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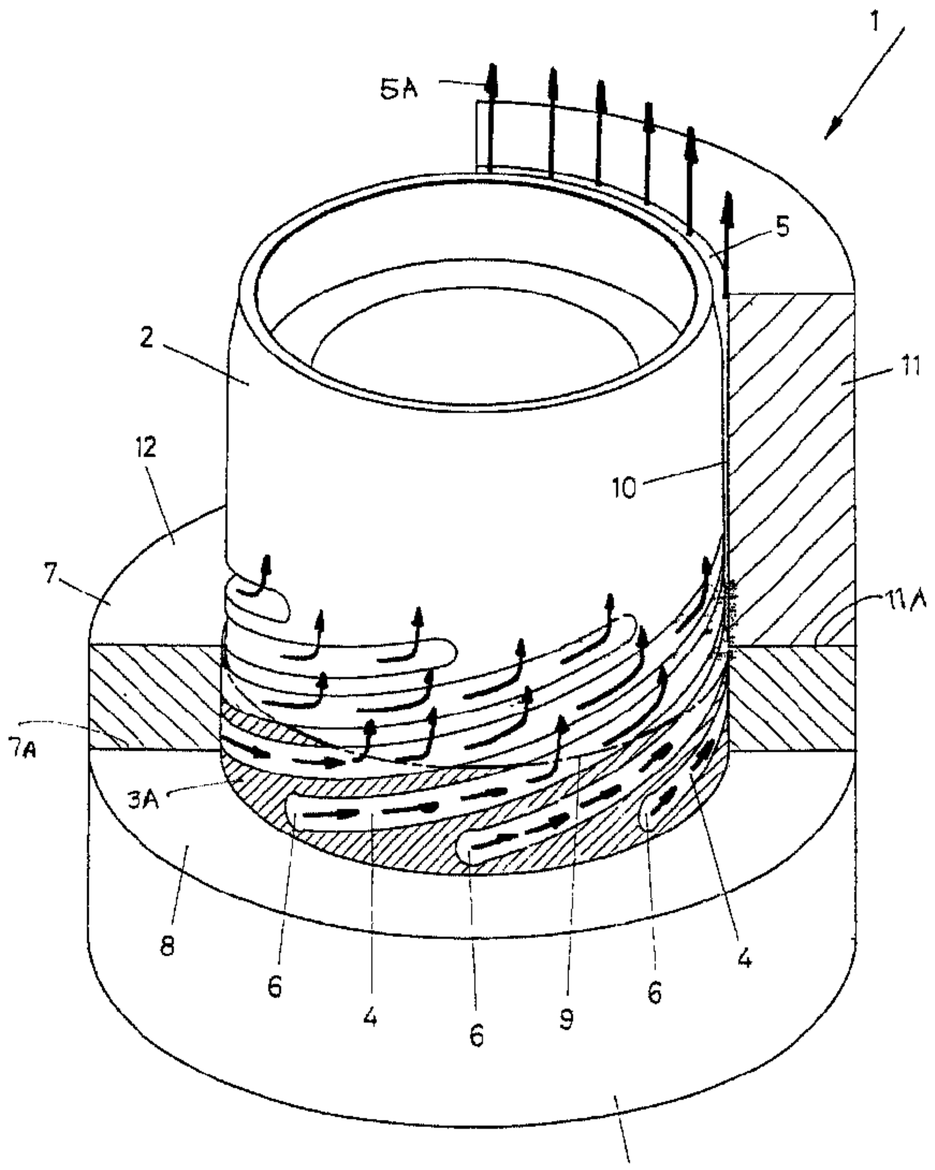

(57) Abrégé/Abstract:
An extruder die head, such as a blown film head, comprises an internal cylindrical mandrel and an outer concentric jacket enveloping the mandrel to provide an annular channel that communicates with a die slit. To avoid slit-like gaps between the mandrel and the jacket, where polymer melt can accumulate and degrade resulting in flaws in the extruded polymer, the mandrel has an integral outwardly extending flange-like foot. At least one supply line for molten polymer, such as a set of boreholes communicating with helical grooves in the outer cylindrical face of the mandrel, is connected to the annular channel in the area adjacent the flange-like foot. A ring is shrunk onto the mandrel against the foot, at a predetermined tension to seal the slit between the mandrel and the jacket, and avoid the effects of differential thermal expansion. The cylindrical jacket is mounted sealingly onto the ring.

