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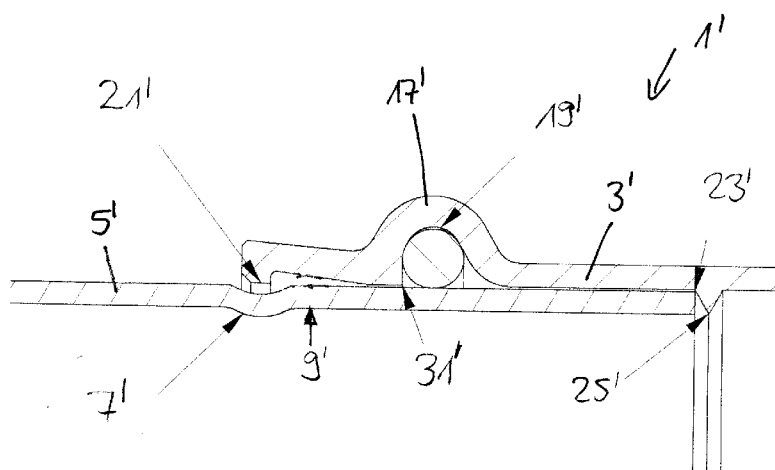


Fig. 3

(57) Abstract: A fitting (3, 3') for connecting
to a tubular element (5, 5') having a first end
section (9, 9') comprising at least one first
connection element (21, 21'), wherein the
diameter of at least a part of the first con-
nection element (21, 21') can be reduced in a ra-
dial direction in order to produce a connec-
tion, wherein the first connection element
(21, 21') comprises at least one first hook ele-
ment (21, 21') and/or at least one first crimp
(237, 437) configured to be connected in for-
ce-fit and/or form-fit manner to at least one
second crimp (7, 7') and/or at least one
second hook element (235) formed on the
outer surface of the tubular element, when
the diameter of at least a part of the first con-
nection element (21, 21') is reduced, as well
as a tubing connection and a method for con-
necting a fitting to a tubular element.

Fitting for connecting to a tubular element, tubing connection and a method for connecting a fitting to a tubular element

Description

The invention relates to a fitting for connecting to a tubular element having a first end section comprising at least one first connection element, wherein the diameter of the first connection element can be reduced in a radial direction in order to produce a connection as well as a tubing connection comprising an inventive fitting and a method for connecting an inventive fitting to a tubular element.

In the state of the art a plurality of fittings is known.

For example EP 1 171 731 B1 discloses a fitting or mounting for producing a press joint with an inserted tube end. It is proposed that the fitting has an end section which can be crimped in order to produce a connection with a tubular component. It is proposed that in an annular bead at least one bulge or indentation is provided to establish a clearance between a sealing ring located in the annular bead and the wall of the end section. The clearance provides a deliberate leakage between the tubular component and the fitting before the crimping of the end section is carried out.

Such a fitting generally only works fine with comparable low pressures. Especially for low pressures the crimping provides sufficient force to establish a force fit between the tubular component and the fitting. However, in case the pressure within the tubular element is increased and/or a force is acting on the tubular element the connection between the fitting and the tubular component might become loose.

In the state of the art further fittings have been proposed to increase a connection between the fitting and the tube. For example DE 100 26 083 C1 discloses a tubular press fitting. The press fitting comprises on the inner side at least one tooth element. When pressing the press fitting the tooth element cuts into the outer surface of the tubular element.

Also EP 2 236 889 B1 shows a fitting for connecting a tube that uses a comparable connection mechanism. It is proposed that the fitting comprises a pressing section. The pressing section comprises at least two cutting blades which are fixly connected on the inner side of a hollow body of the fitting. When the pressing section is compressed the cutting blades cut into the outer surface of the tube.

US6,450,553B1 is directed to an axial swage fitting for large bore pipes and tubes. The fitting for joining pipes, tubes includes a substantially cylindrical sleeve and ring. The sleeve has an inner surface defining a bore, configured to slidably receive the pipe at an open end. The inner sleeve surface also includes protrusions, which deform the outer surface of the pipe upon swaging.

Another fitting is known from US2011/0204624A1 which discloses an universal connection socket comprising a plurality of spaced radially inwardly projecting barbs spanning opposite sides of a circumferential O-ring receiving groove and dimensioned to grip, when crimped, a fluid conduit in sealable engagement within the socket.

Also DE 94 17 646 U1 is directed to a pipe connection with relief notches. It is proposed that the inner diameter of a connection socket is adapted to the outer diameter of the pipe as well as that a sealing element has a relief notch.

Finally US2008/0303277A1 discloses a non-bolt joint structure comprising a packing ring sealing between a receiving opening section and an insertion opening section; an engaging means provided with an inner circumference of the receiving opening section preventing a polyethylene pipe from disengaging from the receiving opening section by engaging with an outer circumferential surface of the polyethylene pipe; and a tubular metallic inner core fitting an inner circumference of the insertion opening section of the polyethylene pipe. The inner core is plastically deformed to include a first bulge portion that its cross-sectional shape bulges toward an outward radial direction.

The shown fittings have however the drawback that the connection force is not sufficient to ensure a secure fastening of the tube within the fitting also when the tube is used in ACR applications (air conditioning and refrigeration applications). In such systems fluids with high pressures are used. At the moment the standard pressure for ACR applications is 40 bar but it is planned to increase the standard pressure to 100 to 150 bar for efficiency reasons. At such pressures the fittings known in the state of the art could not secure a sufficient secure and stiff connection between the fitting and the tube. It has been observed that already below a pressure of 100 bar in fittings known in the state of the art the tube starts to move out of the fitting.

It is thus the object of the invention to further develop the fittings known in the state of the art to allow a use of the fitting in systems using pressures of a fluid above 40 bar, especially to provide a fitting that securely fastens the tube to a fitting at such high pressures.

This object is achieved in that the first connection element comprises at least one first hook element and/or at least one first crimp configured to be connected in force-fit and/or form-fit manner to at least one second crimp and/or at least one second hook element formed on the outer surface of the tubular element, when the diameter of the at least a part of first connection element is reduced.

The fitting might be further characterized in that the first hook element and/or the second crimp is/are radially inwardly extending and/or the first crimp and/or the second hook element is/are radially outwardly extending.

Advantageous embodiments of the fitting might be characterized in that the first crimp and the second crimp are connected to each other by a securing element, preferably comprising at least one latch washer, at least one spring washer and/or at least one wave washer.

It is furthermore proposed that the fitting is characterized by at least one first sealing element, preferably arranged at least partly in at least one radially outwardly extending annular recess, wherein preferably the annular recess is at least partly comprised by the first connection element and/or the first sealing element comprises at least one sealing ring, at least one O-ring, at least one elastomeric material, at least one viscous fluid type sealant, at least one adhesive sealant, at least one receptacle comprising at least one sealant, wherein the receptacle is preferably ruptured

when the diameter of the section is reduced, whereby releasing the sealant contained in the receptacle, at least one metallic seal and/or, at least one labyrinth-sealing.

The invention further more proposes that the sealing element has an internal diameter being smaller, mainly identical or greater than the outer diameter of the tubular element and/or the inner diameter of the fitting.

Also a fitting according to the invention can comprise at least one second connection element provided at a second end section of the fitting, preferably located opposite the first end section, wherein the second connection element preferably comprises at least one threaded section, especially formed on the inner surface or the outer surface of the second end section, at least one third, especially radially inwardly extending, annular hook element and/or third crimp configured to be connected in force-fit and form-fit manner to at least one, especially radially inwardly extending, fourth crimp and/or, especially radially outwardly extending, fourth hook element formed on the outer surface of another tubular element when a diameter of at least a part of the second connection element is radially reduced, at least one click connection at least one compression connection, at least one press connection, at least one flame joint connection, at least one flame free connection, at least one union connection, at least one flanged connection and/or at least one push connection.

For the before mentioned embodiment it is especially preferred that the fitting comprises a plurality of second connection elements, especially forming a plurality of sockets, extending in different angular directions of the fitting with respect to the first connection element, another second connection element and/or a main axis of the fitting.

Inventive fittings might also be characterized in that the fitting comprises at least one alignment element for aligning the tubular element, especially the second crimp, at least one liner body at least partly introduced into the tubular element and/or the second hook with respect to the fitting, especially with respect to the first connection element, the second connection element, the first hook element the first crimp, the third crimp, the fourth crimp, the third hook element and/or the fourth hook element, wherein the alignment element preferably comprises at least one inwardly extending projection and/or step.

Finally an inventive fitting might be characterized by at least one gripping and/or cutting element, preferably comprising at least one sharp edge, at least one anchor element, at least one barb and/or at least one tooth, especially extending inwardly, wherein the gripping element engages the tubular element, especially cuts into the tubular element.

The invention furthermore provides a tubing connection comprising at least one inventive fitting and at least one tubular element connected to the fitting, wherein the tubular element comprises at least one second crimp and/or at least one second hook element formed on the outer surface of the tubular element and the at least one first hook element and/or the first crimp of the fitting engages the second crimp and/or the second hook element in a form-fit and/or force-fit manner.

The tubing connection might be characterized by at least one liner body at least partly introduced into the tubular element, wherein the liner body preferably comprises at least one fifth crimp and/or cut out, the fifth crimp and/or cut out being preferably aligned along the longitudinal axis of the fitting and/or the tubular element with respect to the first hook element and/or the first crimp.

In the before described embodiment it is preferred that the liner body comprises at least one second sealing element, especially arranged at least partly in at least one radially inwardly extending first annular clearance, for sealing a space between the liner body and the tubular element, and/or at least one third sealing element, especially arranged at least partly in at least one radially inwardly extending third annular clearance, for sealing a space between the liner body and the fitting, wherein the second sealing element and/or the third sealing element comprise(s) at least one sealing ring, at least one O-ring, at least one elastomeric material, at least one viscous fluid type sealant, at least one adhesive sealant, at least one receptacle comprising at least one sealant, wherein the receptacle is preferably ruptured when the diameter of the section is reduced, whereby releasing the sealant contained in the receptacle, at least one metallic seal and/or, at least one labyrinth-sealing.

For the before described two embodiments it is proposed that the liner body comprises at least one gripping structure facing the tubular element, especially comprising at least one tooth, at least one barb, and/or at least one cutting edge.

