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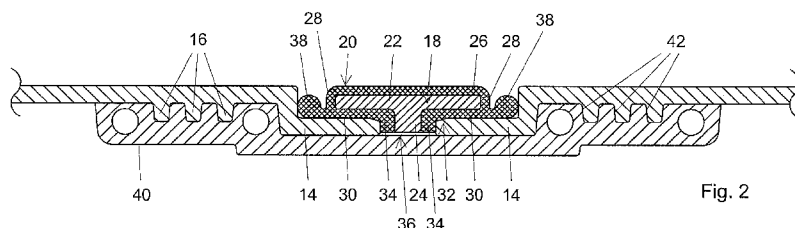


Fig. 2

(57) Abstract: A sealing and joining structure is disclosed connecting two tubular components which are arranged co-axially. The structure comprises a resilient sealing ring (20) including parts (30) which have, radially inwardly thereof, a rigid ring (18) which is adjacent the radially inner faces of the sealing ring parts (30). The sealing ring parts (30) are between the further ring (18) and the radially inner faces of the tubular components. The gap, measured radially, between the radially outer surface of the rigid ring (18) and the inner faces of the components is less than the uncompressed thickness of the sealing ring parts (30) measured in the radial direction.



WO 2013/128395 A2

SEALING AND JOINING STRUCTURES

FIELD OF THE INVENTION

THIS INVENTION relates to sealing and joining structures for tubular components.

BACKGROUND TO THE INVENTION

Many structures include tubular components that must be connected end-to-end in a manner such that the joint between the components does not leak even when there is high pressure in the structure.

A tank comprising two shells is one example of such a structure. A pipe line consisting of end-to-end sections is another example.

BRIEF DESCRIPTION OF THE INVENTION

According to one aspect of the present invention there is provided a sealing and joining structure connecting two tubular components which are arranged co-axially, the structure comprising a ring which has a cylindrical portion co-axial with said components and radially inwardly thereof, and a seal of resilient material between said ring and said components.

According to a further aspect of the present invention there is provided a sealing and joining structure connecting two tubular components which are arranged co-axially, the structure comprising a resilient sealing ring which has, radially inwardly thereof, a further ring which is adjacent a radially inner face of the sealing ring, the sealing ring being between said further ring and the radially inner faces of said components, the gap, measured radially, between the radially outer surface of the further ring and said

inner faces of said components being less than the uncompressed thickness of the sealing ring measured in the radial direction.

In a preferred form said further ring is T-shaped in radial cross section and has a cylindrical portion co-axial with said components and an encircling rib which lies radially outwardly of the cylindrical portion, said sealing ring having a radially inner ring portion which lies radially inwardly of said cylindrical portion, two webs which extend radially outwardly from the ends of said inner ring portion, and a radially outer ring portion which lies outwardly of said further ring and comprises two parts, said parts being between said cylindrical portion and said inner faces of said components and the uncompressed thickness of said parts, measured in the radial direction, being greater than the width of the gap between said cylindrical portion and said components.

End faces of the components can have grooves in them which extend in the circumferential direction and said parts are, adjacent said rib, formed with radially protruding flanges which lie one on each side of said rib, axial extensions of said flanges being in said grooves.

The outer ring portion can be extended axially in both directions beyond said webs and each extension can have a toroidal sealing bead at the free end thereof, said components each having a change of internal diameter thereby to provide internal steps, said beads being against said steps.

Said parts adjacent said rib are preferably formed with radially protruding flanges which lie one on each side of said rib.

According to another aspect of the present invention there is provided a sealing and joining structure connecting two tubular components which are arranged co-axially, the structure comprising a resilient sealing ring which has, radially inwardly thereof, a rigid ring which supports the radially inner face of the sealing ring, the sealing ring being

between said rigid ring and the radially inner faces of said components, the gap, measured radially, between the radially outer surface of the rigid ring and said inner faces of said components being less than the uncompressed thickness of the sealing ring measured in the radial direction, each component having an array of latches protruding axially from an open end thereof and an array of locking elements with a locking element between each pair of latches, the locking elements being configured to move under the latches when said two component are brought into end-to-end contact with the latches interdigitated and the components are thereafter relatively rotated.

According to a still further aspect of the present invention there is provided, in combination, first and second hollow components each having a circular end with an array of circumferentially spaced latches protruding beyond each circular end and locking elements between said latches, each latch being hook-like and having an undercut configuration on the radially inner surface thereof, said locking elements having configurations on the radially outer surfaces thereof which match the configuration of the latches, and each element lying radially inwardly of one of the latches of the other component.

According to a yet another aspect of the present invention there is provided a joint between two cylindrical components each of which has an extension which is semi-cylindrical in form and extends axially beyond the remainder of the component and a semi-circular sleeve of lesser dimension in the axial direction than the extensions and extending the other 180 degree extent of the component, the components being offset by 180 degrees with respect to one another so that the extension of each component, on assembly, enters the gap between the circumferentially spaced edges of the extension of the other component and overlaps the sleeve of the other component, there being grooves in the inner faces of the extensions and the outer faces of the sleeves which grooves register to form a channel between each extension and the

sleeve with which it is overlapped, there being elongate locking elements in said channels and, at each end of each extension, skew passages which form the entrances to short grooves which form continuations, in both circumferential directions, of the channel between each extension and the sleeve with which it is overlapped.

The invention also provides a kit from which tanks can be fabricated, the kit comprising shells which are open at one end and closed at the other, are of different volumes and each of which has a joining and sealing structure encircling the open end thereof, the sealing and joining structures of shells of different volume being compatible with one another so that shells of the same volume and shells of different volume can be attached to one another.

Each shell preferably tapers from its open end towards its closed end whereby shells of the same volume can be nested one within the other.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which;-

Figure 1 is an axial section illustrating a tank which comprises two shells connected by a sealing and joining structure in accordance with the present invention;

Figure 2 is a section, to a larger scale, and illustrating the sealing and joining structure of Figure 1;

Figure 3 is an axial section illustrating a tank which comprises two shells connected by

a sealing and joining structure which is a modification of that illustrated in Figures 1 and 2;

Figure 4 is a section, to a larger scale, and illustrating the sealing and joining structure of Figure 3;

Figure 5 is a side elevation of a tank comprising two shells;

Figure 6 is a pictorial view of the tank of Figure 5;

Figure 7 is an end view of the tank of Figure 6;

Figure 8 is a radial section, to a larger scale, of the joint between the two shells of the tank of Figures 5 to 7;

Figure 9 shows a plurality of nested tank shells;

Figure 10 is a side elevation of a cylinder for containing hot water, the cylinder comprising two shells;

Figure 11 is a section, to a larger scale, and illustrating the joint between the two shells of the cylinder of Figure 10;

Figure 12 is an “exploded” pictorial view of the open ends of the two shells of Figures 10 and 11 and shows the sealing structure between them and flexible rods that are used to lock the two cylinder shells together;

Figure 13 is a similar view of one of the shells and illustrates the position of the sealing structure and the flexible locking rods in relation to that shell;

Figure 14 is a view of the joint between the two shells, only one of the shells being shown;

Figure 15 is a view similar to that of Figure 14 but showing two shells and with the locking rods omitted;

Figure 16 is a pictorial view which illustrates the junction between two shells;

Figure 17 is a section, to a larger scale, through a sealing structure; and

Figures 18, 19 and 20 are diagrammatic sections through three tanks of different volumes.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring first to Figures 1 and 2, the tank 10 illustrated comprises two end-to-end shells 12. The end of each shell 12 has a step in it thereby to form spigot 14 at the open end of each shell 12. Three external circumferentially extending spaced ribs 16 are provided adjacent each step.

