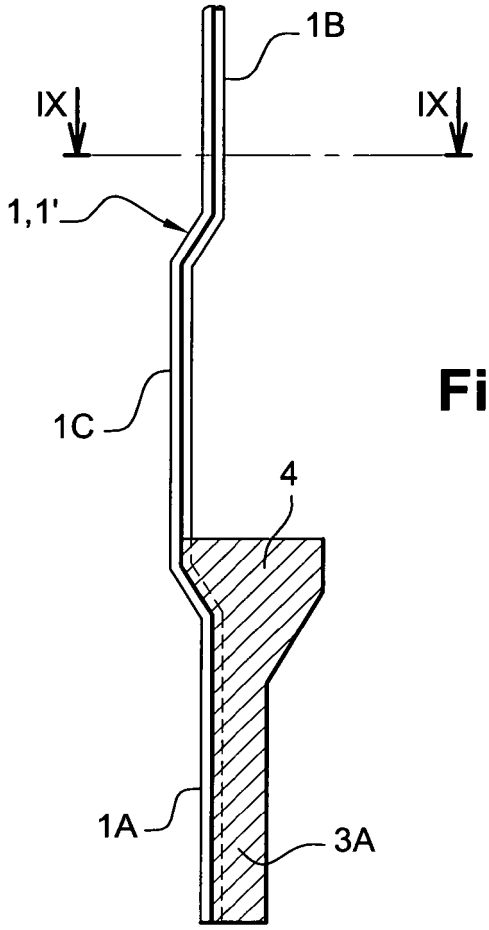

Fig. 5

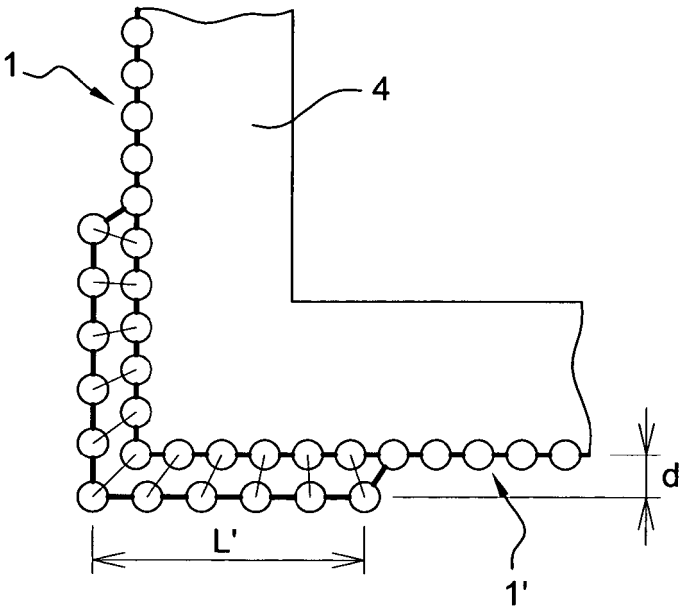

Fig. 9

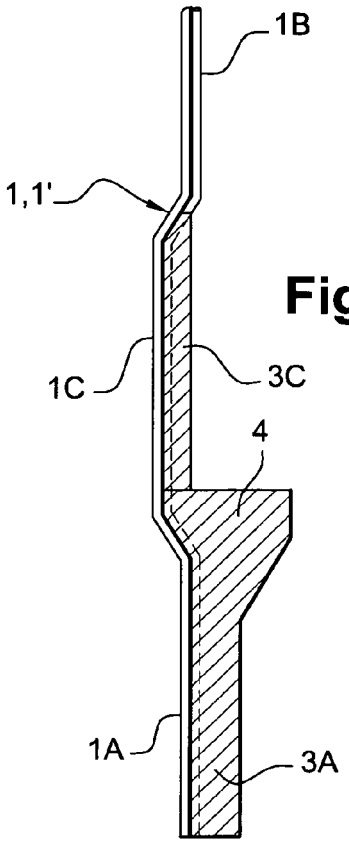

Fig. 6

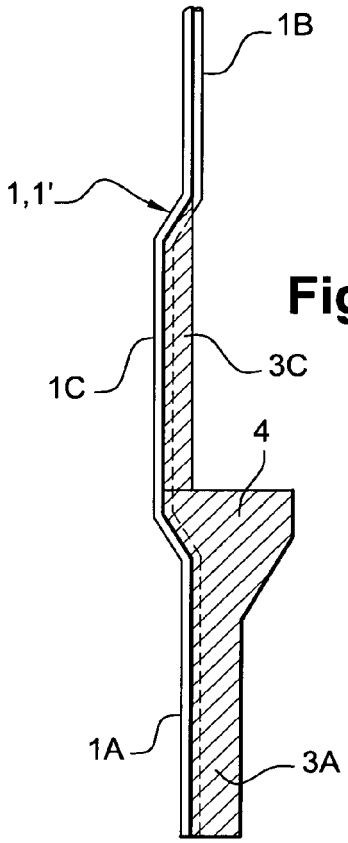