For the tubing connection it is furthermore proposed that a wall thickness of the tubular element in the area of the second crimp and/or the second hook element is mainly constant, especially identical to the wall thickness of the remaining part of the tubular element and/or the second crimp comprises at least one first indentation on the outer surface of the tubular element and at least one elevation on the inner surface of the tubular element, and/or the second hook element comprises at least one elevation on the outer surface and at least one indentation on the inner surface of the tubular element wherein the respective indentation and the respective elevation have complementary cross sectional forms and/or dimensions.

An inventive tubing might also be characterized in that the tubular element and/or the fitting comprises at least one metallic material, especially copper, iron, steel, stainless steel, brass, cast material and/or forged material, at least one carbon material and/or at least one plastic material, especially polymethylmethacrylate, polycarbonate, polyvinyl chloride, glass fiber and/or reinforced plastic, and/or combinations of at least two of the before mentioned materials.

Furthermore the invention provides a method for connecting at least one fitting to at least one tubular element comprising the steps of providing an inventive fitting, inserting the tubular element into the fitting, at least partly reducing a diameter of at least one section of at least a part of the fitting in a radial direction, wherein by the reduction of the diameter at least one first hook element and/or at least one first crimp of a first connection element of the fitting and/or at least one securing element is/are deformed to engage at least one second crimp and/or at least one second hook element formed on the surface of the tubular element such that a force-fit and/or form-fit connection of the fitting to the tubular element is provided.

For the method it is furthermore proposed that the first hook element and/or the first crimp of the first connection element and/or crimp and/or the second hook element of the tubular element is/are formed by the reduction of the diameter.

For the method it is also proposed that the first crimp, the first hook element, the second crimp and/or the second hook element is/are formed on the outer surface of the tubular element and/or the inner surface of the fitting, especially the first connection element, prior to the pressing of the fitting, is especially preformed in the tubular element and/or the fitting.

Advantageous embodiments of the inventive method might be characterized in that before, during and/or after inserting the tubular element into the fitting at least one liner body is inserted into the tubular element.

Finally the inventive method might be characterized in that the at least partly reduction of the diameter is reached by pressing the at least one section with at least one press tool, preferably a crimping tool, and/or by sliding at least a cap and/or ring onto the section, wherein especially the inner diameter of the cap and/or ring is in at least one sector decreasing in an axial direction of the ring and/or cap, preferably in a sector coaxial with the section of the fitting and/or the ring and/or cap are threaded onto the section and/or connected to the section by at least one bayonet connection.

The invention is thus based on the astonishing perception that by using annular hook elements it becomes possible to connect the fitting to a tubular element so that the connection can resist pressure fluids of above 40 bar. The hook element might be formed as an element that runs circumferentially around the tubular element and/or the fitting or might be formed by and/or included in a plurality of tongues providing a plurality of separated segments partly circumferentially running around the tubular element and/or the fitting, respectively. This makes the fitting especially applicable in ACR applications. By the hook element it becomes possible that the hook element engages a crimp that is formed on the outer surface of the tubular element or the inner surface of the fitting in a form-fit and force-fit manner.

A crimp in the sense of the invention is an indentation on the outer surface of the tubular element and/or the inner surface of the fitting wherein the thickness of the wall of the tubular element and/or fitting is/are however constant over the area of the indentation.

In comparison to cutting elements known in the state of the art that produce a cut into the outer wall of the tubular element a crimp in the sense of the invention does not weaken the structure of the tubular element/fitting. Especially in fittings known in the state of the art that use cutting elements it can be observed that the cutting elements lead to a weakening of the structure. When high pressures are used especially the tubular element tends to break in the area of the cut.

In comparison to such a cutting element a hook in the sense of the invention if at all only deforms a corresponding surface of the tubular element fitting but does not cut into the surface. Depending on the material used for the fitting and the tubular element the respective crimp and/or the respective hook element might be pre-formed in the tubular element, for example in case the tubular element comprises plastic materials.

In case the tubular element and/or the fitting comprise(s) for example a metal material it is possible that by reducing the diameter of the pressing section of the press fitting, for example by a press tool, the respective crimp(s) and/or the respective corresponding hook element(s) is/are formed within the tubular element by a hook element and/or the press tool. Due to the fact that the hook is annular, that means is running around the whole periphery of the fitting, it is secured that the form fit leads to the effect that the tube cannot be disconnected from the fitting also when pressures of more than 200 bar are used.

The inventive fitting has especially been tested for pressures of about 200 bar and no movement of the tubular element with the spectrum fitting could be observed but the test equipment failed.

To provide a sealing of the connection of the fitting with the tubular element is proposed that a sealing element is provided. However the sealing might be reached by the fitting and the tubular element itself especially their form without a separate additional sealing element. The sealing element could be an elastomeric seal that is located within an annular recess. For example the seal might comprise an O-ring. Such a seal might also be used as an indication for a missing connection of the tubing element and the fitting.

In case the seal is dimensioned to have a greater inner diameter in comparison to the auto diameter of the tubular element a leakage is occurring in case the fitting is not pressed. Alternatively the sealing element might comprise a viscous fluid type sealant contained within a suitable receptacle that may be essentially circular and located in place of or adjacent to the O-ring. The pressing action, when reducing the diameter of the press fitting ruptures the receptacle and releases the sealing liquid.

A fitting might furthermore comprise at least one second end section. This second end section might have any form and function, for example allowing a connection of the fitting to an

additional tubular element. This second end connection might allow a connection with an additional tubular element in any way known in the state of the art. The connection to the additional tubular element might be preferably reached by a threaded connection or by a connection element comprising a hook that engages a crimp that are provided within the fitting and further tube, respectively.

Also other connection types for connecting the fitting to another tube maybe used, like click connections, connections via an adhesive material or by welding.

Especially the fitting might be formed as a distributor that means that the fitting comprises a plurality of sections that are directed into different directions, especially off set from a longitudinal axis of the first end section.

To secure a correct positioning of the respective hook relative to the respective crimp, that is/are especially preformed the invention furthermore proposes at least one a alignment element. To reach a coincidence of the hook element with the internal projection within the fitting, especially a circumferential projection might be used. The projection engages with the tube end such that a distance between the projection and the hook element is approximately the same as the distance of the end of a tube element and the crimp.

To further secure the connection between the tubular element and the fitting an additional crimping or cutting element might be provided. Probably such a gripping or cutting element does not cut into the outer surface of the tubular element when the diameter of the fitting is reduced. However in case the tubular element tends to move out of the fitting the gripping element engages the outer surface of the tubular element and hinders the tubular element from a further movement out of the fitting. In such a case the displacement of the tubular element with respect to the fitting can be seen from outside as the hook will not anymore fully engage the crimp and thus becomes visible at least partly.

As already mentioned the structure of the inventive fitting elements allows that the fitting and on/or the tubular element to be made of a variety of different materials, like metallic materials and/or plastic materials and combinations. Thus the fitting becomes useable for nearly any function within an ACR-application.

The reduction of the diameter of the fitting may be reached in different ways. The reduction might be reached by a pressing tool. However it is also possible that the reduction or deformation of the fitting element is achieved by means of an external cap that is shaped to urge a diametrical reduction pressed into a place by an axial pressing of the cap into the fitting. To reach this aim the cap might have a frustoconical cross section such that when the cap is pushed onto the fitting the diameter of the fitting is reduced. The pushing movement might be reached by a turning action to connect the cap to the fitting by a thread and/or a bayonet connection. In general the invention covers any radial movement, linear movement or combination of such movements of a tool or member that leads to an introduction of the hook element into a tubular element, especially a crimp, irrespective whether the tubular element has been preformed, especially whether the crimp has been preformed or not.

In an alternative embodiment there is no interlink between a hook element and a cooperating crimp but two crimps are interlocked by a securing element. The crimps might be formed in the outer surface of the tubular element and the inner surface of the fitting, respectively and when connecting the tube element to the fitting the securing element, like a spring ring is located in one of the crimps such that the securing element interlinks the crimps when the tube element and the fitting are aligned.

Further aspects and advantages of the claimed invention become apparent from the following description of preferred embodiments of the invention that are explained with the help of the following figures in which

Fig. 1 is a cross sectional view of an inventive tubing connection according to a first embodiment;

Fig. 2 is a schematic cross sectional view of an inventive tubing connection according to a second embodiment;

Fig. 3 is a cross sectional detail view of the section A in Fig. 2;

Fig. 4 is a cross sectional partial view of a third embodiment of the invention;

Fig. 5 is a cross sectional partial view of a fourth embodiment of the invention;

- Fig. 6 is a cross sectional partial view of a fifth embodiment of the invention;
- Fig. 7 is a cross sectional partial view of a sixth embodiment of the invention.
- Figure 8a is a cross sectional view of a seventh embodiment of the invention in a preconnected state;
- Figure 8b is a cross sectional view of the seventh embodiment of figure 8a in a connected state;
- Figure 9a is a cross sectional partial view of an eighth embodiment of the invention in a preconnected state;
- Figure 9b is a cross sectional view of the eighth embodiment of the invention in a connected state;
- Figures 9c to 9e are variations of the eighth embodiment shown in figure 9a;
- Figure 10 is a cross sectional view of a connection element;
- Figure 11 is a cross sectional partial view of a ninth embodiment of the invention;
- Figure 12a is a cross sectional partial view of a further connection element in a preconnected state; and
- Figure 12b is a cross sectional view of connection element in a connected state.

Fig. 1 shows a cross sectional view of a tubing connection according to a first aspect of the invention. The tubing connection 1 comprises a fitting 3 and a tubular element 5. As can be taken from Fig. 1 the tubular element 5 comprises a crimp 7 forming a second crimp in the sense of the claims formed on the outer surface of the tubular element.

The thickness of the wall of the tubular element 5 is constant over the whole length of the tubular element 5, especially in the area of the crimp 7. The fitting 3 comprises a first section 5 including a first connection element 11. Furthermore the fitting 3 comprises a second end section 13 comprising a second connection element in form of a thread 15.

In the area of the end section 9 furthermore an annular groove 17 is provided in which a first sealing element in form of an O-ring 19 is located. According to the invention the first connection element 11 comprises a hook element 21 forming a first hook element in the sense of the claims. The hook element 21 is formed as an annular element that is projecting radially inwardly from the fitting 3.

To connect the fitting 3 to the tubular element 5 to provide the tubing connection 1 the tubular element 5 is introduced into the fitting 3 such that an end 23 of the tubular element 5 engages an alignment element in form of a step 25. With the step 25 it is secured that the crimp 7 is aligned with the hook 21. With a pressing tool known in the state of the art the end section 9 is then compressed such that the diameter of the fitting, especially of the area of the hook 21, is at least partly reduced, such that the hook 21 engages in a form-fit and force-fit manner into the crimp 7.