The sealing structure comprises a continuous tension ring 18 of metal and a moulded resilient ring 20 of a material such as Viton. Viton is the registered trade mark of Dupont Performance Elastomers LLC and is a fluoroelastomer. It is resistant to many corrosive substances and is resilient in terms of its mechanical properties.

The ring 18 is T-shaped in radial cross-section and comprises a ring portion 22 which is elongate in the axial direction and a rib 24 which protrudes radially outwardly from the centre of the radially outer surface of the ring portion 22.

The ring 20, in section, comprises a radially inner ring portion 26 and two webs 28 which extend radially outwardly from the ends of the section 26. The radially outer, circumferentially extending ends of the webs 28 are each joined to one of the two parts 30 of a split outer ring portion 32. Each part 30 extends axially in each direction from its junction with the respective web 28.

At one end of each part 30 there is a radially outwardly protruding flange 34, the flanges defining a gap 36 which receives the rib 24. At the other end of each part 30 there is a circumferentially extending sealing bead 38. The beads 38 lie radially inwardly of the parts 30 and adjacent the webs 28.

A ring clamp 40 encircles the structure described above. The ring clamp 40 comprises two semi-circular halves which are joined to one another by a pivotal connection (not shown). The free ends of the ring clamp halves are formed with means, such as studs and tapped bores, for pulling the two halves towards one another and reducing the inner diameter of the ring clamp.

The ring clamp 40 has two sets of three internal grooves 42 for receiving the ribs 16.

The seal is assembled by distorting the ring 20 so that the gap 36 between the flanges 34 opens up thereby permitting the ring 20 to be pulled onto the ring 18.

The dimensions of the rings 18 and 20 are such that the ring 20 has to be stretched so that it fits onto the ring 18. The ring 20 is consequently tensioned.

The assembly of the two rings 18, 20 is then presented to one of the spigots 14. One of parts 30 slides onto the spigot 14 until the flange 34 encounters the free end of the spigot 14 and the bead 38 encounters the step of the shell. The spigot 14 of the other

shell 12 is then pressed against the assembled rings 18 and 20 until the free end of the spigot 14 encounters the other flange 34 and the step of the other shell encounters the other bead 38.

The flanges 34 are compressed between the spigots 14 and the rib 24.

The clamp ring 40 is then placed around the assembled sealing structure and the semi-circular halves pivoted towards one another. Using the studs and tapped bores provided, the free ends of the halves are connected together and the ring clamp is pulled tight around the sealing structure. The ribs 16 and grooves 42 interlock to prevent movement of the shells 12 axially with respect to the ring clamp 40

When the pressure inside the tank increases, the beads 38 are compressed and seal against the steps formed where the spigots 14 join the main parts of the shells. The embodiment of Figures 3 and 4 illustrates a structure which is a modification of that illustrated in Figures 1 and 2. For convenience like parts have been designated with like references to which the suffix .1 has been added.

The shells 12.1 are not stepped to form spigots as in the embodiment of Figures 1 and 2 but are thicker over zones adjacent their ends than over their remainders. The thickened end zones of the shells 12.1 are formed with grooves 44 which extend entirely around the ends of the shells 12.1. The thickened zones each have four external ribs 46. The clamp ring 40.1 likewise has two sets of four internal grooves 48 for receiving the ribs 46. The clamp ring 40.1 has a thickened circumferentially extending internal zone which forms an internal rib 50 which faces the circumferentially extending radially outer surface of the rib 24.1.

The flanges 34.1 have sections 52 at their radially outer edges, the sections 52 being in the form of rings.

The ring 20.1 is distorted to receive the ring 18.1 before being pressed against the end of one of the shells 12.1 so that one of the ring sections 52 enters the groove 44.

The other shell 12.1 is then presented to the part assembled sealing structure until the groove 44 receives the other ring section 52. Thereafter the ring clamp 40.1 is placed around the sealing structure and tightened. The rib 50 presses against the flanges 34.1 and also against the sections 52 of the ring 20.1 which lie on either side of the gap 36.1 between the flanges 34.1.

Turning now to Figures 5 to 9, the tank 60 comprises two identical components in the form of shells 62. The tension ring (see Figure 8) is designated 64 and the moulded resilient ring is designated 66. The flanges 68 of the resilient ring 66 are abutted by the circular end surfaces 70 of the shells 62.

Each shell 62 includes four circumferentially spaced latches 72 each of which protrudes beyond the circular end surface 70 (see Figure 8) of that shell. Each latch 72 is in the form of a hook which has an undercut 74. Between the latches 72 there are locking elements 76 each of which stands proud of the radially outer surface of the shell 62. Each locking element 76 has a protrusion 78 which is directed away from the end surface 70 of the shell of 62 of which it forms a part. The surfaces of the protrusions 78 which are designated 82 match the shape of the undercut surfaces 74.

Each element 76 midway between adjacent latches 72. The space between adjacent latches 72 on each side of the elements 76 is cylindrical and devoid of any protrusions.

The tank is assembled by inserting the ring 64 into the ring 66, as described above, and then pressing the assembled rings into the end of one of the shells 62. For the sake of description it will be assumed that the left side of the ring 66 has been pushed into the left hand shell 62 in Figure 8.

The right hand shell 62 is then presented to the left hand shell 62. The latches 72 of the two shells are not aligned with one another but with the plain parts of the inter-latch gaps of the other shell. There are thus no obstructions which prevent the surface 70 of the right hand shell 62 moving to a position in which it abuts the left hand flange 68.

The shells 62 are then rotated relatively to one another so that each locking element 76 moves circumferentially under one of the latches 72 and the elements 76 and latches 72 engage as shown in Figure 8.

When the tank 60 is pressurised the shells 62 tend to move apart thus forcing the protrusions 78 into the undercuts 74 of the latches 72. The flanges 68 are compressed as are the parts of the ring 66 which are immediately adjacent the flanges 68 to provide sealing between the two shells 62.

The cylinder 120 shown in Figures 10 to 17 of the drawings comprises two identical shells 122, 124 each of which is open at one end and closed at the other end by a hemispherical dome.

The shell 122 has a cylindrical side wall 126 which, over half its circumference, terminates in a forward semi-circular edge 128 (see Figure 12) and, over the other half of its circumference, terminates in a rearward semi-circular edge 130. This configuration gives rise to a semi-cylindrical extension designated 132 which projects axially beyond the edge 130. The boundary between the extension 132 and the semi-cylindrical sleeve designated 134, of which the edge 130 forms the circumferentially extending boundary, is constituted by two diametrically opposed axially extending edges. The edges of the shell 122 are designated 136 and the edges of the shell 124 are designated 138.

The cross-sectional shape of the extension 132 is best seen in Figure 11. The free end

of the extension has a step in it to provide a spigot 140 which extends the full extent of the extension 132. In the radially inner surface of the extension 132 there is a groove 142 which also extends the full extent of the extension 132.

The extension 132 has an internal step, the extension being thinner in the radial direction to the left of the step as viewed in Figure 11. This arrangement provides an axially facing end surface 144 in which there is a circumferentially extending recess 146. The recess 146 is consequently in the thicker part of the extension 132 which is to the right of the internal step.

A circumferentially extending groove 148 in the outer surface of the extension 132 and the undercuts 150 have no function but are provided solely for the purpose of equalising the wall thicknesses of the extension 132 as this minimises distortion during moulding.

The cross sectional shape of the sleeve 134 can also best be seen in Figure 11. The sleeve 134 is provided, in its radially outer surface, with a groove 152 which, on assembly, comes into register with the groove 142. The free axially facing edge of the sleeve 134 is designated 154 and has in it a circumferentially extending recess designated 156 which comes into register with the recess 146 during assembly. The undercuts 158 have the same function as the undercuts 150.