ABSTRACT

An extruder die head, such as a blown film head, comprises an internal cylindrical mandrel and an outer concentric jacket enveloping the mandrel to provide an annular channel that communicates with a die slit. To avoid slit-like gaps between the mandrel and the jacket, where polymer melt can accumulate and degrade resulting in flaws in the extruded polymer, the mandrel has an integral outwardly extending flange-like foot. At least one supply line for molten polymer, such as a set of boreholes communicating with helical grooves in the outer cylindrical face of the mandrel, is connected to the annular channel in the area adjacent the flange-like foot. A ring is shrunk onto the mandrel against the foot, at a predetermined tension to seal the slit between the mandrel and the jacket, and avoid the effects of differential thermal expansion. The cylindrical jacket is mounted sealingly onto the ring.

1222-29

EXTRUDER DIE HEAD

This invention relates to an extruder die head, such as a blown film head, generally consisting of an internal cylindrical mandrel and an outer concentric jacket, which envelops the mandrel. Between the outer cylindrical surface of the mandrel and the inner concentric surface of the jacket an annular channel is provided that empties into an annular die slit. The die head also includes at least one feed line, which empties into the annular channel in the area remote from the die slit, and through which a polymer melt is fed. In a typical die head, the feed line comprises a set of boreholes communicating with helical grooves in the outer cylindrical face of the mandrel. The depth of the grooves decreases towards the die slit, starting from the boreholes, so that the polymer melt overflows more and more the webs between the helical grooves, and assumes a uniform flow in the axial direction of the die head toward the die slit. Extruder die heads of this type, typically used for blown film heads, are well known.

The prior art extruder die heads pose the special problem that adjacent the boreholes, the outer cylindrical surface of the mandrel is made as a close fit into the outer concentric jacket. However, when the extruder die head becomes warm due to the polymer melt flowing through the extruder die head, the outer jacket expands more, on account of its larger diameter, than the inner mandrel so that a slit can form between the two cylindrical faces due to this differential thermal expansion. Since the polymer melt is fed under pressure into the die head, it penetrates into the slit and accumulates there. Due to the resulting long residence time of the trapped polymer in the hot

die head, it can decompose and become brittle; particles of the deposited melt can then be dragged along by the melt. Such particles become obvious in the extruded polymer as defects.

This invention seeks to provide an extruder die head of this type, wherein a slit-like gap, in which the polymer melt can accumulate, deposit and become brittle, is avoided between the inner central cylindrical mandrel and the outer concentric jacket. In the extruder die head of this invention, the mandrel is made with an integral outwardly radially extending flange-like foot. Adjacent to the foot, the mandrel is provided with at least one borehole, through which the polymer melt is fed for extrusion. Additionally, a ring is shrink fitted onto the mandrel adjacent to the foot, and the outer concentric jacket is mounted sealingly onto the ring. This construction eliminates the formation of a slit-like gap between the cylindrical surfaces of the inner mandrel and the outer concentric jacket due to differential thermal expansion.

In the extruder die head of this invention, the mandrel is reliably sealed to the flange-like foot, which is fabricated with the mandrel as one piece, by means of the ring. The ring is shrunk onto the mandrel with sufficient pre-tension so that even when the mandrel and ring expand when heated, a slit-like gap, into which polymer melt can penetrate and degrade, cannot form between the two. The cylindrical jacket is mounted on the ring and connected sealingly to it, to provide the annular channel required for polymer extrusion.

Thus this invention seeks to provide an extruder die head comprising in combination:

an inner cylindrical mandrel including an outwardly radially extending flange-like foot formed integrally with the mandrel, which, in the area adjacent to the foot, is provided with at least one borehole through which a polymer melt is fed into the die head,

a shrink fitted ring under a predetermined level of pre-tension located onto the mandrel in sealing contact with the inner cylindrical surface of the mandrel adjacent the flange-like foot, and

a cylindrical jacket mounted onto the shrink fitted ring to provide an annular channel which terminates in an annular die slit,

wherein the level of pre-tension in the ring is predetermined to preclude the formation of an annular gap between the mandrel and the ring due to differential thermal expansion of the ring and the mandrel during the use of the die head.

Preferably, the outer surface of the mandrel includes in its area adjacent to the foot one or several helical groove(s), in which the depth decreases towards the die slit and which is (are) closed at the lower end near to the flange-like foot. The mandrel also includes boreholes, through which the polymer melt is fed into the grooves near to the closed end(s)in the vicinity of the foot.