Fig. 7

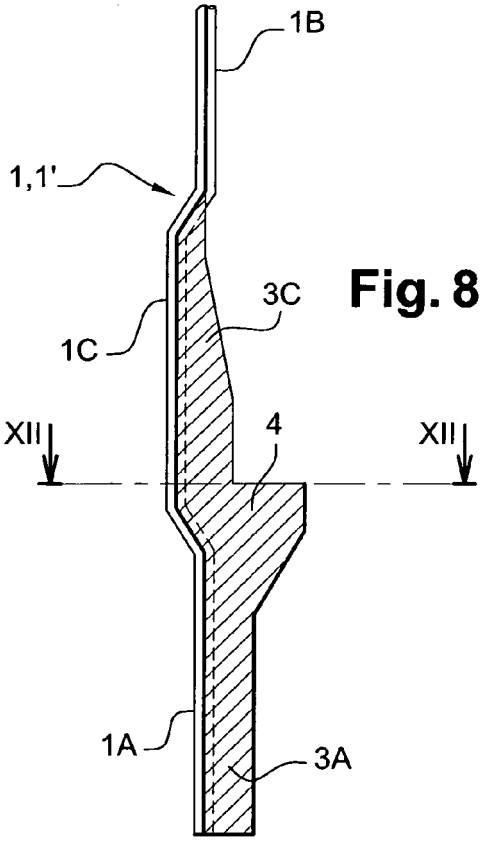

Fig. 8

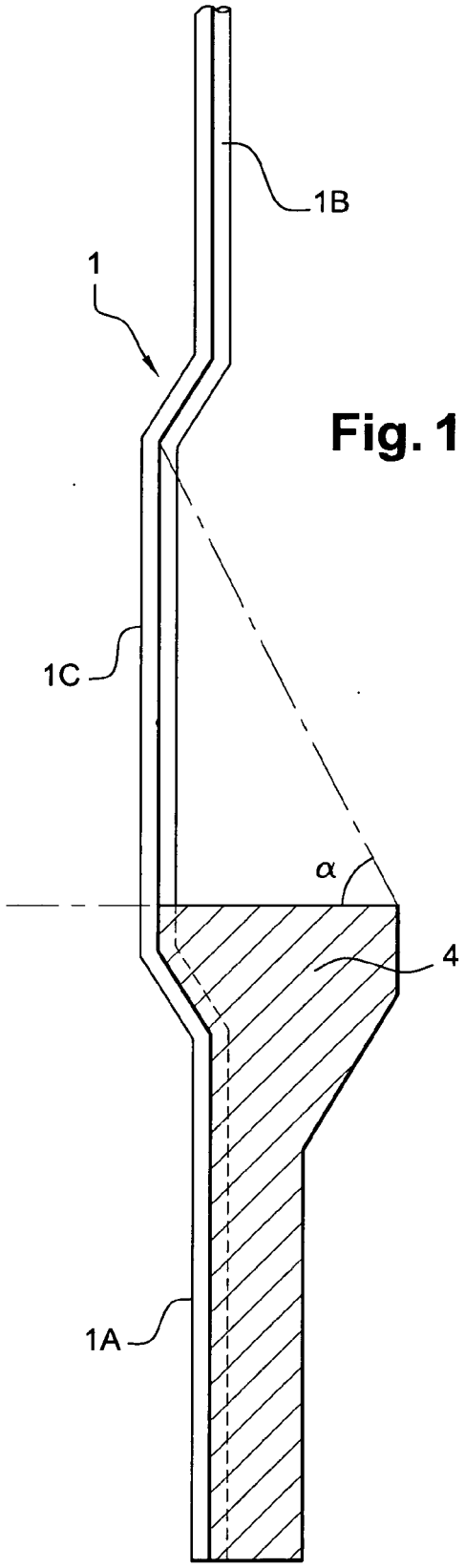

Fig. 10

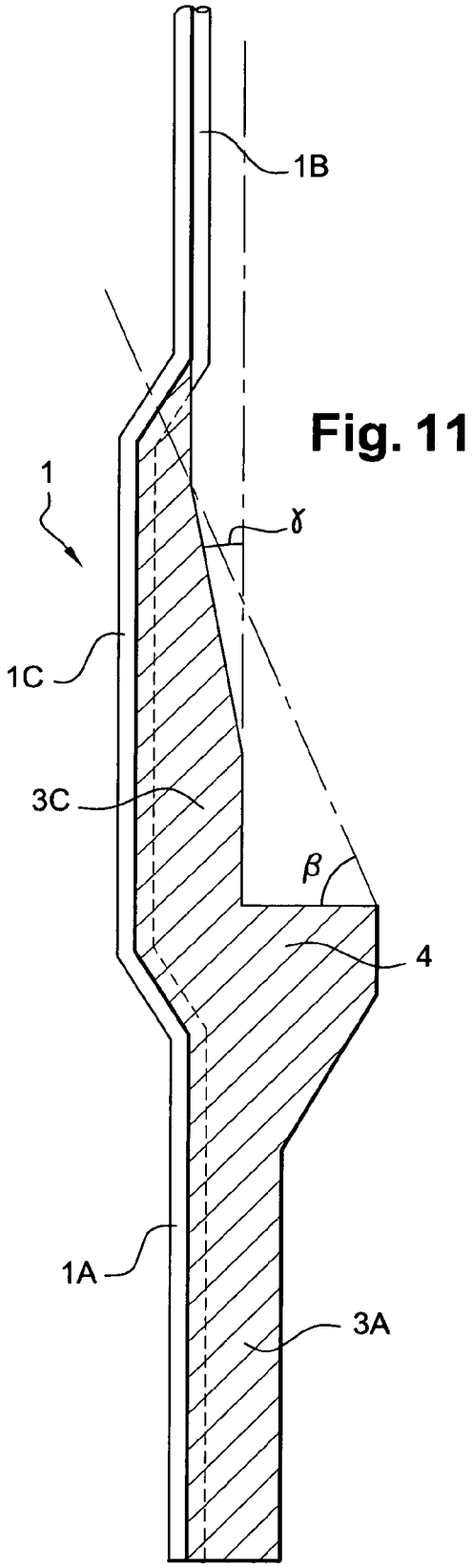

Fig. 11