As already described above in Fig. 1 an embodiment of the invention is shown in which the end section 9 having the inventive hook 21 is combined with a threaded section 13.

As can be taken from Fig. 2 the invention might however be also utilized such that the fitting comprises two end sections comparable to the end section 9. In Fig. 2 the tubing connection 1' does comprises an end section 9' and an end section 13'.

The elements of the tubing connection 1' that are functionally corresponding to the elements of the tubing connection 1 have the same reference number, however ticked. In comparison to the step 25 in the tubing connection 1' a circumferential projection 25' is provided. Furthermore the end section 13' comprises an annular groove 27' comparable to the groove 17' and a hook element 29' representing a third hook element in the sense of the claims comparable to the hook element 21'.

Thus to connect the tubular elements the tubular elements are inserted into the fitting 3' and the end section 9' as well as the end section 13' are pressed such that at least a part of the diameter of the respective end sections, especially in the area of the hooks 21', 29', is reduced. Variations of such fittings and tubing connections provide multiple sockets with different angular directions and/or tube diameters. The tubular element 5 as well as the fitting 3 may be metallic or made of plastic.

In Fig. 3 a detail view of the section A in Fig. 2 is shown. From Fig. 3 it becomes especially apparent that the (first) hook 21' is positioned to coincident with a preformed circumferential indentation forming the (second) crimp 7'. To provide a coincident of the hook 21' and the crimp 7' an inclusion of an internal circumferential projection 25' to engage with a tube end 23' is used. In this way the distance between the hook element 21' and the projection 25' is approximate to the distance between the crimp 7' and the tube end 23'. As it is furthermore shown in Fig. 3 in the area of the groove 17' a gripping element in form of a sharp edge 31' is utilized to provide additional tube engagement, especially in case a movement of the tubular element 5' relative to the fitting 3' occurs.

In Figure 4 a partial cross sectional view of a third embodiment of an inventive tube connection 101 is shown. The elements of the tube connection 101 that correspond to the elements of the tube connection 1 and 1', respectively, have the same reference numbers, however increased by 100.

In comparison to the before described embodiments in the embodiment shown in figure 4 at least partly pressing of the first connection 111 is reached by a cap element 133. As can be seen from figure 4 the cap 133 has an inclined inner surface such that when the cap 133 is pushed into the direction B in figure 4 the first connection element 111 is compressed, especially the hook element 121 is forced into the crimp 107. The movement of the cap 133 might be reached by a not shown thread.

In figure 5 the partial cross sectional view of a fourth embodiment of an inventive tube connection 201 is shown. The elements of the tube connection 201 that correspond to the elements of the tube connection 1 have the same reference numbers, however increased by 200.

In contrast to the before described embodiments the respective hook element of the first connection element is not formed in the fitting 203 but is provided in the tubular element in form of a hook element 235 representing a second hook element in the sense of the claims. The hook element 235 is cooperating with a crimp 237 that is formed in the fitting 203 and represents a first crimp in the sense of the claims.

In figure 5 the tube connection 201 is shown in the connected status. This means that the fitting 203 has at least partly been compressed, especially in the area of the first connection element 211 such that the crimp 237 engages in a force-fit and form-fit manner the hook 235 formed in the tubular element 205. Before the compression the crimp 237 had a greater diameter to receive the tubular element 205, especially the hook 235. Especially an end element 239 provided a diameter of the fitting 203 that was greater than the diameter of the tubular element 205 in the area of the hook 235.

Figure 6 shows a partial cross sectional view of a fifth embodiment of an inventive tube connection 301. The elements of the tube connection 301 that correspond to the elements of the tube connection 1 have the same reference number, however increased by 300.

The tube connection 301 mainly differs from the tube connection 1 in that neither the (second) crimp 307 nor the (first) hook element 321 have been preformed in the tubular element 305 and a fitting 303, respectively. Both the crimp 307 and the hook element 321 have been formed when the diameter of the first connection element 311 has been at least partly reduced.

Thus in the unconnected state the fitting 303 and the tubular element 305 have a mainly flat or cylindrical cross sectional form. However by the pressing the hook element 321 is formed and due to the pressure that is transferred via the hook element 321 onto the surface of the tubular element 305 the crimp 307 is formed. However still a form-fit between the crimp 307 and the hook element 321 is reached such that due to the annular form of the hook element 321 and the crimp 307 a relative movement between the tubular element 305 and the fitting 303 also at high pressures is avoided.

In figure 7 a sixth embodiment of the invention in form of a tube connection 401 is shown. The elements of the tube connection 401 that correspond to the elements of the tube connection 1 have the same reference number, however increased by 400.

In contrast to the tube connections 1, 1', 101, 201, 301 described before the form-fit and force-fit connection between the fitting 403 and the tubular element 405 is not reached by a hook/crimp connection but a connection between two crimps. Similar to the tube connection 1 the tubular element 405 comprises a (second) crimp 407. Comparable to the tube connection 201 the fitting

403 comprises a (first) crimp 437. To reach a form-fit and force-fit connection between the crimps 407, 437 in the crimps a securing element in form of a latch ring 441 is positioned. To connect the tubular element 405 to the fitting 403 the latch ring 441 is located within the crimp 407, when the fitting 403 is pushed over the tubular element 405. However at this point of time before a pressing of the fitting 403 the diameter of the tubular element 405 is increased, especially in the area of the crimp 437 such that the latch ring 441 can be located in the area of the crimp 437. When the diameter of the first connection element 411 is at least partly reduced the crimp 437 engages the latch ring 441 leading to a form-fit and force-fit connection of the tubular element 405 and the fitting 403.

Figure 8a shows a cross sectional view of a tubing connection 501 according to a seventh embodiment of the invention. The elements of the tubing connection 501 which corresponds to the elements of the tubing connection 1 have the same reference number, however increased by 500. Similar to the tubing connection 101 the tubing connection 501 comprises a cap 533. The cap 533 forms a part of the fitting 503 which comprises a fitting body 543 and the cap 533 in form of a sleeve.

Furthermore the tubing connection 501 differs from the before described tubing connections, especially fittings, in that the hook element 521 is formed by a plurality of teeth 547 that are formed on a plurality of tongues 545. In addition to the teeth 547 covering only a part of the circumference of the tubular element 505 respectively, the tongues 545 furthermore comprises respective sleeve retainers 549.

In figure 8a the tubing connection 501 is shown in a preconnected state, that means the hook element 521 is in a form-fitted manner but not in a force-fitted manner connected to the crimp 507. By pushing the sleeve 533 into the direction of the fitting body 543 the engagement surface 551 on the inside of the sleeve 533 gets into contact with the surface of the hook element 521 such that a radially outward movement of the hook element 521 is prohibited as shown in figure 8b. Furthermore in this position an engagement element 553 is in connection with the sleeve retainer 549 such that the sleeve 533 is hold in the position shown in figure 8b.

In not shown embodiments the sleeve and the fitting might be connectable via a threaded connection and/or a bayonet connection. Thus by a rotational movement of the sleeve a longitudinal movement of the sleeve along the fitting is caused.

In figure 9a a partial cross sectional view of an eighth embodiment of the invention in form of a tubing connection 601 is shown. The elements of the tubing connection 601 with corresponds to the elements of the tubing connection 1 have the same reference number, however increased by 600. The tubing connection 601 comprises a metallic fitting 603 and a tubular element 605 which is made at least partially of a plastic material.

To allow an electrical connection via the tubular element 605 the tubular element comprises a conductive pipe layer 655. Furthermore the tube connection 601 comprises a pipe insert 657. The pipe insert 657 is inserted partly into the tubular element 605 and comprises a indentation. This indentation might have the form of a fifth crimp 659 having a continuous thickness but might also be formed by a cut out, a pressed indentation or any other forming style.

Furthermore the pipe insert 657 comprises a first clearance 661 into which a second sealing element in form of an O-Ring 663 is inserted. By the O-Ring 663 a gap between the tubular element 605 and the pipe insert 657 is sealed. Furthermore the pipe insert 657 comprises a second clearance 665 into which a third sealing element in form of an O-Ring 667 is inserted. By the O-Ring 667 a gap between the pipe insert 657 and the fitting 603 is sealed.

In figure 9b the tube connection 601 is shown in a connected state. As can be taken from the figure 9b by pressing a part of the connection 611 in a radial direction the tubular element 605 has been deformed in the area of the hook element 621 and the crimp 659, respectively. By this deformation a first crimp 607 is formed within the tubular element 605. As can be taken furthermore from figures 9a and 9b the step 625 fulfils the function of an alignment element to align the pipe insert 657 relative to the fitting 603. Furthermore by a step 669 formed within the pipe insert 657 the tubular element 605 is aligned relative to the pipe insert 657 and thus relative to the fitting 603.

The use of the pipe insert 657 further allows a user to better check the correct position of the fitting 603 relative to the tubular element 605 by a marking process. For this purpose the user can

use the step 669 to align the pipe insert 657 with the tubular element 605 before the pressing of the fitting 603. In a first step the user positions the end of the tubular element 605 side by side to the pipe insert 657 such that the step 669 abuts the end 623 of the tubular element 605. The user then marks on the outside of the tubular element 605 where the fifth crimp 659 is located. In other words the user uses the crimp 659 as a guidance for a depth marking. In the next step the user then inserts the pipe insert 657 into the tubular element 605 as shown in figure 9a and presses the fitting 603.

In case the tubing connection 601 is connected in the correct way the position of the marking will fall under the hook element 621. Thus in case the position of the marking and the hook element 621 will not fall together it is indicated to the user that the fitting 603 is not connected correctly.

In figures 9c to 9e variations of the tube connection 601 are shown. As can be taken from a comparison of figures 9a and 9c the crimp 659 within the pipe insert 657 might have different cross sectional forms.

Furthermore the tube connection might comprise, as shown in figure 9d, a pipe conductor 671 leading to an electrical connection of the pipe insert 657 with the pipe layer 655.

Such a connection might also be provided by a pipe layer 655 that extends out of the tubular element 605 as shown in figure 9e.

In figure 10 a tubing connection 701 is shown which does not represent an embodiment of the invention but which is helpful in understanding the same. The elements of the tubing connection 701 which correspond to the elements of the tubing connection 601 have the same reference number, however increased by 100, except for the element 707 being an indentation. In not shown alternatives of the tubing connection 701 the element 707 could be formed as a crimp in the sense of the invention, i.e. that a wall thickness of the tubular element in the area of the crimp 707 is mainly constant.