Adjacent each circumferential end of each extension 132 there is a skew passage 160 (best seen in Figure 16) which forms the entrance to a short groove 162 (Figure 13) which is in the radially inner surface of the extension 132 and emerges through the adjacent axially extending edge 136, 138. The two short grooves 162 are open on their radially inner sides. It will be understood that the two skew passages 160 of each extension 132 are oppositely orientated.

Turning now to Figure 17, the sealing structure 164 illustrated comprises a strip 166 of

aluminium or plastics material bent to circular shape. The sealing structure also comprises a resilient seal 168 which has a “dumbbell” shape. More specifically it comprises a pair of circumferentially extending circular section lobes 170 and a centre section 172 which has a circumferentially extending recess 174 in its outer surface for receiving the strip 166.

Flexible elongate locking rods 176 of rectangular cross section, best seen in Figure 12, serve as will be explained, to secure the shells 122, 124 to one another.

On assembly of the cylinder 120, the two shells 122, 124 are presented to one another with one turned thorough 180 degrees with respect to the other. As the shells come together the edges 136, 138 of the two extensions 132 come into contact as best seen in Figure 16. The sealing structure 164 is positioned between the shells 122, 124 and enters the recesses 146, 156 of the shells 122, 124 as the shells come together. The flared configuration of the mouths of the recesses 146, 156 facilitates entry of the sealing structure 164 into the recesses 146, 156.

The lobes 170 are squeezed to substantially square configuration during assembly as shown in Figure 11. The strip 166 prevents the seal 168 being extruded between the surfaces 136, 138 when the cylinder is under pressure.

The groove 142 of each extension 132 comes into register with the groove 152 of each sleeve 134. This provides two channels each of which extends around half the circumference of the cylinder and each of which channels is extended for a short distance beyond the contacting surfaces 136, 138 by the grooves 162 leading to the skew passages 160.

A first elongate flexible rod 176 is pushed, as shown by the arrow A1 in Figure 12, through one of the skew passages 160 into the short groove 162 in the inner surface of

the extension 132 and via this groove into the channel constituted by the registering grooves 142, 152. The rod 176 is fed in until its leading end crosses, at a diametrically opposed location, the joint constituted by the other two surfaces 136, 138 and enters the other short groove 162 before emerging into inner end of the other skew passage 160 of that extension. A second rod 176 is pushed, as shown by the arrow A2, into one of the skew passages 160 of other extension 132 and fed in until it crosses the contact line between the surfaces 136, 138 but in the opposite direction to the first rod 176.

It will be understood, and this is best illustrated in Figure 14, that the shells 120, 124, at the two diametrically opposed zones where the surfaces 136, 138 are in contact, are secured by two rods 176 crossing these zones. This provides added strength at the locations which are the weakest in the structure illustrated.

In Figure 5 the shells 62 are of the same size and hence of the same capacity. The volume of the tank 60 is consequently twice the volume of each shell 62.

In Figures 18 to 20, tanks 178, 180 and 182 constituted by shells 184 and 186 are illustrated. The shells 184 in Figure 18 are the same size as one another and the volume of the tank 178 is consequently twice that of one shell.

In Figure 19 the shell 184 is secured to a shell 186 of larger volume. The volume of the resultant tank 180 is consequently the sum of the volumes of the two shells 184, 186.

The tank 182 in Figure 20 is constructed using two of the shells 186 and its volume is twice the volume of each shell 186.

The joining means 188 at the open ends of the shells 184, 186 are identical in configuration and size thereby permitting any shell 184, 186 to be connected to any other shell 184, 186 to obtain a tank of the requisite volume. The means 188 used to

join the shells 184, 186 can be of any of the forms described above with reference to Figures 1 to 17.

More than two sizes of shell can be provided to enable a range of volumes to be obtained.

The tapering shape of the shells of the same volume is such that they nest within one another thereby saving space during transport and storage.

CLAIMS:

1. A sealing and joining structure connecting two tubular components which are arranged co-axially, the structure comprising a ring which has a cylindrical portion co-axial with said components and radially inwardly thereof, and a seal of resilient material between said ring and said components.
2. A sealing and joining structure connecting two tubular components which are arranged co-axially, the structure comprising a resilient sealing ring which has, radially inwardly thereof, a further ring which is adjacent a radially inner face of the sealing ring, the sealing ring being between said further ring and the radially inner faces of said components, the gap, measured radially, between the radially outer surface of the further ring and said inner faces of said components being less than the uncompressed thickness of the sealing ring measured in the radial direction.
3. A structure as claimed in claim 2, wherein said further ring is T-shaped in radial cross section and has a cylindrical portion co-axial with said components and an encircling rib which lies radially outwardly of the cylindrical portion, said sealing ring having a radially inner ring portion which lies radially inwardly of said cylindrical portion, two webs which extend radially outwardly from the ends of said inner ring portion, and a radially outer ring portion which lies outwardly of said further ring and comprises two parts, said parts being between said cylindrical portion and said inner faces of said components and the uncompressed thickness of said parts, measured in the radial direction, being greater than the width of the gap between said cylindrical portion and said components.
4. A structure as claimed in claim 3, wherein said outer ring portion is extended

axially in both directions beyond said webs and each extension has a toroidal sealing bead at the free end thereof, said components each having a change of internal diameter thereby to provide internal steps, said beads being against said steps.

5. A structure as claimed in claim 3 or 4, wherein said parts are, adjacent said rib, formed with radially protruding flanges which lie one on each side of said rib.
6. A sealing and joining structure connecting two tubular components which are arranged co-axially, the structure comprising a resilient sealing ring which has, radially inwardly thereof, a rigid ring which supports the radially inner face of the sealing ring, the sealing ring being between said rigid ring and the radially inner faces of said components, the gap, measured radially, between the radially outer surface of the rigid ring and said inner faces of said components being less than the uncompressed thickness of the sealing ring measured in the radial direction, each component having an array of latches protruding axially from an open end thereof and an array of locking elements with a locking element between each pair of latches, the locking elements being configured to move under the latches when said two component are brought into end-to-end contact with the latches interdigitated and the components are thereafter relatively rotated.
7. A structure as claimed in claim 3, wherein end faces of the components have grooves in them which extend in the circumferential direction and said parts are, adjacent said rib, formed with radially protruding flanges which lie one on each side of said rib, axial extensions of said flanges being in said grooves.
8. In combination, first and second hollow components each having a circular end with an array of circumferentially spaced latches protruding beyond each circular end and locking elements between said latches, each latch being hook-like and having an undercut configuration on the radially inner surface thereof, said

locking elements having configurations on the radially outer surfaces thereof which match the configuration of the latches, and each element lying radially inwardly of one of the latches of the other component.

9. A joint between two cylindrical components each of which has an extension which is semi cylindrical in form and extends axially beyond the remainder of the component and a semi-circular sleeve of lesser dimension in the axial direction than the extensions and extending the other 180 degree extent of the component, the components being offset by 180 degrees with respect to one another so that the extension of each component, on assembly, enters the gap between the circumferentially spaced edges of the extension of the other component and overlaps the sleeve of the other component, there being grooves in the inner faces of the extensions and the outer faces of the sleeves which grooves register to form a channel between each extension and the sleeve with which it is overlapped, there being elongate locking elements, in said channels and, at each end of each extension, skew passages which form the entrances to short grooves which form continuations, in both circumferential directions, of the channel between each extension and the sleeve with which it is overlapped.
10. A kit from which tanks can be fabricated, the kit comprising shells which are open at one end and closed at the other, are of different volumes and each of which has a joining and sealing structure encircling the open end thereof, the sealing and joining structures of shells of different volume being compatible with one another so that shells of the same volume and also shells of different volumes can be attached to one another.
11. A kit as claimed in claim 10, where each shell tapers from its open end towards its closed end whereby shells of the same volume can be nested one within the other.