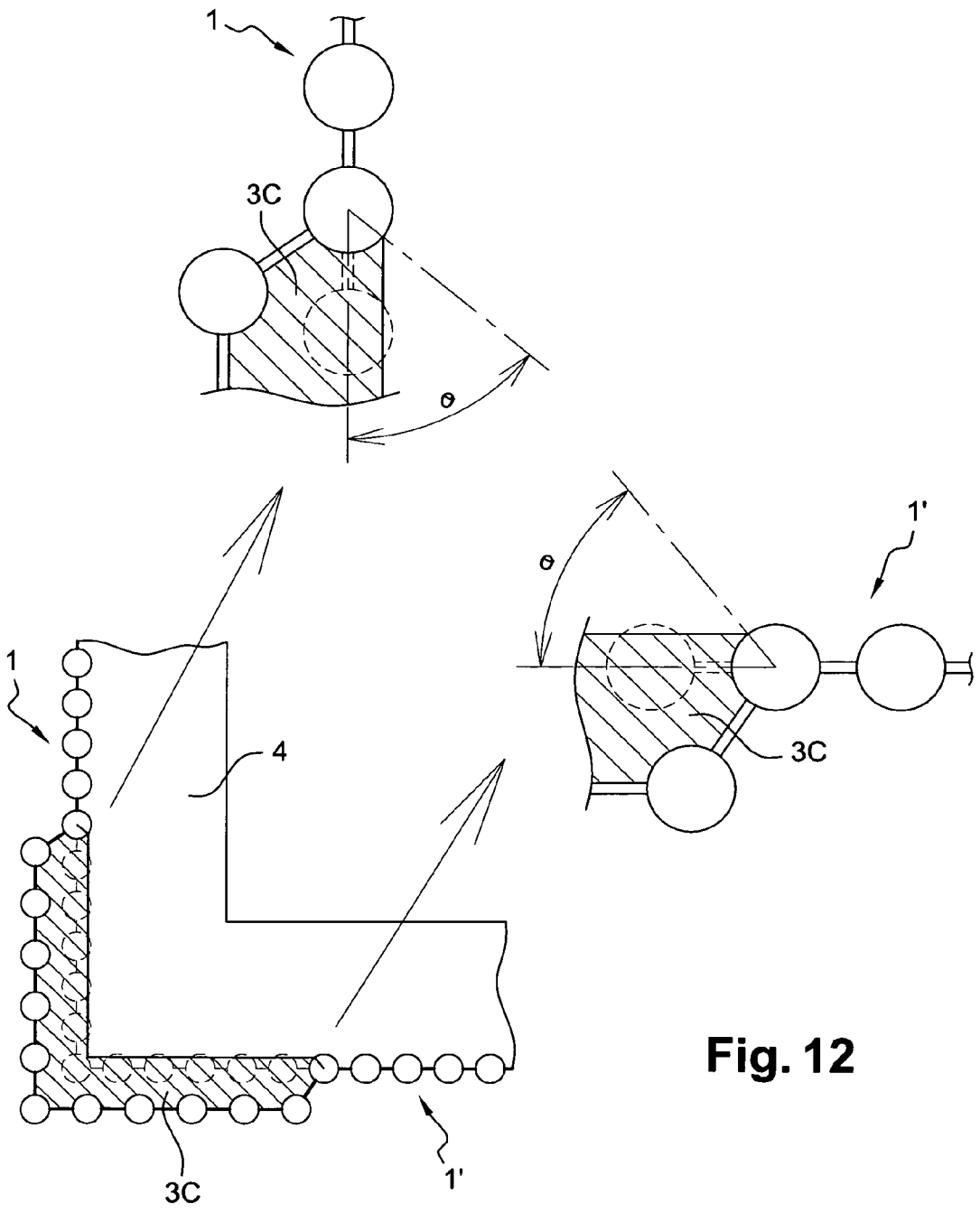

Fig. 12

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0457779 A **[0003]**
- EP 0653588 A **[0008]**
- EP 0384500 A **[0037]**
- EP 0385500 A **[0052]**