As can be taken from figure 10 the pipe insert 757 might have a flat or plain surface, especially might not have an additional crimp. Irrespective of this missing crimp by a pressing of the

connection 711 the hook element 721 deforms the tubular element 705 such that an indentation on 707 is formed that is in form-fit and force-fit connection to the hook element 721.

In figure 11 a ninth embodiment of the invention in form of a tube connection 801 is shown. The elements of the tubing connection 801 that correspond to the elements of the tubing connection 601 have the same reference number, however increased by 200.

In comparison to the tube connection 601 the tube connection 801 comprises a pipe insert 857 that provides a gripping structure on the outer surface in form of teeth 873.

A variation of the tubing connection 801 is shown in figure 12a in form of a tubing connection 901 which does not represent an embodiment of the invention but which is helpful in understanding the same. Elements of the tubing connection 901 corresponding to tubing connection 601 have the same reference number, however increased by 300 except for element 907. In the tube connection 901 the pipe insert does not provide a crimp corresponding to the crimp 859 but nearly the complete outer surface of the pipe insert 957 is formed with a gripping structure comprising teeth 973.

In figure 12b the tube connection 901 is shown in a connected state. By the pressing of the connection 911 the tubular element 905 has been deformed such that an indentation 907 is formed which is engaged by the hook element 921 in a form-fit and in force-fit manner. In not shown alternatives of the tubing connection 901 the element 907 could be formed as a crimp in the sense of the invention, i.e. that a wall thickness of the tubular element in the area of the crimp 907 is mainly constant.

The features disclosed in the claims, the specification and the drawings might be relevant for the claimed subject-matter in its different embodiments separately or in any combination.

Reference sign list

1, 1', 101, 201, 301, 401, 501, 601, 701, 801, 901	tubing connection
3, 3', 103, 203, 303, 403, 503, 603, 703, 803, 903	fitting
5, 5', 105, 205, 305, 405, 505, 605, 705, 805, 905	tubular element
7, 7', 107, 207, 307, 407, 507, 607	crimp
707, 907	indentation
9, 9', 109, 209, 309, 409, 509, 609, 709, 809, 909	end section
11, 11', 111, 211, 311, 411, 511, 611, 711, 811, 911	connection
13, 13'	end section
15	thread
17, 17', 117, 217, 317, 417, 517, 617, 717, 817, 917	grove
19, 19', 519, 619, 719, 819, 919	O-ring
21, 21', 121, 321, 521, 621, 721, 821, 921	hook element
23, 23', 123, 223, 323, 423, 523, 623, 723, 823, 923	end
25, 125, 225, 325, 425, 525, 625, 725, 825, 925	step
25'	projection
27'	grove
29'	hook element
31'	edge

133, 533	cap
235	hook element
237, 437	crimp
239	end element
441	latch ring
543	fitting body
545	tongue
547	teeth
549	sleeve retainer
551	engagement surface
553	engagement element
655, 755, 855, 955	pipe layer
657, 757, 857, 957	pipe insert
659, 859	crimp
661, 761, 861, 961	clearance
663, 763, 863, 963	O-Ring
665, 765, 865, 965	clearance
667, 767, 867, 967	O-Ring
669, 769, 869, 969	step
671	pipe conductor

873, 973

teeth

A

section

B

direction

Claims

1. Fitting (3, 3', 103, 203, 303, 403, 503, 603, 803, 903) for connecting to a tubular element (5, 5', 105, 205, 305, 405, 505, 605, 805, 905) having a first end section (9, 9', 109, 209, 309, 409, 509, 609, 809, 909) comprising at least one first connection element (21, 21', 121, 321, 521, 621, 821, 921), wherein the diameter of at least a part of the first connection element (21, 21', 121, 321, 521, 621, 821, 921) can be reduced in a radial direction in order to produce a connection, characterized in that the first connection element comprises at least one first hook element (21, 21', 121, 321, 521, 621, 821, 921) and/or at least one first crimp (237, 437) configured to be connected in force-fit and/or form-fit manner to at least one second crimp (7, 7', 107, 207, 307, 407, 507, 607, 907) and/or at least one second hook element (235) formed on the outer surface of the tubular element (5, 5', 105, 205, 305, 405, 505, 605, 805, 905), when the diameter of at least a part of the first connection element is reduced.
2. Fitting according to claim 1, characterized in that the first hook element (21, 21') and/or the second crimp (7, 7') is radially inwardly extending and/or the second hook element (235) and/or the first crimp (237, 437) is/are radially outwardly extending.
3. Fitting according to claim 1 or 2, characterized in that the first crimp (437) and the second crimp (407) are connectable to each other by a securing element, preferably comprising at least one latch washer (441), at least one spring washer and/or at least one wave washer.
4. Fitting according to one of the preceding claims, characterized by at least one first sealing element (19, 19'), preferably arranged at least partly in at least one radially outwardly extending annular recess (17, 17'), wherein preferably the annular recess (17, 17') is at least partly comprised by the first connection element and/or the first sealing element comprises at least one sealing ring, at least one O-ring (19, 19'), at least one elastomeric material, at least one viscous fluid type sealant, at least one adhesive sealant, at least one receptacle comprising at least one sealant, wherein the receptacle is

preferably ruptured when the diameter of the section is reduced, whereby releasing the sealant contained in the receptacle, at least one metallic seal and/or, at least one labyrinth-sealing.

5. Fitting according to claim 4, characterized in that the sealing element (19, 19') has an internal diameter being smaller, mainly identical or greater than the outer diameter of the tubular element and/or the inner diameter of the fitting.
6. Fitting according to one of the preceding claims, characterized by at least one second connection element (15, 15', 29') provided at a second end section (13, 13') of the fitting (3, 3'), preferably located opposite the first end section (9, 9'), wherein the second connection element preferably comprises at least one threaded section (15, 15'), especially formed on the inner surface or the outer surface of the second end section (13, 13'), at least one third, especially radially inwardly extending, annular hook element (29') and/or third crimp configured to be connected in force-fit and form-fit manner to at least one, especially radially inwardly extending, fourth crimp and/or, especially radially outwardly extending, fourth hook element formed on the outer surface of another tubular element when a diameter of at least a part of the second connection element (29') is radially reduced, at least one click connection at least on capnut connection, at least one compression connection, at least one press connection, at least one flame joint connection, at least one flame free connection, at least one union connection, at least one flanged connection and/or at least one push connection.
7. Fitting according to claim 5, characterized in that the fitting comprises a plurality of second connection elements, especially forming a plurality of sockets, extending in different angular directions of the fitting with respect to the first connection element, another second connection element and/or a main axis of the fitting.

8. Fitting according to one of the preceding claims, characterized in that the fitting (3, 3') comprises at least one alignment element (25, 25') for aligning the tubular element (5, 5'), especially the second crimp (7, 7'), at least one liner body (657, 857, 957) at least partly introduced into the tubular element (605, 805, 905) and/or the second hook with respect to the fitting (3, 3'), especially with respect to the first connection element, the second connection element, the first hook element (21, 21') the first crimp, the third crimp, the fourth crimp, the third hook element and/or the fourth hook element, wherein the alignment element preferably comprises at least one inwardly extending projection (25') and/or step (25).
9. Fitting according to one of the preceding claims, characterized by at least one gripping and/or cutting element (31'), preferably comprising at least one sharp edge (31'), at least one anchor element, at least one barb and/or at least one tooth, especially extending inwardly, wherein the gripping element (31') engages the tubular element (5'), especially cuts into the tubular element.
10. Tubing connection (1, 1') comprising at least one fitting (3, 3') according to one of the preceding claims and at least one tubular element (5, 5') connected to the fitting (3, 3'), characterized in that the tubular element (5, 5') comprises at least one second crimp (7, 7') and/or at least one second hook element formed on the outer surface of the tubular element (5, 5') and the at least one first hook element (21, 21') and/or the first crimp of the fitting (3, 3') engages the second crimp (7, 7') and/or the second hook element in a form-fit and/or force-fit manner.
11. Tubing connection according to claim 10, characterized by at least one liner body (657, 857, 957) at least partly introduced into the tubular element (605, 805, 905), wherein the liner body (657, 857, 957) preferably comprises at least one fifth crimp (659, 859) and/or cut out the fifth crimp and/or cut out being preferably aligned along the longitudinal axis of the fitting (603, 803, 903) and/or the tubular