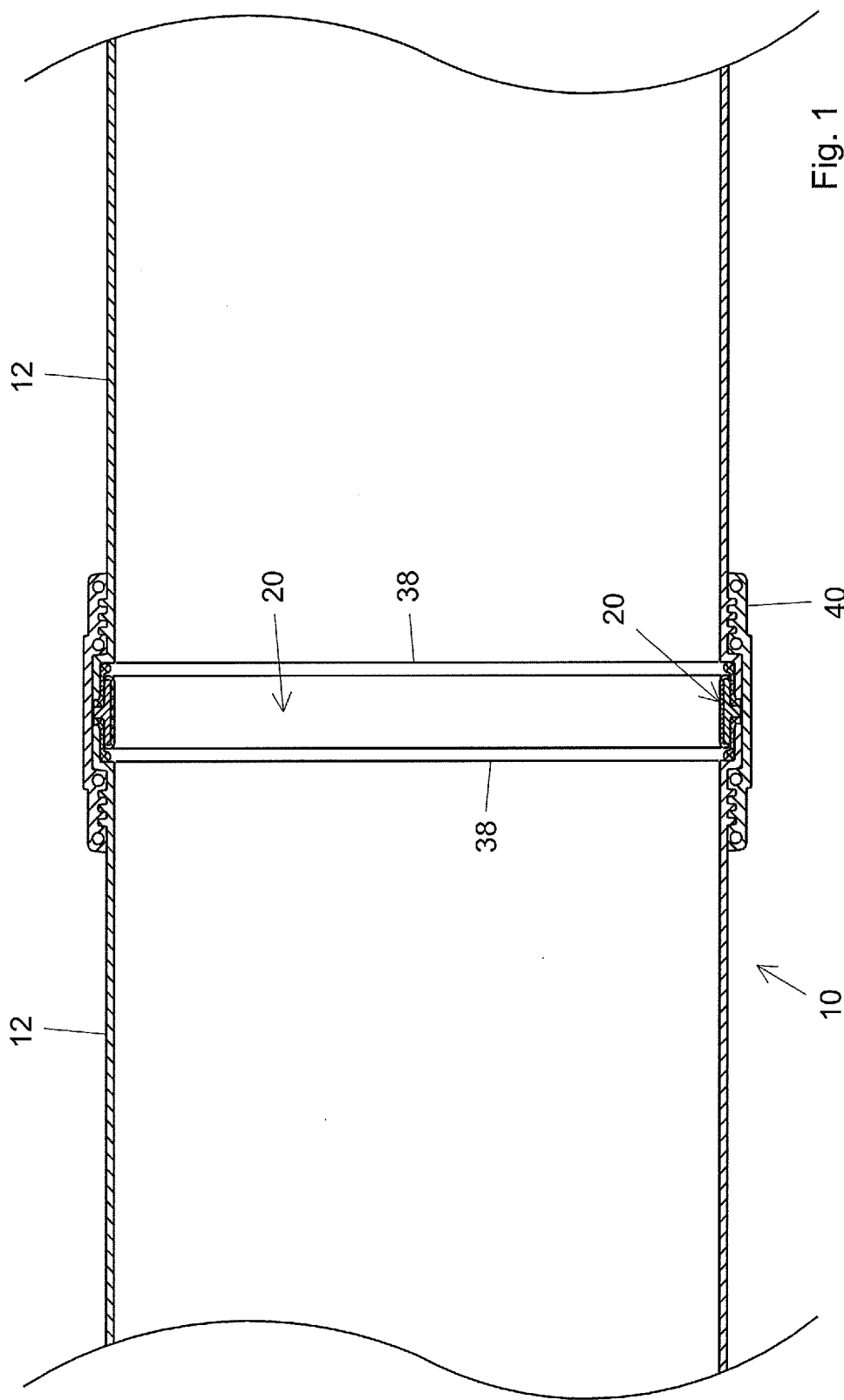


Fig. 1

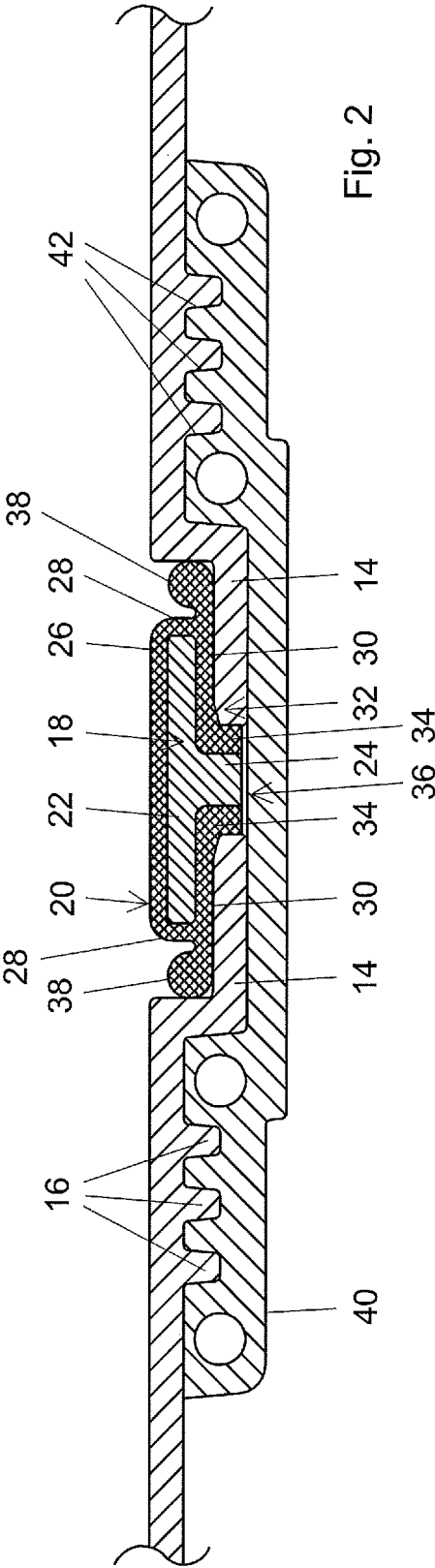


Fig. 2

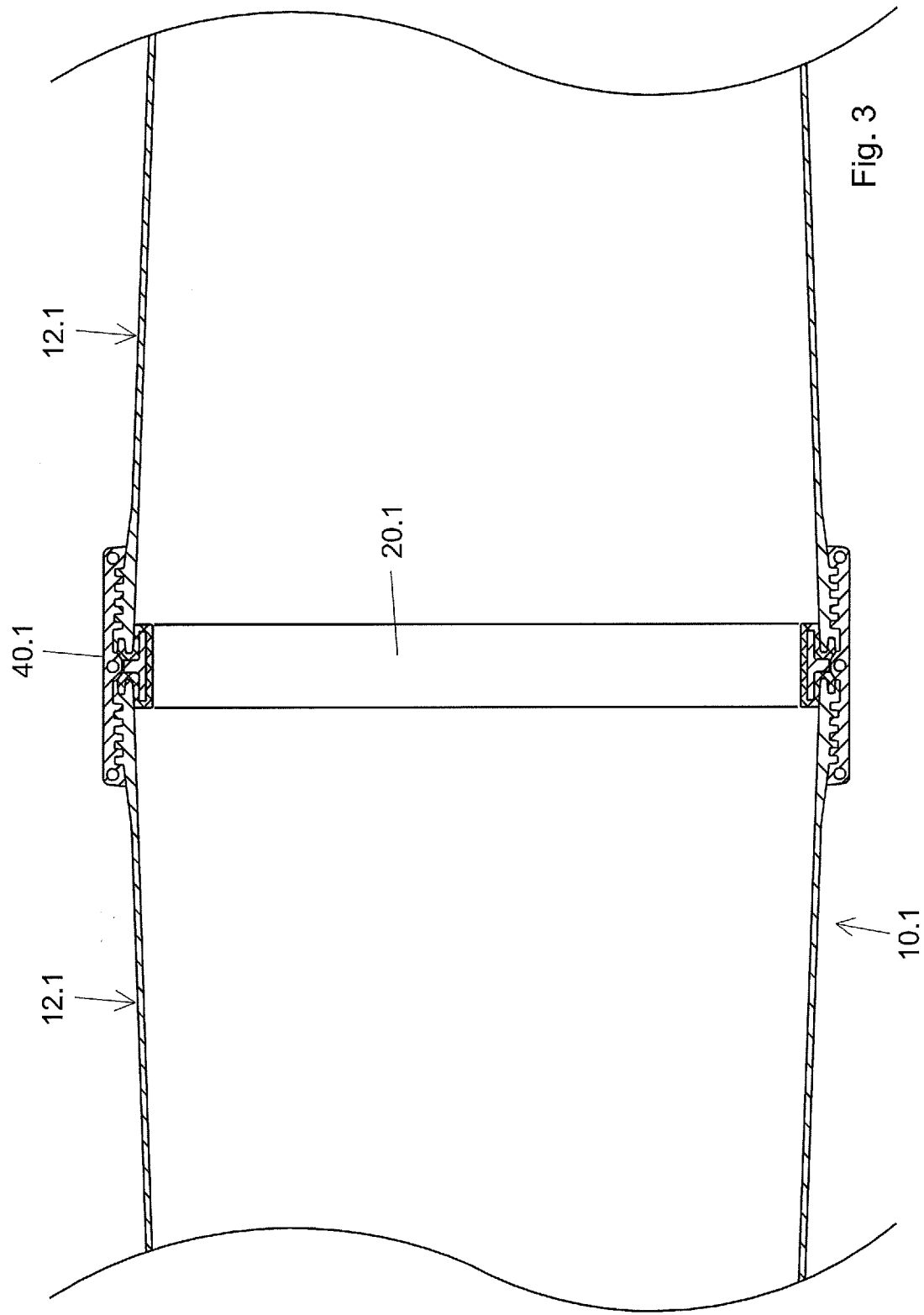


Fig. 3

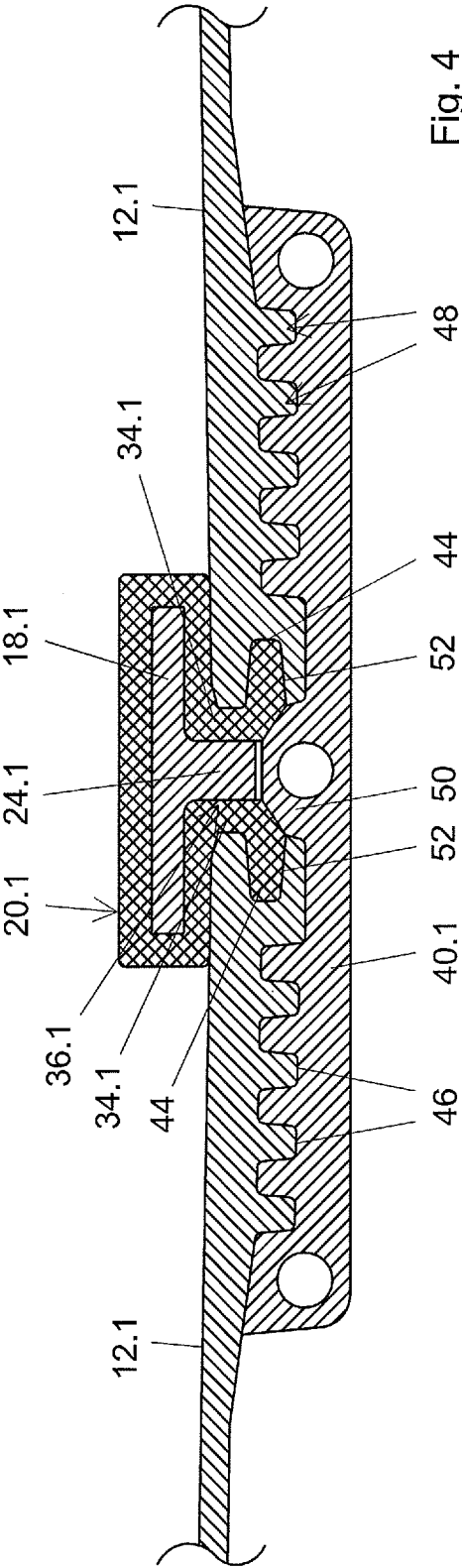
