

THREADED JOINT FOR METAL TUBES WITH INTERNAL COATING

The invention generally concerns the use of layers or coatings on tubes and threaded joints for tubes for in particular protecting them from corrosion or improving the conditions in respect of circulation of fluids in the interior thereof, and concerns the tubes and threaded joints for metal tubes which are provided with such an internal coating or
5 layer. Such corresponding tubes and threaded joints are used for exploiting deposits of oil and gas, in particular for wells into which injections of water are effected. The invention concerns in particular more generally any tube and threaded joint associated therewith, which because of the conditions of use are subjected to severe corrosion by virtue of contact with the fluid flowing therein. That is in particular and in a non-limiting
10 fashion the situation with the tubes and threaded joints which are used for circulating water as for example in the above-mentioned oil wells or wells for geothermal purposes, by virtue of the composition and the temperature of the water which is in contact with the tubes.

15 It is known and it is possible for the internal wall of tubes as well as the components of joints associated with those tubes to be protected from corrosion by a thin adhesive layer of a plastic coating such as a resin based for example on a polyepoxide. Such a coating has excellent adhesion to steel and very good resistance to corrosion. Irrespective of such corrosion problems, such coatings are also used on tubes and the
20 components of joints associated with those tubes to reduce the pressure drops and in particular to reduce the roughness of the surface of the internal wall of the tubes and the components of the joints and to eliminate to the maximum degree the turbulence phenomena which may occur at the internal walls of the tubes and joints when the fluids are flowing therethrough.

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At the location of a joint between for example the annular surface of the male end of a tube portion and an annular surface forming an abutment of the female component of the joint however, it is found, when the joint is screwed together, that the tightening pressure tends to cause the protective coating to crack and split in the immediate vicinity
30 of the contact zone. That results in flaking and very substantial localised corrosion of the subjacent metal which is thus exposed, or, in the situation where the coatings are used to improve the surface quality of the walls in contact with the flow of fluid, that gives rise to disturbances in the flow of fluid.

Even if the corrosion involved does not cause immediate leaks, it does prevent re-use without repair of the components of the joint after it has been unscrewed. That corrosion may go so far as to involve destruction of the abutment zones and the sealing surfaces of the joints.

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Different solutions for preventing that localised corrosion have been proposed. They involve sealing rings of elastomers or of certain plastic materials.

Some sealing rings such as those made of polytetrafluoroethylene (PTFE) have the
10 combined advantages of good mechanical strength and excellent resistance to corrosion and good compatibility with the plastic coatings used for metal tubes and their means of assembly. The rings used may be reinforced by glass or carbon fibres.

A number of examples describe the use of such rings.

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Thus US patent No. 3 100 656 describes an assembly of integral type in which the threaded male end of a tube portion is fitted by screwing into a female housing of another tube portion. The internal walls of the tubes and the components of the joint are coated with a layer of a phenolic resin such as phenol formaldehyde measuring from 0.002 to
20 0.006 inch (from 0.05 to 0.15 mm).

A sealing ring based on polytetrafluoroethylene is partially engaged into an annular housing in the female wall bearing against a shoulder thereof. That ring is of an I-shaped section such that its enlarged external zone engages into the housing while the end of the
25 male element, at the end of the screwing operation, tightens a lateral edge of the ring against the shoulder. The degree of tightening is limited by abutments.

US patent No. 4 875 713 describes another method of assembling two tube portions. This involves a sleeve permitting end-to-end assembly of the male ends of two tube
30 portions. The internal wall of the tube is protected from corrosion by a plastic coating formed by a layer of phenolic resin or epoxyphenolic resin or by epoxypolyamides. In this case the ring is mounted at the middle of the sleeve in a double groove. The ring is a ring of PTFE reinforced by 5% of glass fibres and 5% of carbon fibres; it is of a reversed U-shape, with the two arms of the U being engaged into two parallel grooves. The two front

ends of the male elements partially cover over the top of each arm of the U-shape, thus blocking the joint in its housing. Abutment shoulders at the ends of the sleeve control the degree of screwing of each element.

5 US patent No. 5 236 230 describes an assembly similar to that of US patent No. 4 875 713. This arrangement however uses a ring of PTFE whose section is substantially rectangular and whose radial height is about 1.5 times the width as measured parallel to the axis.

10 As shown in Figures 4 A and 4 B, when the opposite front male ends are clamped against the ring, its initially rectangular section is deformed into a T-shape and its internal surface defines a flow section equal to the flow section of the tubes, which prevents any disturbance in the flow of fluid.