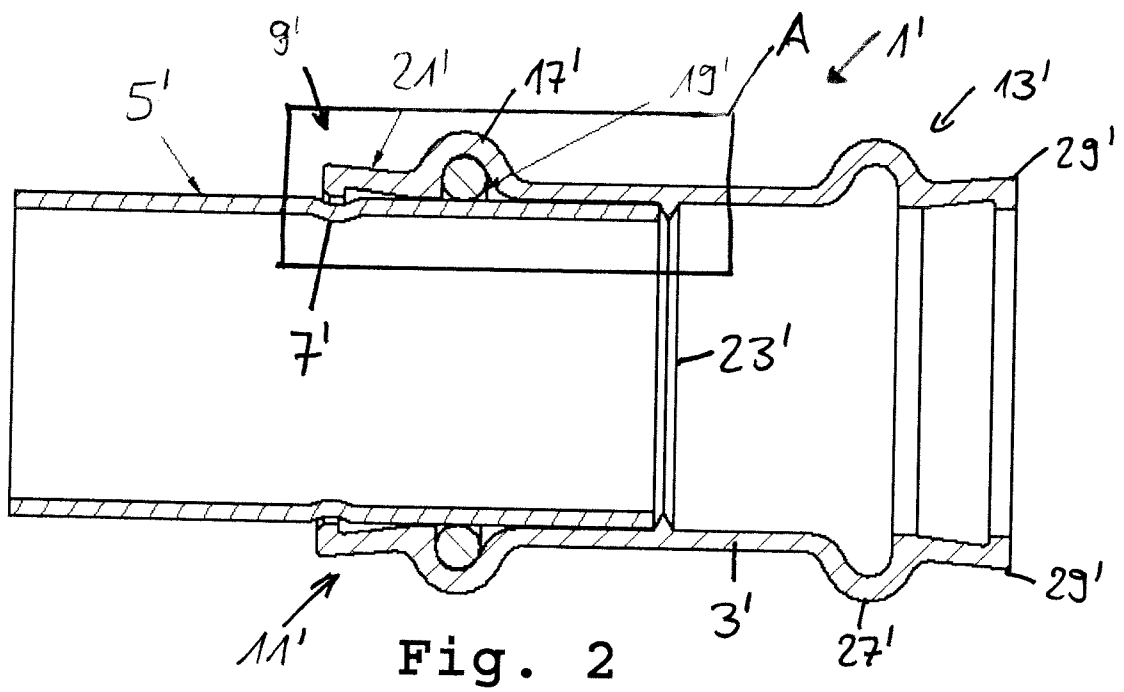
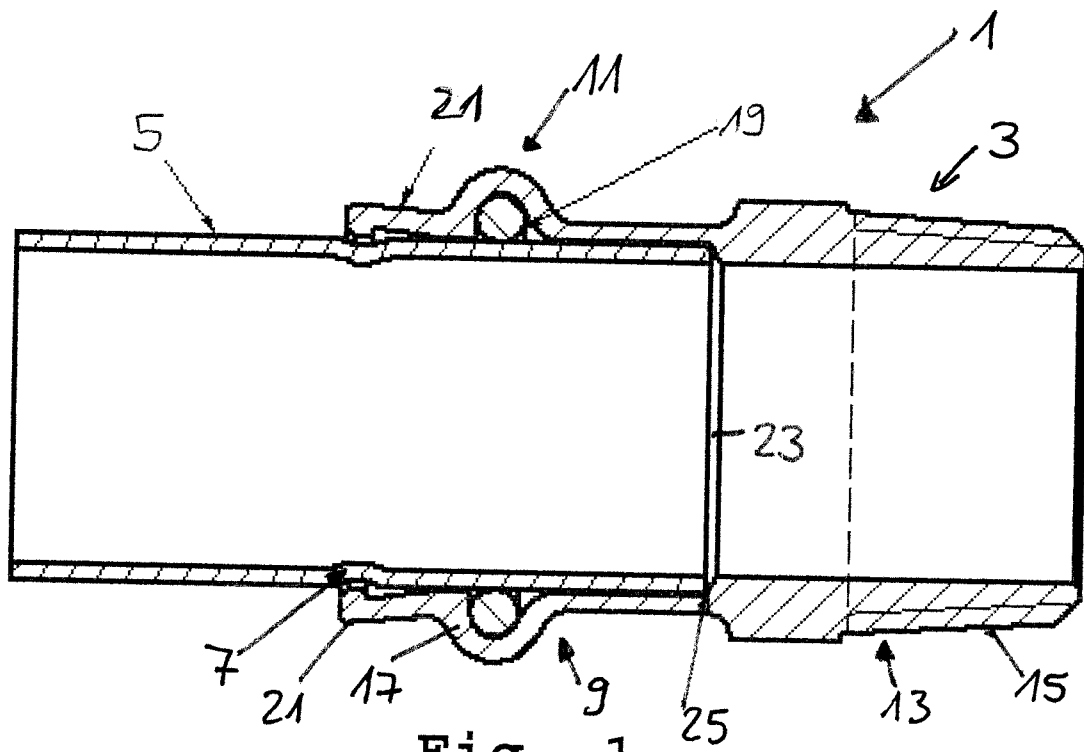
element (605, 805, 905) with respect to the first hook element (621, 821, 921) and/or the first crimp (607, 907).

12. Tubing connection according to claim 11, characterized in that, the liner body (659) comprises at least one second sealing element (663), especially arranged at least partly in at least one radially inwardly extending first annular clearance (661), for sealing a space between the liner body (659) and the tubular element (605), and/or at least one third sealing element (667), especially arranged at least partly in at least one radially inwardly extending third annular clearance (665), for sealing a space between the liner body (659) and the fitting (603), wherein the second sealing element (663) and/or the third sealing element (667) comprise(s) at least one sealing ring, at least one O-ring (663, 667), at least one elastomeric material, at least one viscous fluid type sealant, at least one adhesive sealant, at least one receptacle comprising at least one sealant, wherein the receptacle is preferably ruptured when the diameter of the section is reduced, whereby releasing the sealant contained in the receptacle, at least one metallic seal and/or, at least one labyrinth-sealing.
13. Tubing connection according to claim 11 or 12, characterized in that, the liner body (857, 957) comprises at least one gripping structure (873, 973) facing the tubular element (805, 905), especially comprising at least one tooth (873, 973), at least one barb and/or at least one cutting edge.
14. Tubing connection according to one of the claims 10 to 13, characterized in that a wall thickness of the tubular (5, 5') element in the area of the second crimp (7, 7') and/or the second hook element is mainly constant, especially identical to the wall thickness of the remaining part of the tubular element (5, 5') and/or the second crimp (7, 7') comprises at least one first indentation on the outer surface of the tubular element (5, 5') and at least one elevation on the inner surface of the tubular element (5, 5'), and/or the second hook element comprises at least one elevation on the outer surface and at least one indentation on the inner surface of the tubular element wherein the respective indentation and the respective elevation have complementary cross sectional forms and/or dimensions.

15. Tubing connection according to one of the claims 10 to 14, characterized in that the tubular element (5, 5') and/or the fitting (3, 3') comprises at least one metallic material, especially copper, iron, steel, stainless steel, brass, cast material and/or forged material, at least one carbon material and/or at least one plastic material, especially polymethylmethacrylate, polycarbonate, polyvinyl chloride, glass fiber and/or reinforced plastic, and/or combinations of at least two of the before mentioned materials.
16. Method for connecting at least one fitting (3, 3') to at least one tubular element (5, 5') comprising the steps of providing a fitting (3, 3') according to one of the claims 1 to 9, inserting the tubular element (5, 5') into the fitting (3, 3'), at least partly reducing a diameter of at least one section (9, 9') of at least a part of the fitting (3, 3') in a radial direction, wherein by the reduction of the diameter at least one first hook element (21, 21') and/or at least one first crimp of a first connection element of the fitting (3, 3') and/or at least one securing element is/are deformed to engage at least one second crimp (7, 7') and/or at least one second hook element formed on the surface of the tubular element (5, 5') such that a force-fit and/or form-fit connection of the fitting (3, 3') to the tubular element (5, 5') is provided.
17. Method according to claim 16, characterized in that the first hook element and/or the first crimp of the first connection element and/or crimp (7, 7') and/or the second hook element of the tubular element (5, 5') is/are formed by the reduction of the diameter.
18. Method according to claim 15 or 16, characterized in that the first crimp (7, 7'), the first hook element, the second crimp and/or the second hook element is/are formed on the outer surface of the tubular element (5, 5') and/or the inner surface of the fitting, especially the first connection element, prior to the pressing of the fitting (3, 3'), is/are especially preformed in the tubular element (5, 5') and/or the fitting.

19. Method according to one of the claims 16 to 18, characterized in that, before, during and/or after inserting the tubular element (605, 805, 905) into the fitting at least one liner body (657, 857, 957) is inserted into the tubular element (605, 805, 905).
20. Method according to one of the claims 16 to 19, characterized in that the at least partly reduction of the diameter is reached by pressing the at least one section (9, 9') with at least one press tool, preferably a crimping tool, and/or by sliding at least a cap and/or ring onto the section, wherein especially the inner diameter of the cap and/or ring is in at least one sector decreasing in an axial direction of the ring and/or cap, preferably in a sector coacting with the section of the fitting and/or the ring and/or cap are threaded onto the section and/or connected to the section by at least one bayonet connection.

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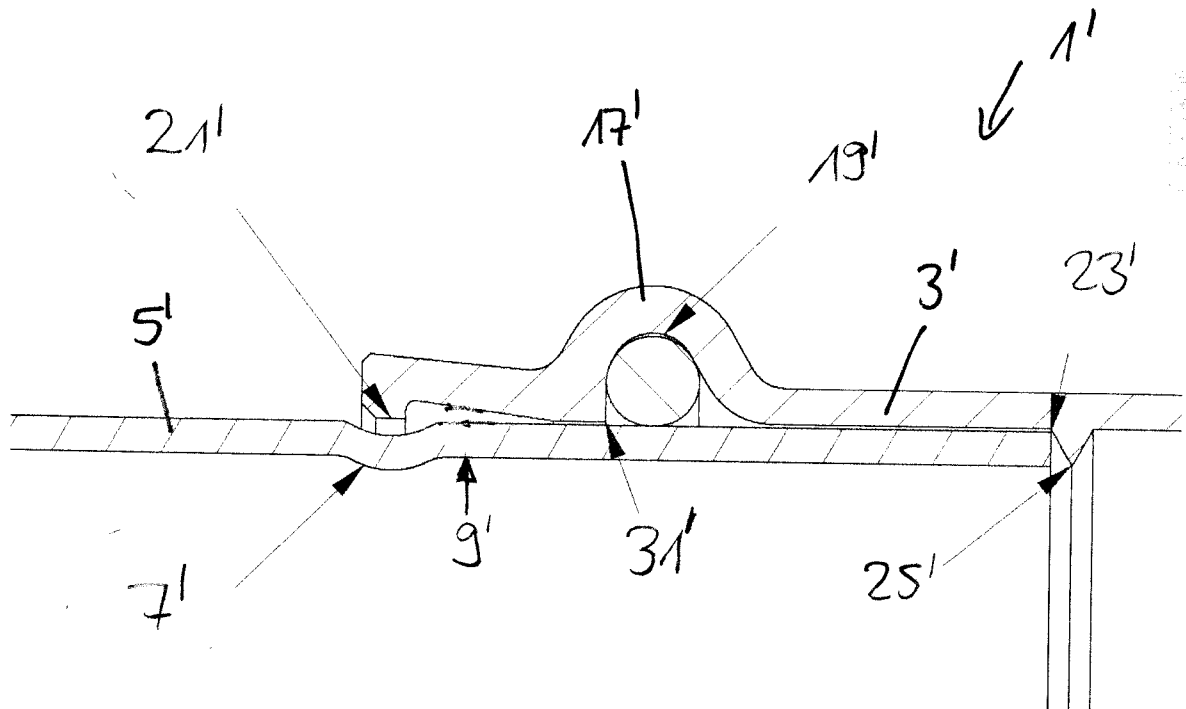