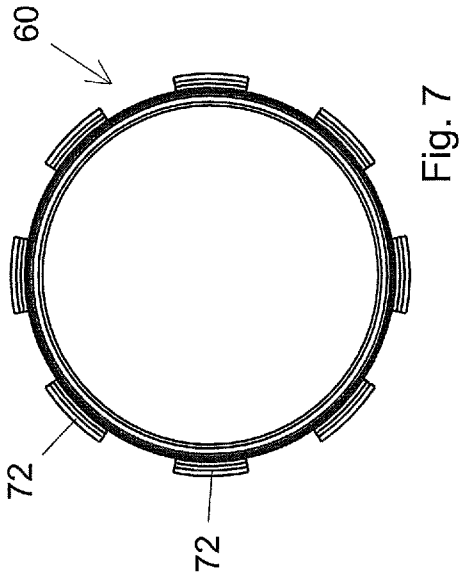
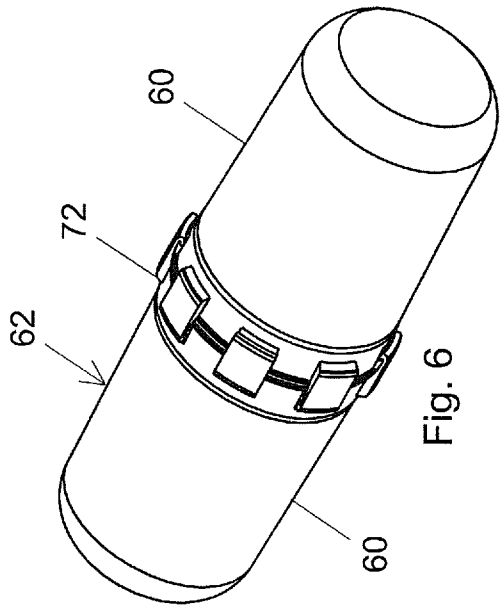
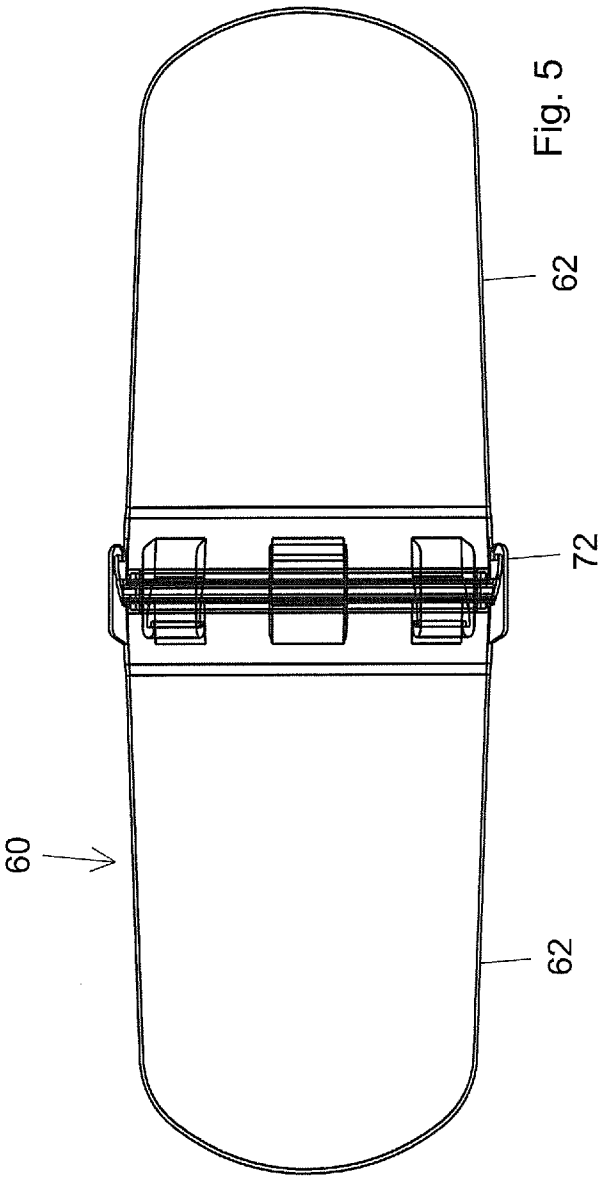
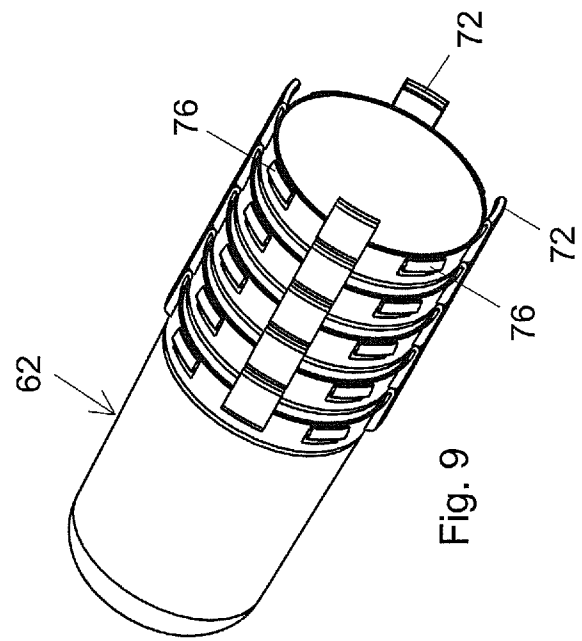
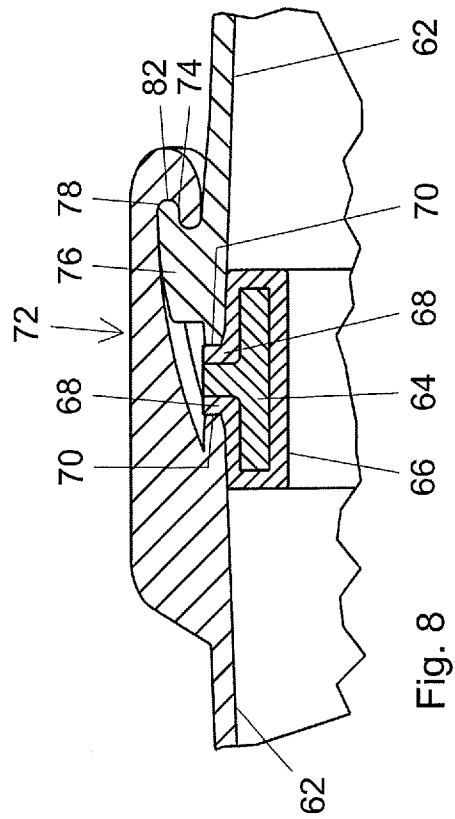