15 The clamping effect is controlled by stop shoulders. No indication is given in regard to the risks of cracking of the coating at the right angles or the nearly right angles which are shown in Figure 4 B.

Although those different methods of protecting the junction zone of the joints from
20 corrosion have certain advantages, they all suffer from the disadvantage of using rings of elastomer or plastomer which in themselves involve real disadvantages. Those rings generally have to be set in place with precision in order for them to bear correctly against the sealing surfaces; they also have to be carefully checked in each unscrewing and re-screwing operation and in most cases replaced because of ageing or plastic deformation.
25 In the case of the relatively rigid rings such as those of PTFE, they can be severed if they are badly positioned and they can possibly also give rise to cracks in the plastic coating which is much softer. The rings can thus be expelled from their housing and can be disposed in the interior of the tube or may be torn away or damaged when the tubes are subjected to internal checking. It is also noted that, on the operating site, those rings
30 necessitate additional handling operations which have to be carried out with precision.

The attempt is generally made to improve the resistance of the layers or coatings deposited on the internal walls of the tubes at the location of the junction of the tubes

without having recourse to rings, whether those layers are used for affording protection from corrosion or a reduction in pressure drops in the tubes or any other use.

A way of avoiding the use of sealing rings of elastomers or plastomers such as PTFE is generally sought. Also sought is the possibility of effecting a substantial number of operations of unscrewing and re-screwing the junctions of tubes or portions of metal tubes which are coated with a plastic layer and without involving any rings, without causing flaking of that layer in the sealing connecting zone between the end of a tube and another component of the joints, which flaking causes rapid corrosion of the subjacent metal.

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Another aim is to suppress the sealing rings both in the case of a connection between male ends of two tube portions, which is produced by a sleeve comprising two female housings, and in the case of a direct connection, which is referred to as "integral", between the male end of a tube portion and the female end of the following tube portion.

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The joint for metal tubes according to the invention permits the assembly, with protection from corrosion, of two tubes which are fitted together by threads.

This joint comprises two tubular components each provided with a thread for assembly thereof, those components being provided on the ends of tubes or tube portions to be fitted together.

Assembly of the two components is effected by screwing and tightening at least one component comprising a male thread in a corresponding threaded female housing.

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Each component comprises a tubular internal zone which corresponds to the internal wall of the component in question in the vicinity of the junction zone. The diameter of that tubular internal zone will be the same as the internal diameter in a running part of the tube, on the end of which the component is provided, or will be slightly different from that diameter in the case where the end of the tube has been preformed, for example by making it conical, before the component is produced thereon.

That tubular internal zone is prolonged at the location of the junction by an annular surface of general radial orientation with respect to the tubular internal zone.

The annular surfaces of the two components are designed so that, upon assembly of the joint, they are in common abutment contact at a part of their surface which is disposed towards the exterior of the component. That common abutment contact involves a common
5 contact generatrix, in a section plane passing through the axis of the joint, over a fraction of the total radial extent of those annular surfaces.

That common contact generatrix is advantageously formed by a segment of a straight line which may either be perpendicular to the axis of the joint or inclined with respect to said
10 axis of the joint. It may also be formed by any segment of a curve of constant or variable curvature.

The tubular internal zone of each component is covered with a layer which is intended to protect the metal from corrosion due to the fluid flowing in the interior of the components
15 or any other use such as for example to reduce pressure drops. That protective layer is prolonged from the tubular internal zone, for each of the components, over at least a fraction of the radial extent of the annular surface defined above.

Over the fraction of the radial extent of the annular surfaces, which is disposed on the
20 side of the tubular internal zone where those surfaces are not in contact in the screwed state, imparted to each of the generatrices defining each of the annular surfaces, and disposed in a section plane passing through the axis of the joint, is a shape such that, in the screwed state, the generatrices form a progressive opening as from an initial point of common contact, the axial distance between the two generatrices progressively increasing
25 on going from the initial point towards the axis of the joint and the two generatrices rejoining the tubular internal zone of their respective component.

That progressive opening is created by departing from the natural geometrical prolongation, towards the interior of the component, of the common contact generatrix, for
30 at least one of the annular surfaces.

Prior to the first screwing operation the layer will extend over a more or less substantial fraction of the annular surfaces. It may for example cover a part of the abutment zones of each component beyond the initial point or it may stop in the vicinity of the initial point.

By way of example and without limitation the opening may assume the shape of a V, each of the sides of the opening corresponding to a conical surface centred on the axis of the joint.