Fig. 3

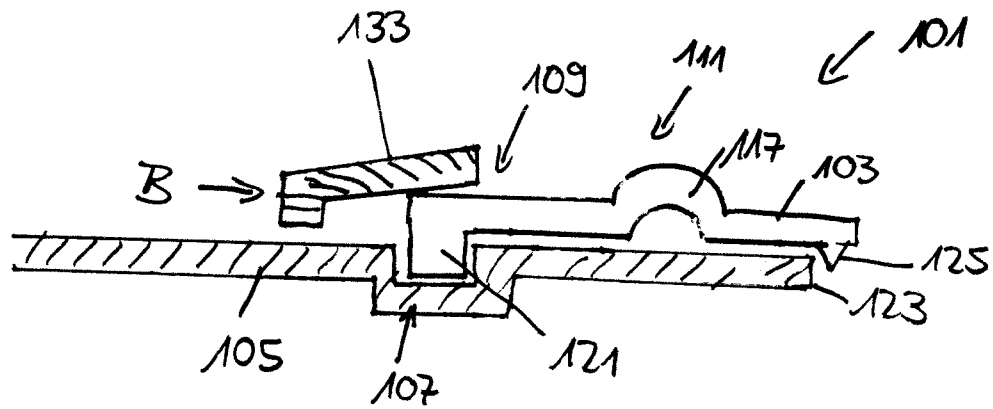


Fig. 4

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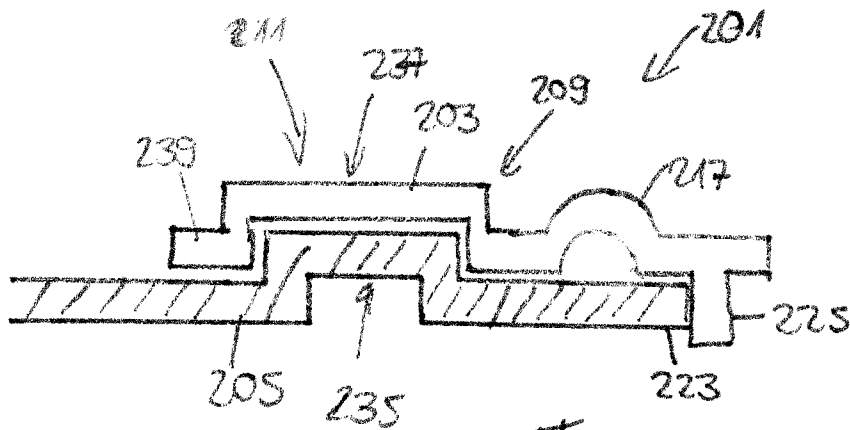


Fig. 5

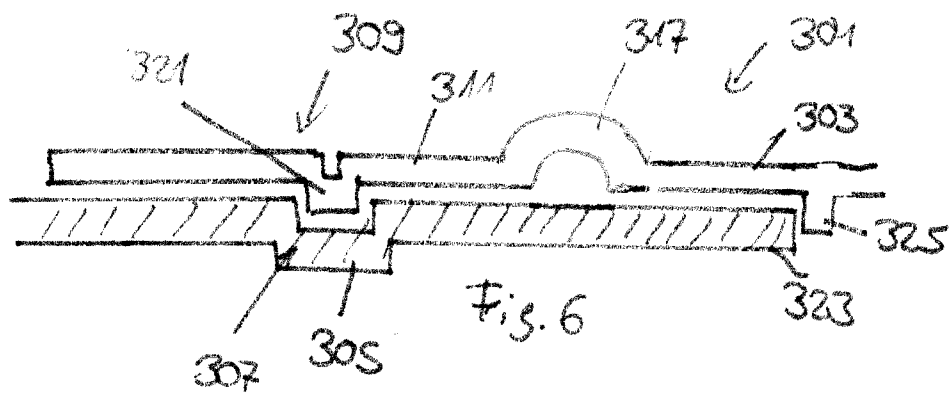


Fig. 6

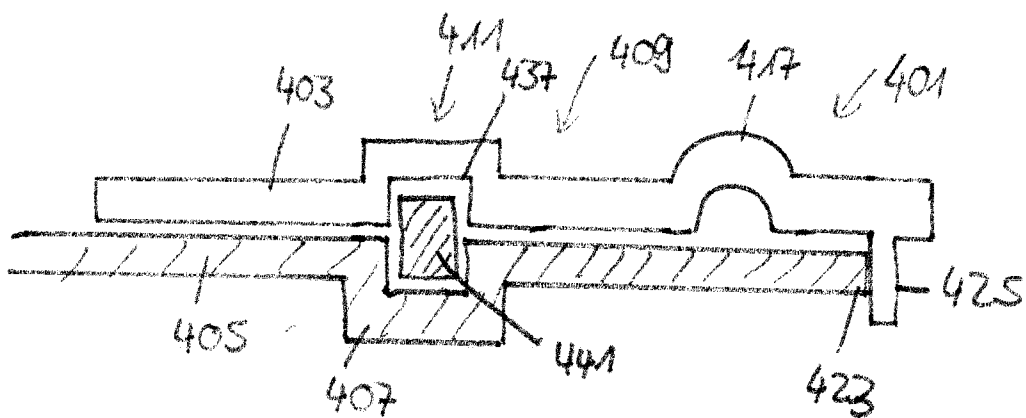


Fig. 7

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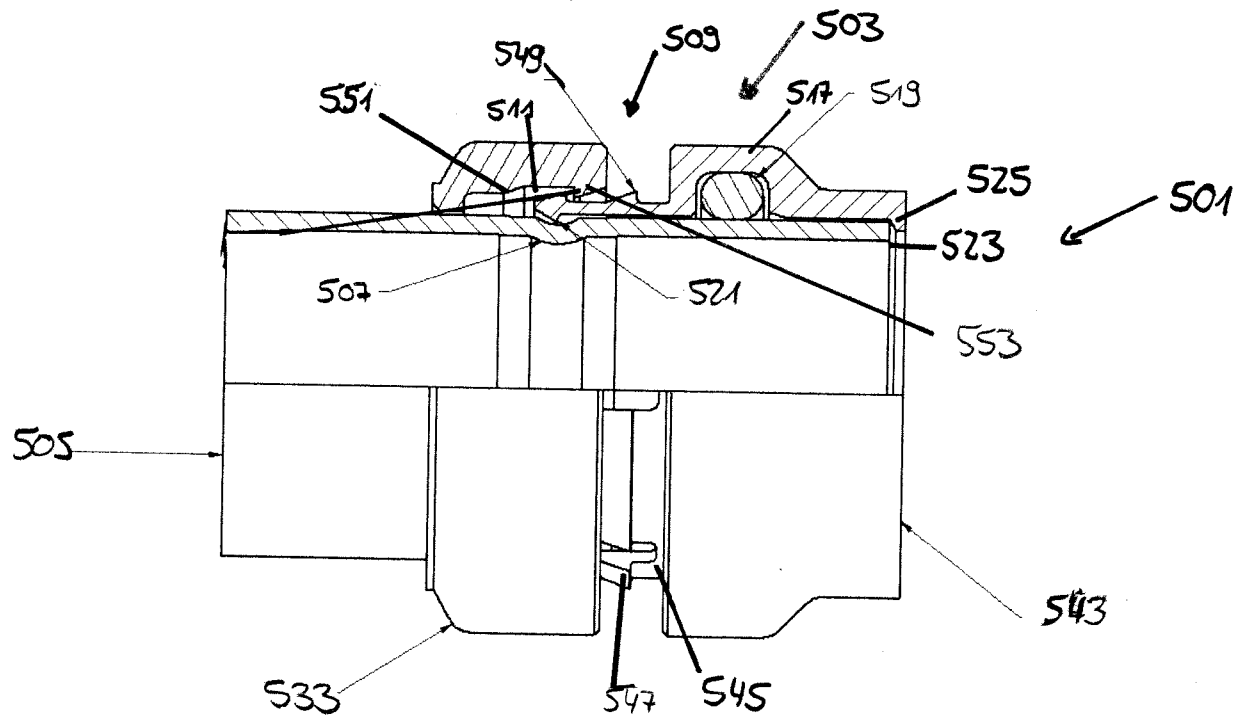