Fig. 4





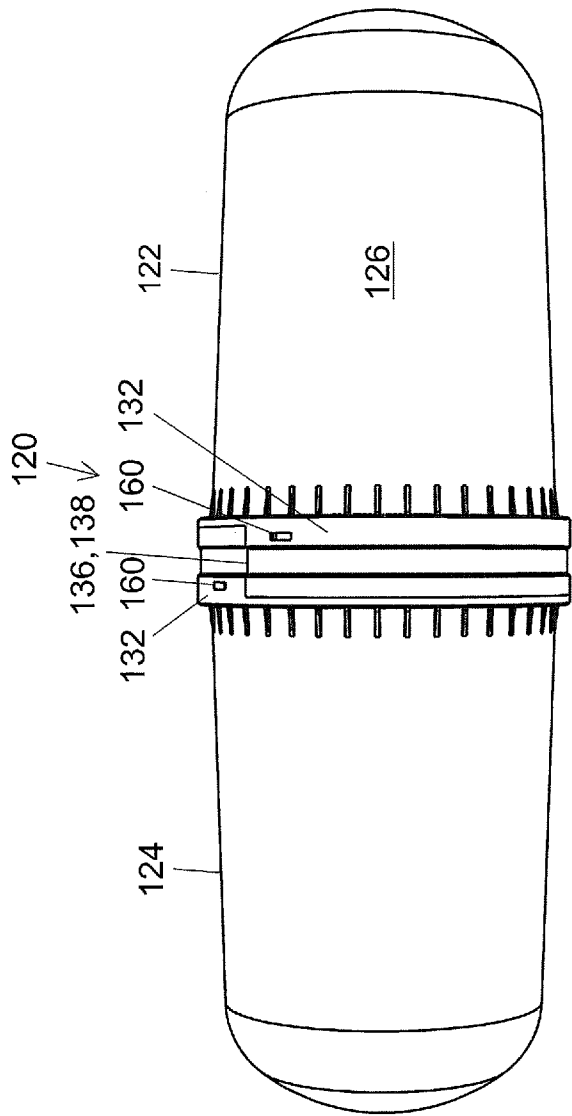


Fig. 10

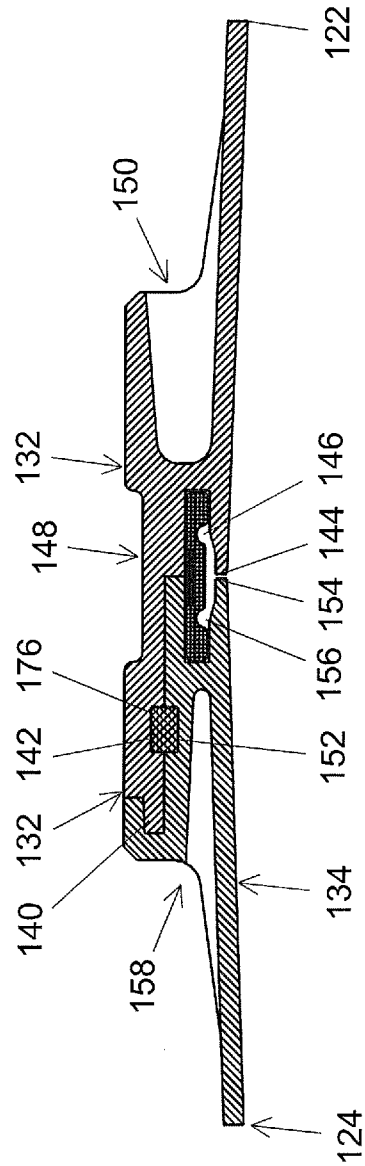


Fig. 11

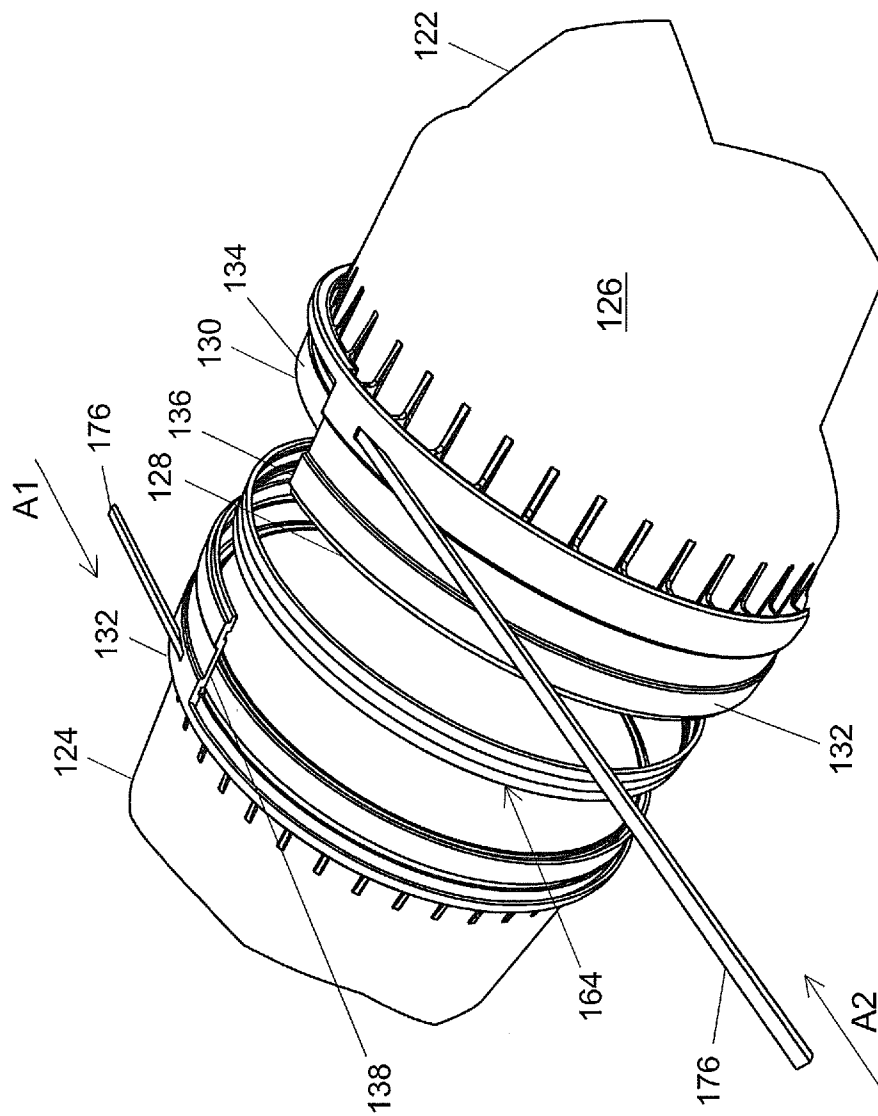