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The opening is so dimensioned that, when the joint is assembled, the annular surfaces being in abutment contact, the opening is at least in part filled by the protective layers which are in contact of the two components.

10 The opening which is characterised by its angle of opening at the initial point and its length will advantageously be so determined that the contact pressures between the two coating layers progressively decrease from the initial point to the end of the opening, the layers remaining in contact over at least a part of the length of the opening.

15 In that way by appropriately selecting the position of the initial point, on the one hand that retains a common contact generatrix of sufficient length to absorb under good conditions the screwing and/or compression forces which occur in operation and, on the other hand, that provides for distribution of the pressures created by contact of the abutment surfaces in the coating layer in such a way that progressive decompression takes
20 place in the opening, the layer retaining in the opening and by virtue of the shape thereof sufficient overall cohesion so that no part of the metal is exposed without a protective layer.

In a highly advantageous manner, the opening will be so dimensioned that it is prolonged substantially to the point where the two layers are no longer in contact with each
25 other, that making it possible to avoid creating in the flow of fluid in the tube a recess or a discontinuity in diameter which may give rise to turbulence or an accumulation of flowing fluid.

The angle of the opening will depend on the radial length of the generatrix which is
30 available from the initial point. In practice, by way of non-limiting example, that angle may be for example from 5 to 15° and should preferably not be greater than 30° in order to achieve progressive decompression of the coating layers as explained above.

If, by way of example, the opening is in the shape of a V, it will be seen that, if the length of wall necessary for decompression of the coating layers is identified by "L", for a layer of a thickness "e" and a total angle of opening "X", that gives $L=e/\sin X/2$.

- 5 If for example "e" = 0.1 mm and $X = 10^\circ$, that gives $L = 1.15$ mm. It is possible to create that fixing zone of the layer which performs an essential function by increasing the value of "L" which is found in that way. It is possible to distribute the angle of opening between the generatrices of the zone of opening of the two components so as to provide for example a symmetrical arrangement. It is also possible to provide the angle only on a
10 single component.

Beyond that opening zone, the coated wall is connected to the tubular internal zone of the corresponding component.

- 15 In that connecting zone it is also important to reduce to the minimum the stresses due in particular to the geometrical and temperature variations and shapes with acute angles will preferably be avoided. When there is an angle for example 90° with the generatrix of the tubular internal zone in that connecting zone, there will preferably be a chamfer for example at about 45° which is possibly connected by rounded portions or angles which are cut away
20 for example by sand blasting, or any other general progressive shape will be used.

- The tests carried out showed the possibility of thus producing joints in accordance with the invention as between two components which are coated on their tubular internal zone with a layer of epoxy type, which can withstand about 10 unscrewing and re-screwing
25 operations, after a first initial screwing operation, without noticeable deterioration and even without any deterioration at all in the coating layer.

- In particular, everywhere except in the abutment contact zone of the annular surfaces where the layer has been worn away, there remains an adhesive film in contact with the
30 metal which is sufficient to protect the metal, the abutment contact zone of the annular surfaces being protected by the layers filling the opening.

The joint according to the invention, as regards its basic structure, may be designed in a number of different ways of which two embodiments are set out hereinafter without this being limiting in character.

- 5 In a first embodiment of the joint the two tubular components are two male elements and each comprise an external thread in the vicinity of their end.

Each of those components comprises in the vicinity of its end a tubular internal zone which is prolonged at the end of the component by a front annular surface of general radial
10 orientation.

Each of those two components is engaged into a housing comprising a female thread corresponding to the male thread of the component which is to be engaged therein, the two housings being provided at the two ends of a coupling sleeve, the shape and the length of
15 the coupling sleeve being such that they permit the annular surfaces of the two components to come into abutment contact at a part of their surface, being the part which is disposed on the external diameter side of said components, upon assembly of the joint by screwing and axial tightening.

- 20 The zone which is disposed in the interior of the sleeve, between the two housings with the female thread, permits the passage of the ends of the male components of the joint and may be designed in addition to perform different functions. In this way it is possible to provide on that internal zone shapes which make it possible to provide for a sealing effect by means of metal-metal sealing surfaces as between each component of the joint and the
25 sleeve, which sealing surfaces may be for example conical surfaces involving a relatively shallow taper for example of the order of 2° to 30° relative to the axis of the joint.

It is also possible to provide both on the sleeve and on the male component or components, abutment shoulders which make it possible to achieve precise centring of the
30 two components in the sleeve, while providing for screwing and tightening of the joint.