Fig. 8a

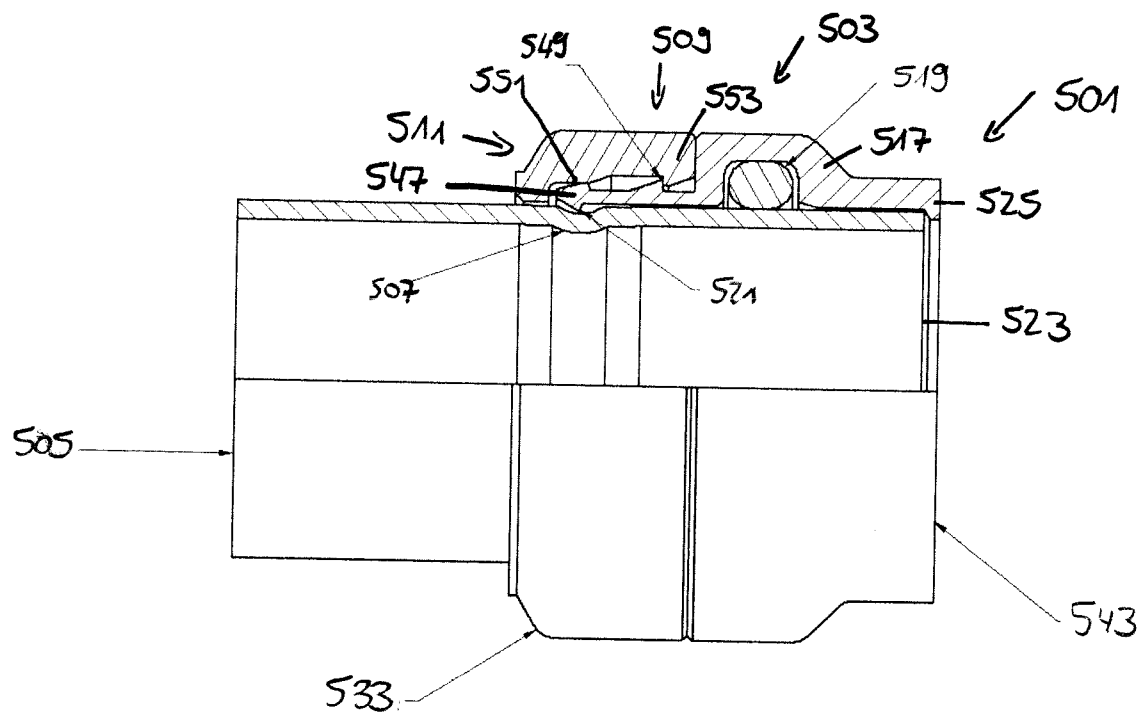


Fig. 8b

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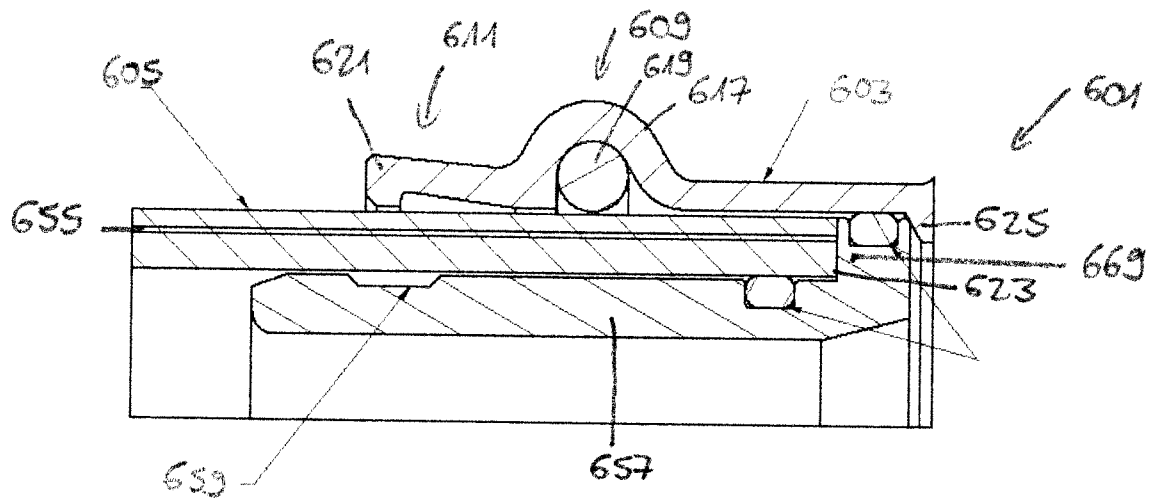


Fig. 9a

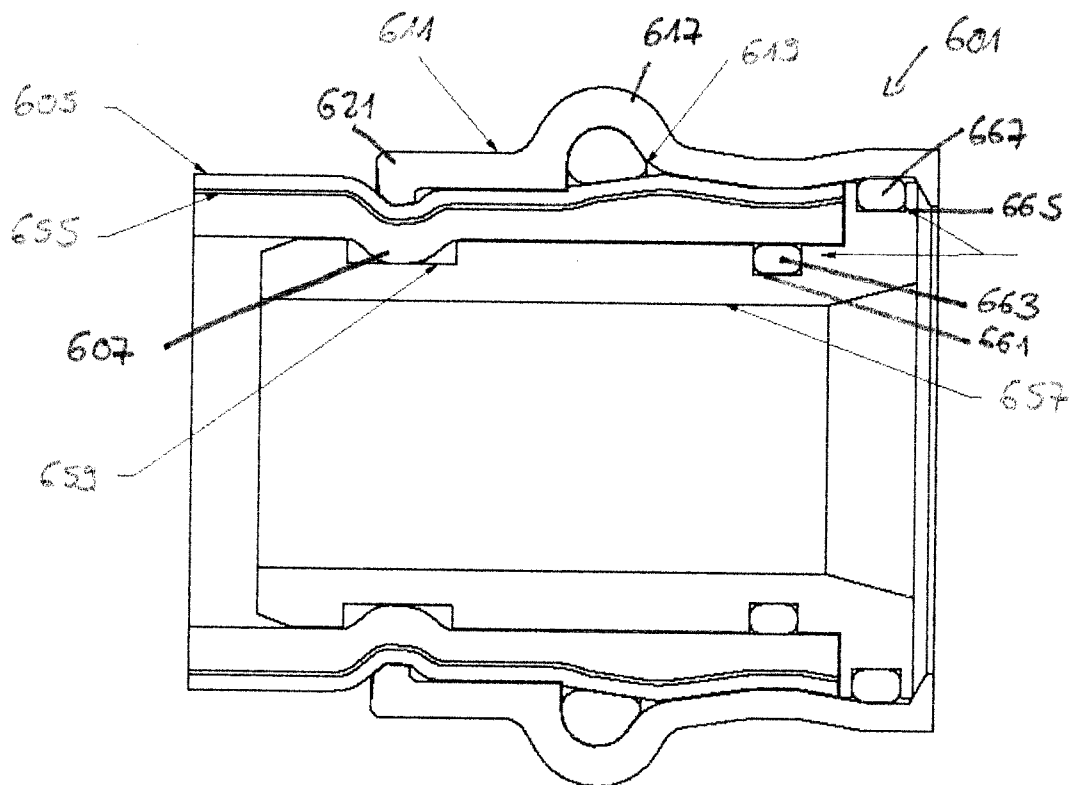


Fig. 9b

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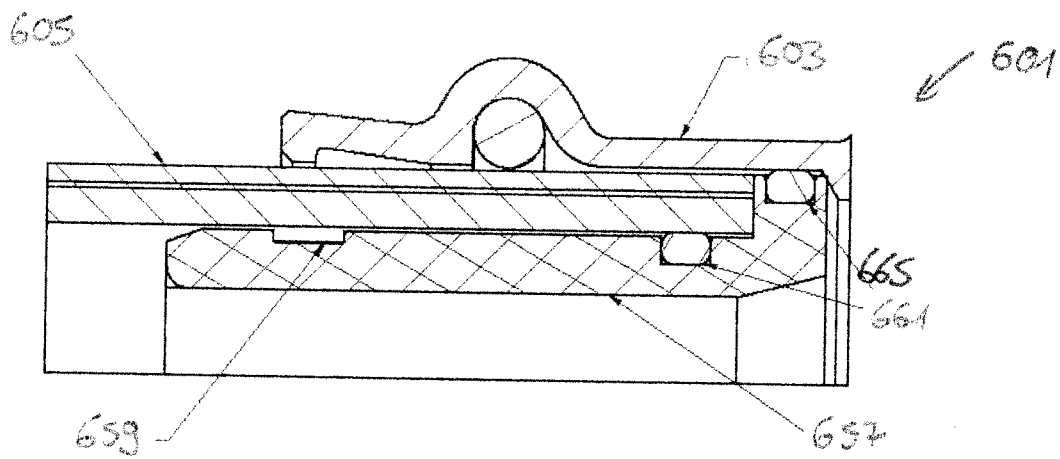


Fig. 9c

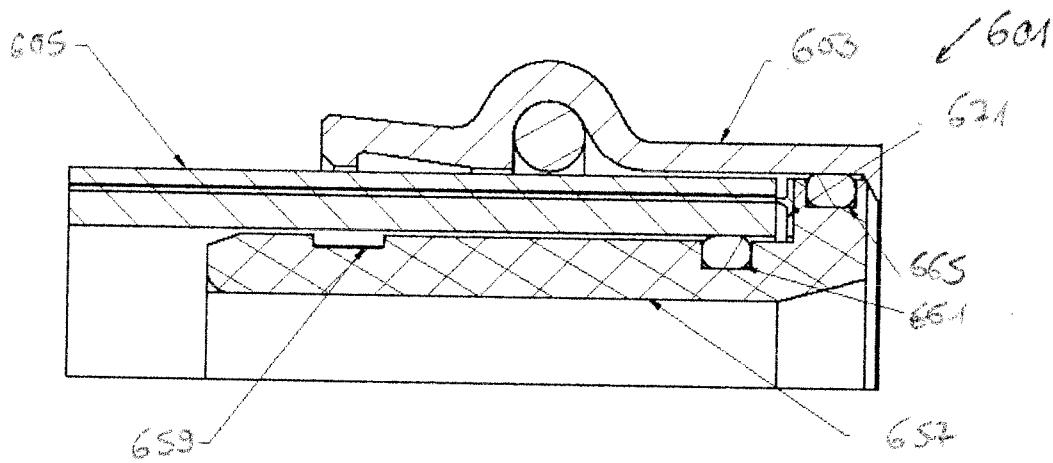


Fig. 9d

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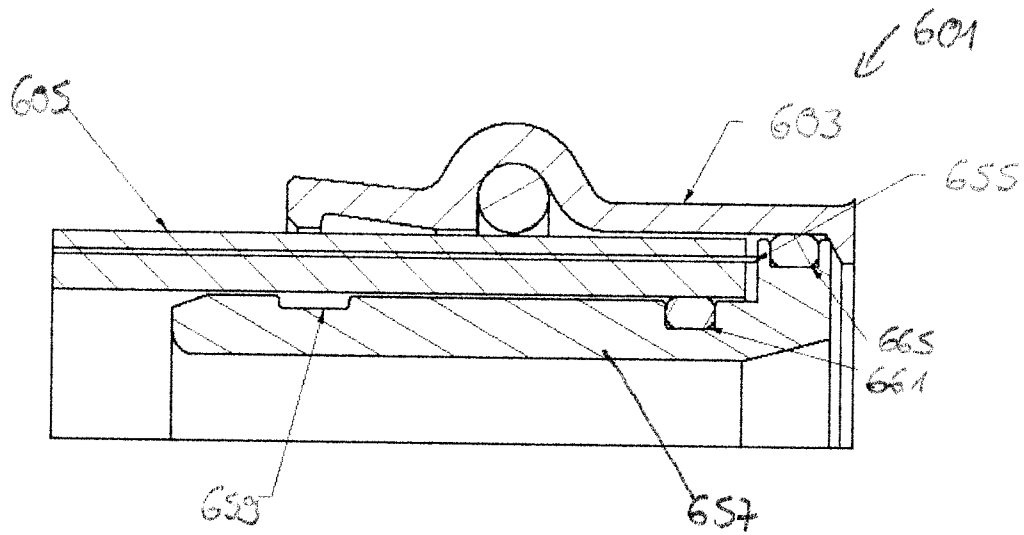