Fig. 12

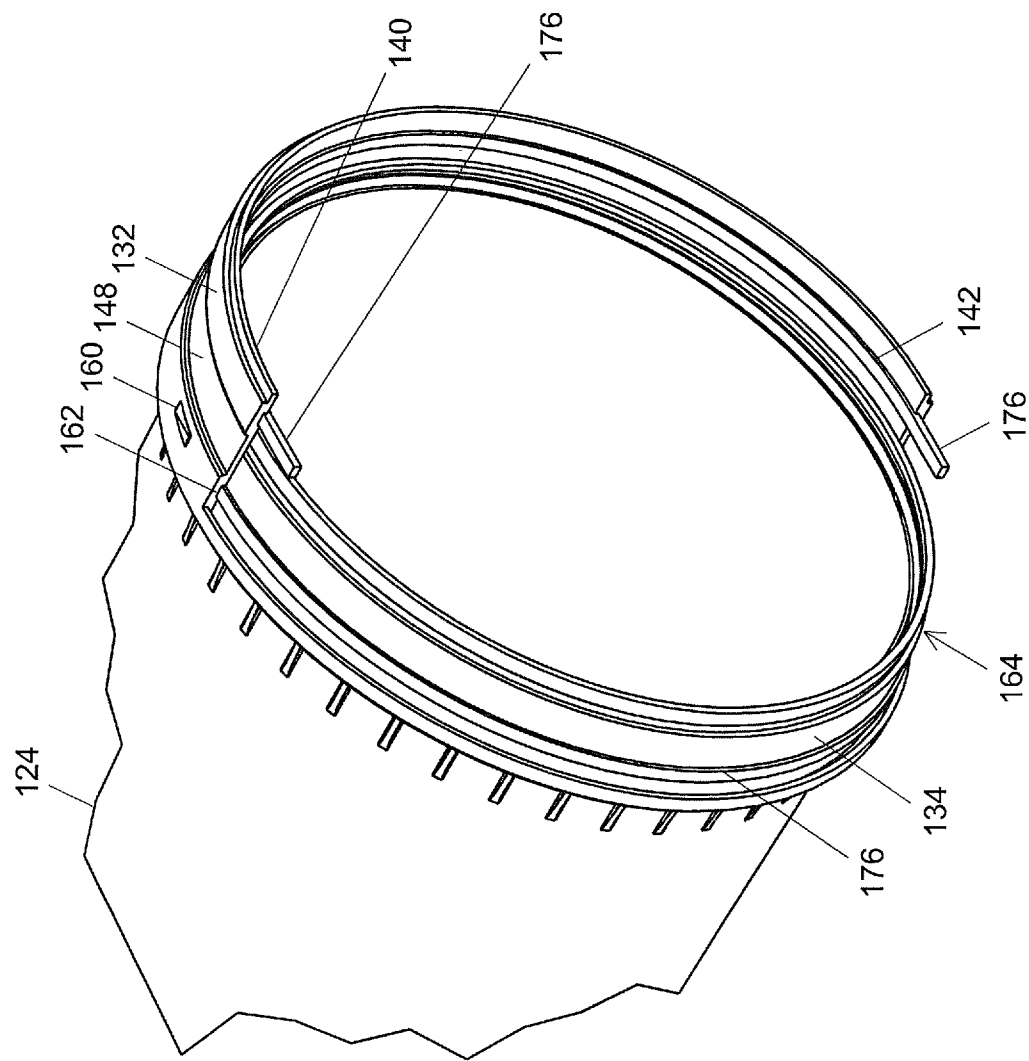


Fig. 13

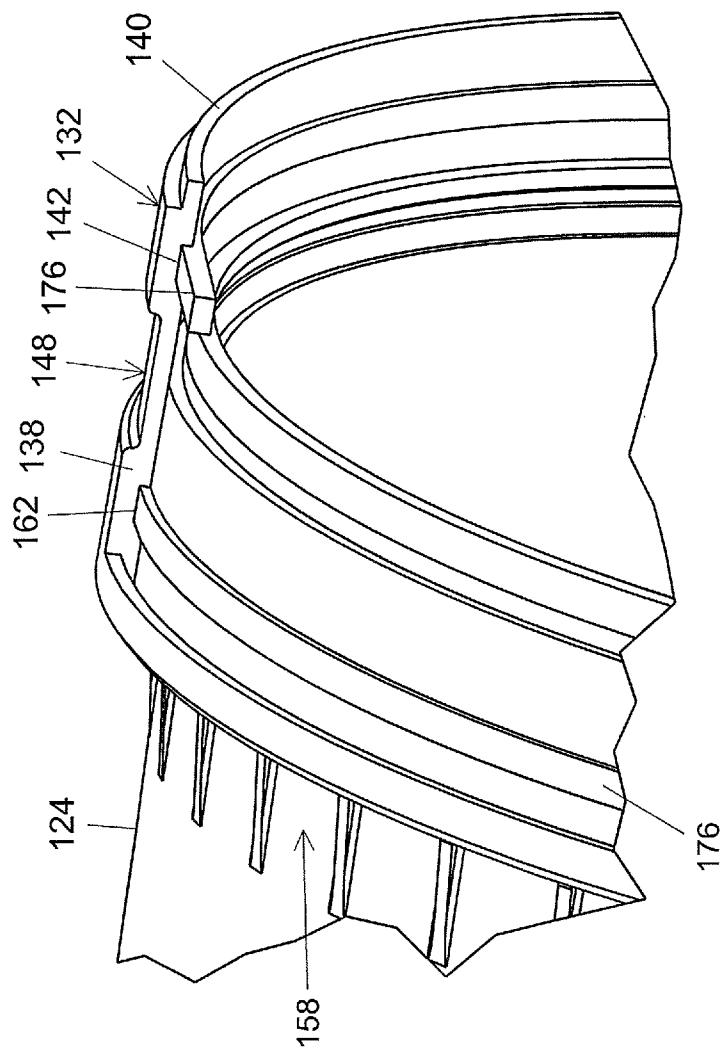


Fig. 14