Preferably, the shrunk-on ring extends towards the die slit from the flange-like foot, to enclose the groove-free end of the mandrel, and the initial part of the helical grooves. In this embodiment, the shrunk-on ring seals without a gap the initial regions of the grooves, so that the polymer melt, fed into the grooves can only enter into the annular channel between the inner

mandrel and the outer concentric jacket. In this space the melt can assume increasingly and uniformly an axial flow.

Preferably, the foot and the ring are each provided with radial annular surfaces, which can aligned in a common plane, which can lie sealingly on each other, and which can be mounted together so as to provide a sealed joint.

Preferably, the ring and the jacket are also provided with radial annular surfaces, which can be aligned in a common plane to locate them side by side in a sealing relationship when they are mounted together.

Preferably, the outer concentric jacket, the ring, and the foot are clamped together by axially located tightening screws located in cooperating bores in the jacket, the ring, and the foot.

Preferably, in a blown film extruder die head, boreholes or channels are provided in the known manner both for feeding in the molten plastic, and for feeding in the blowing air.

One embodiment of the invention is explained in detail below with reference to the drawing, which shows a partially sectioned schematic drawing of a blown film extruder die head.

The blown film head 1 comprises an internal mandrel 2, which is made as one piece with an outwardly radially projecting flange-shaped foot 3. Starting from the region in the vicinity of the foot 3, the mandrel 2 is provided with multiple rows of helical grooves 4, whose depth decreases towards the die slit 5. The initial regions of the grooves 4 are closed at the ends adjacent direction of the flange-shape foot 3. The mandrel 2 is also

provided with boreholes 6(omitted for clarity), through which the polymer melt is fed into the initial ends of the grooves 4. A ring 7 is shrink fitted onto the mandrel 2. The ring as shown has a rectangular cross section, whose radial annular surface 7A rests flush on the outwardly projecting radial annular surface 8 of the foot 3. It can thus be seen that in this construction the ring is fitted up against the right angle step provided in the flange like foot. If desired, a different face angle can be used.

The shrink fitted ring 7 envelops the initial region of the helical grooves 4 of the mandrel 3, and in particular in such a manner that it rests with considerable pretension sealingly on the shaded part 3A of the mandrel 3, thus covering the webs and edges defining the grooves 4. The region of the mandrel 2, enveloped by the ring 7, terminates at the dashed line 9. Thus, at the upper edge of the ring 7, marked by the dashed line 9, the melt enters into the annular channel 10 formed between the inner surface of a cylindrical annular jacket 11 and the outer surface of the part of the mandrel 2 extending beyond the line 9. The polymer melt flows through the annular channel 10 and leaves the extrusion head through the die slit 5 as indicated by the arrows 5A.

The outer cylindrical jacket 11 is provided with a radial annular sealing surface 11A, which rests flush onto, and seals with, the upper annular surface 12 of the shrink fitted ring 7 that is shrunk on. As noted above for the other face of the ring, these mating faces are aligned in a common radial plane substantially at a right angle to the axis of the die head. If desired, a different face angle can be used. Both the cylindrical jacket 11, the ring 7, and the foot 3 are conveniently provided with

cooperating axial bores (not illustrated), into which are inserted tightening screws (not illustrated) to clamp the foot 3, the ring 7 and the jacket 11 together. This form of construction is well known.

1222-29

What is claimed is:

1. An extruder die head comprising in combination:
an inner cylindrical mandrel including an outwardly radially extending flange-like foot formed integrally with the mandrel, which, in the area adjacent to the foot, is provided with at least one borehole through which a polymer melt is fed into the die head,
a shrink fitted ring under a predetermined level of pre-tension located onto the mandrel in sealing contact with the inner cylindrical surface of the mandrel adjacent the flange-like foot, and
a cylindrical jacket mounted onto the shrink fitted ring to provide an annular channel which terminates in an annular die slit,
wherein the level of pre-tension in the ring is predetermined to preclude the formation of an annular gap between the mandrel and the ring due to differential thermal expansion of the ring and the mandrel during the use of the die head.

2. An extruder die head according to Claim 1 which is a blown film die head.

3. An extruder die head according to Claims 1 or 2 wherein the outer surface of the mandrel includes adjacent to the flange-like foot at least one helical groove, in communication with a bore hole through which a polymer melt is fed into the die head, in which the depth decreases towards the die slit and which is closed at the end adjacent to the flange-like foot.