Fig 9e

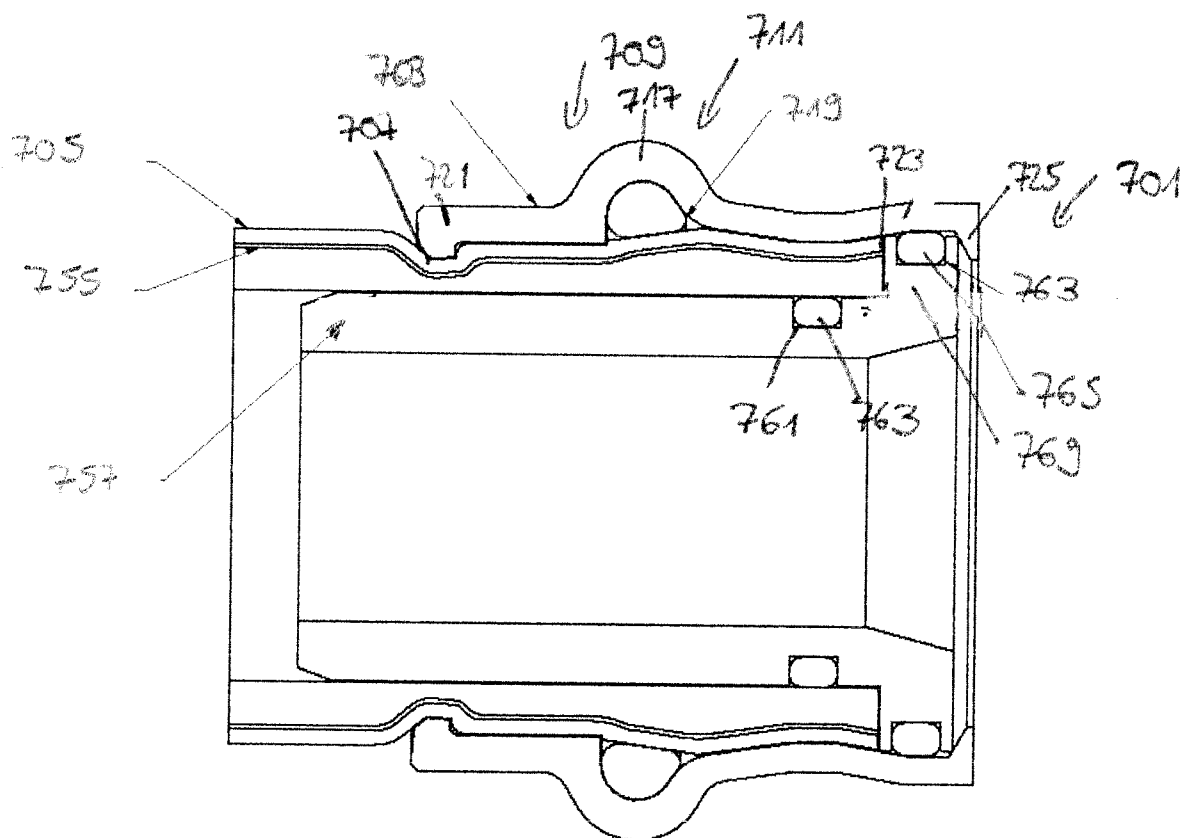


Fig. 10

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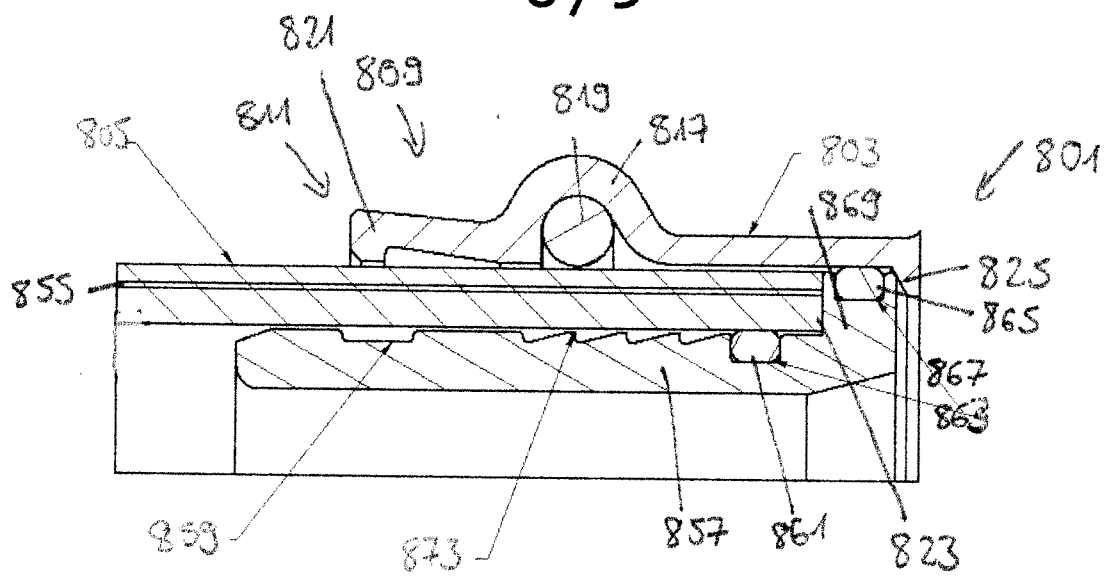


Fig. 11

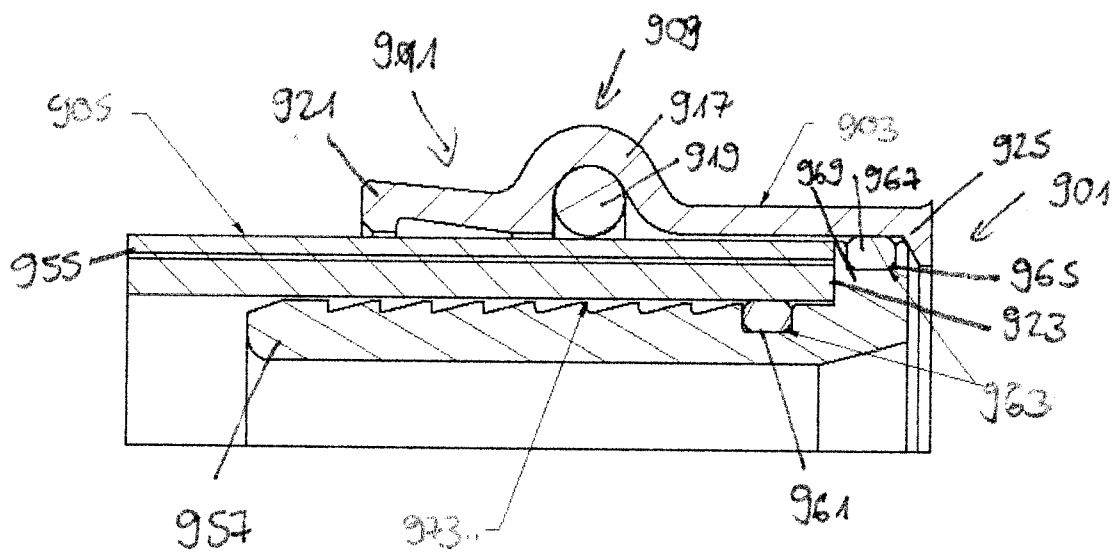


Fig. 12a

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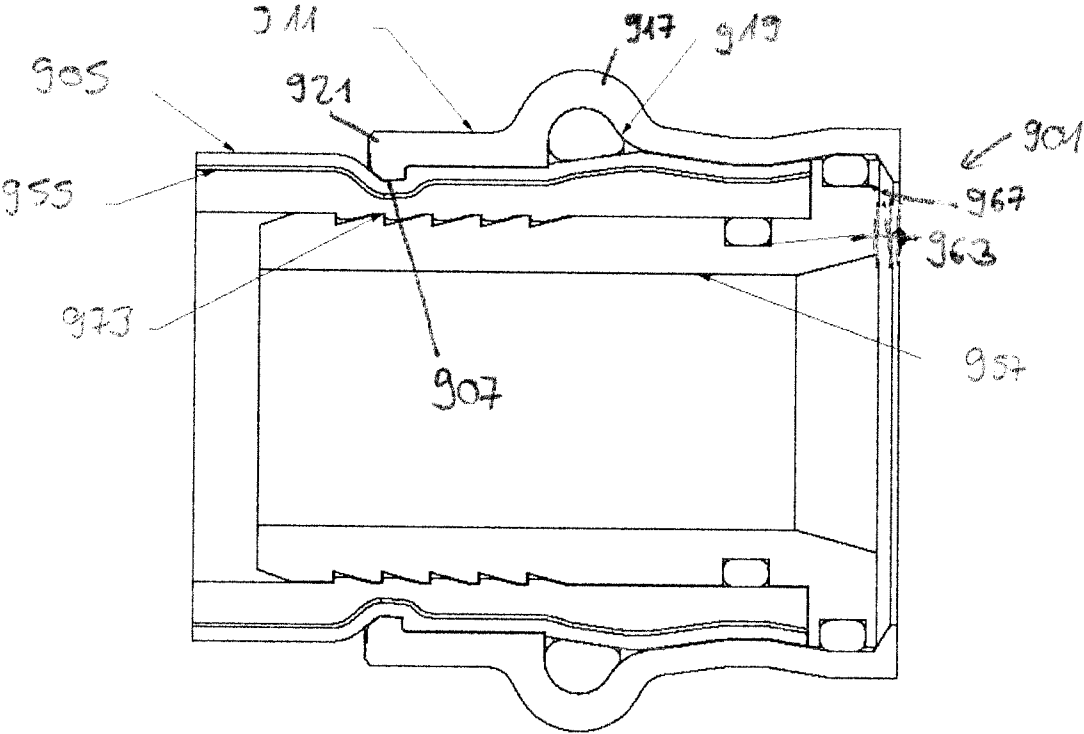


Fig. 12b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2015/058341

A. CLASSIFICATION OF SUBJECT MATTER

F16L 13/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16L 13/-; F16L 25/-; F16L 33/-; F16L 19/-;

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,WPI,EPODOC,CNKI:fitting,tubular,connection,hook,crimp,diameter,gripping,securing,washer,seal+,recess,sealant, extend+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6450553 B1 (MECHL L.L.C.) 17 September 2002 (2002-09-17) column 3, line 58 - column 7, line 16, figures 1-5	1, 2, 4-7, 9, 10, 14-18, 20
X	US 2011204624 A1 (NIBCO INC.) 25 August 2011 (2011-08-25) paragraphs [0024]-[0035], figures 1-7	1, 2, 4-20
X	EP 0710793 A1 (SEPPELFRICKE ARMATUREN G.M.B.H & CO.) 08 May 1996 (1996-05-08) column 2, line 50 - column 4, line 4, figures 1-3	1-13, 15-17, 19, 20
X	US 2008303277 A1 (YAMASHITA, TAMOTSU ET AL.) 11 December 2008 (2008-12-11) abstract, figures 1-7	1-11, 15-20
A	CN 2497135 Y (CHEN, WEIDONG) 26 June 2002 (2002-06-26) the whole document	1-20
A	CN 2797823 Y (BU, YING) 19 July 2006 (2006-07-19) the whole document	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

08 January 2016

Date of mailing of the international search report

21 January 2016

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/IB2015/058341

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