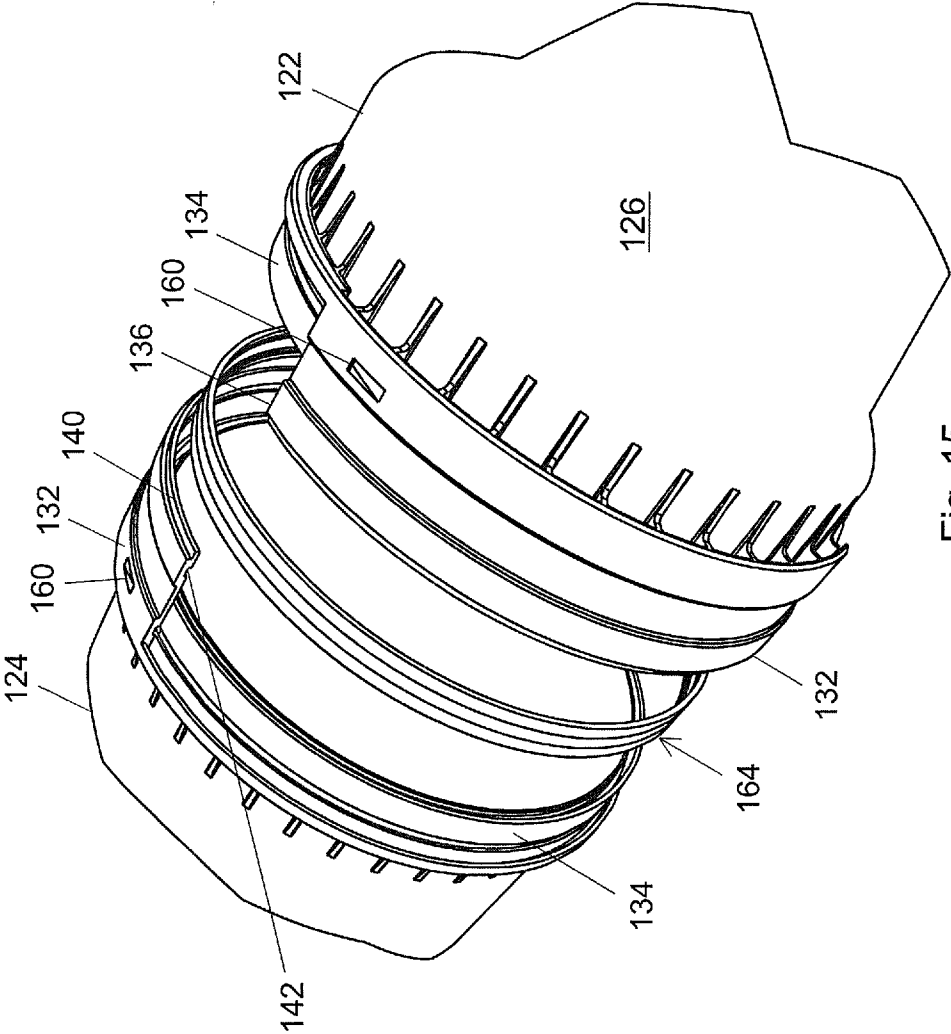
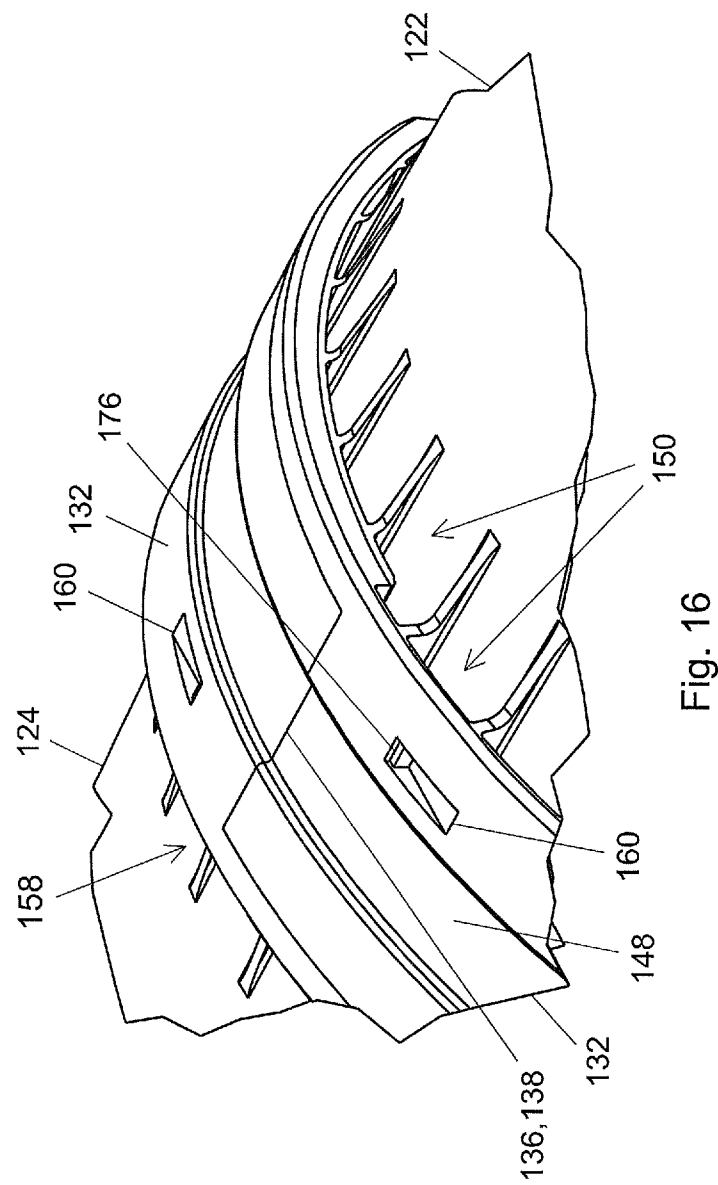


Fig. 15



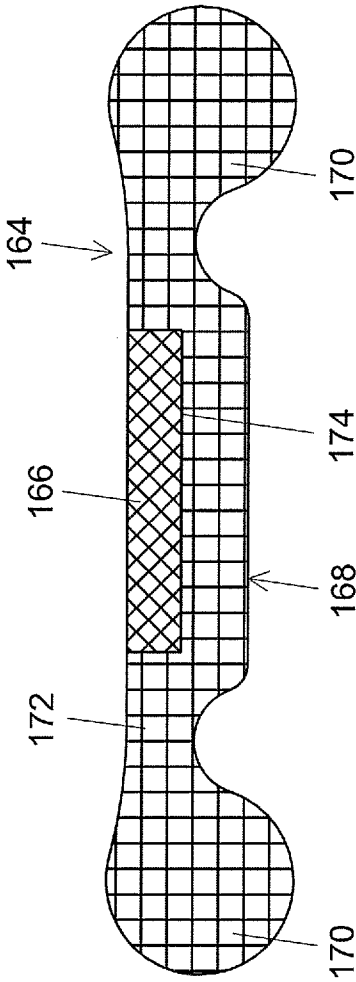


Fig. 17