4. An extruder die head according to Claim 3 wherein the shrink fitted ring encloses the groove-free end of the mandrel, and the initial part of the helical grooves.

5. An extruder die head according to Claims 1, 2, 3 or 4 wherein the flange-like foot and the shrink fitted ring are each provided with radial annular surfaces, which can aligned in a common plane, which can lie sealingly on each other, and which can be mounted together so as to provide a sealed joint.

6. An extruder die head according to Claims 1, 2, 3, 4 or 5 wherein the ring and the jacket are provided with radial annular surfaces, which can be aligned in a common plane to locate them side by side in a sealing relationship when they are mounted together.

7. An extruder die head according to Claims 1, 2, 3, 4, 5, or 6 wherein the outer concentric jacket, the ring, and the foot are clamped together by axially located tightening screws located in cooperating bores in the jacket, the ring, and the foot.

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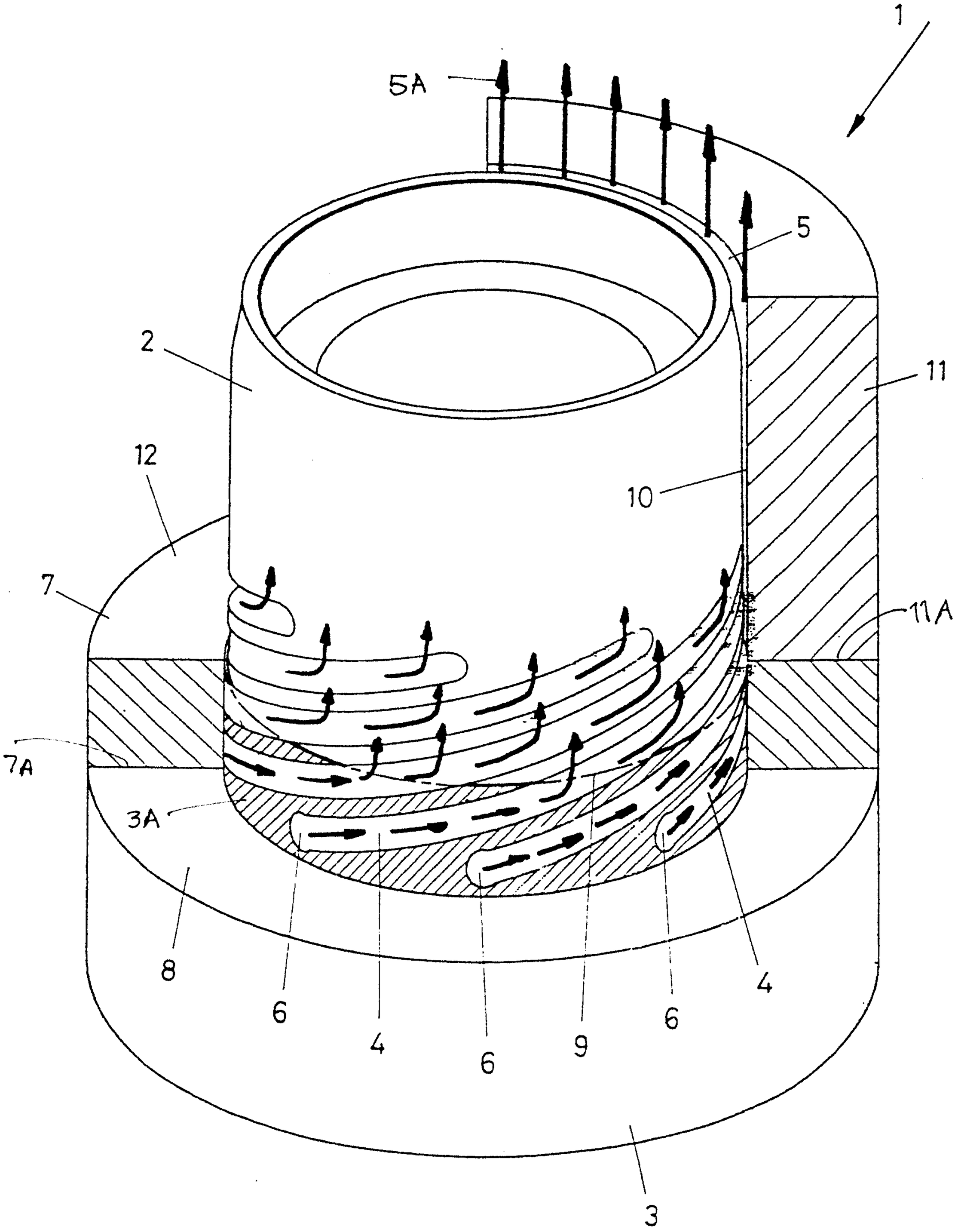

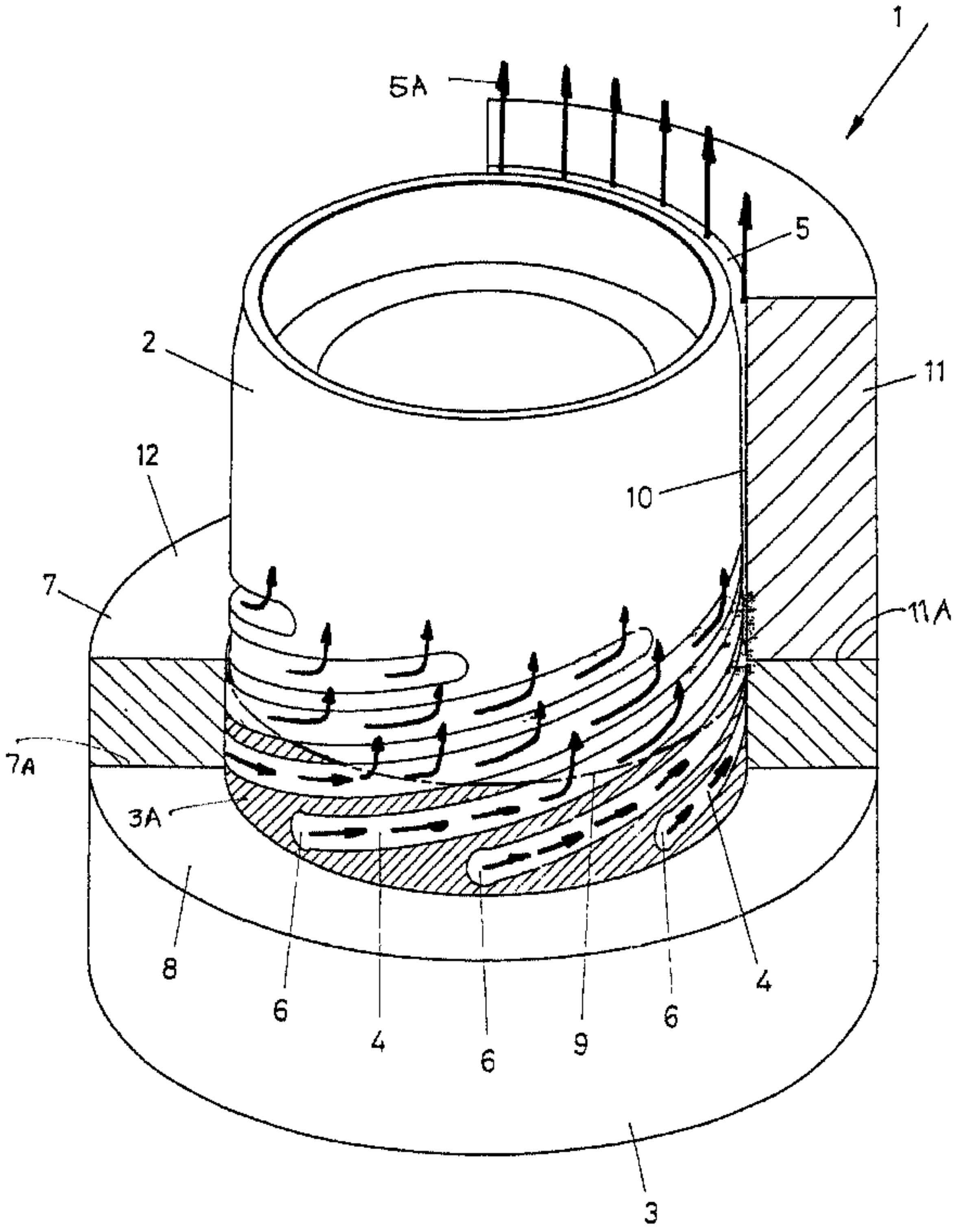
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