In a second embodiment the joint comprises a male component with an external thread, which component is provided in the vicinity of its end with a tubular internal zone which is

prolonged at the end of said component by a front annular surface of general radial orientation.

The other component is a female component provided with an internal thread forming a housing in the vicinity of its end. Beyond the internal end of the thread that component comprises a tubular internal zone which is prolonged at its thread end by an annular surface of general radial orientation. The female threaded housing into which the male component is screwed is formed by the female component itself, being a component whose dimensions, shape and thread are designed to correspond in every way to the male component and, upon assembly by screwing and tightening, to permit the annular surface of the male component to come into partial abutment contact with the annular surface of the female component, at the external diameter side of the tubes.

Between the annular surface and the thread of each component the shapes of the two components may make it possible to effect different functions such as for example affording sealing integrity by means of metal-metal sealing surfaces in accordance with per se known principles and configurations.

In the second embodiment of the basic structure of the joint which has just been described the female component may be designed at the end of a tube of great length. That situation involves a joint which is referred to as an integral joint, for directly connecting two tubes together. To provide the desired thicknesses of metal, it will be advantageously provided that diametral expansion of the female component and diametral contraction of the male component are effected beforehand, using per se known procedures.

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In an alternative configuration of the second embodiment the female component may be formed by the end of a coupling sleeve which also constitutes a housing for the male component, the second end of the sleeve permitting housing of another tube provided with an end having a male thread, the connection then operating under the same conditions at the two sides of the sleeve, with the two housings being separated by a flange portion of which the internal wall constitutes the tubular internal zone of the female component.

It will be appreciated that in all the embodiments of the basic structure of the joint, which has been described hereinbefore, the tubular internal zones and the annular surfaces

which prolong them are coated with a layer which extends as already described for example to the vicinity of the initial point.

Those layers which can be intended to provide protection from corrosion or to perform
5 other functions may be made of any known materials used for the deposit of thin layers on metals to perform a required function and they may be deposited by using any known procedures. Thus, without this constituting a limitation, it is possible to use layers based on plastic material such as for example a polyepoxide, often referred to as epoxy layers. In order to increase their resistance to wear those layers may also contain non-metallic
10 particles such as for example glass, carbon or ceramics in a binder of plastic material permitting them to be deposited under good conditions.

It will be appreciated that such a layer will also be deposited over the whole of the interior of the tubes which are assembled by the joint according to the invention.

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When the annular surface of the second component is a surface which forms part of a female housing, into which is screwed the threaded male end of the first component whose annular surface comes to bear partially against said surface, it is possible in known manner to complete the arrangement according to the invention by providing for metal/metal sealing
20 integrity between a surface for example of the convex frustoconical type which is disposed in the immediate vicinity of the front end of the male component on its external wall and a corresponding surface for example of the concave frustoconical type which is provided on the wall of the female housing, the inclination of the substantially parallel generatrices of those two surfaces with respect to the axis of the joint being for example about 2° to 30° .

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That arrangement guarantees excellent sealing integrity in relation to internal or external over-pressures to which the joint according to the invention is subjected.

The layer which is deposited before the first screwing operation may cover the whole of
30 the annular surfaces. That layer, in the part where the annular surfaces will be in abutment contact, will have a tendency to be damaged by the contact pressure. By virtue of the controlled opening created between the annular surfaces in the screwed-together state, that however does not prevent attaining cohesion of the protective layer on the parts of the components which are subjected to corrosion.

The following Figures non-limitatively describe embodiments of the joint according to the invention.

5 Figure 1 is a diagrammatic view in section showing the central part of a joint according to the invention in the case involving assembly by means of a sleeve of two male components which can come into abutment contact in the screwing operation,

Figure 2 also shows a view in section of the ends of the two male components of
10 Figure 1 in abutment contact,

Figure 3 is a view in section of an alternative embodiment of the joint shown in Figures 1 and 2 at the location of the annular zones, and

15 Figure 4 is a diagrammatic view in section of a joint according to the invention in the situation where the male component is screwed into a female component provided in a sleeve.

Figure 1 shows in its central part and on a greatly enlarged scale the non-threaded end
20 zones 1, 2 of the two male components 3, 4 of the joint 5 which is shown in axial section, only the part of the section which is above the axis X1-X1 of the joint being shown, those components 3,4 being provided on the ends of the tubes (not shown in the Figure) which are to be fitted together.

25 As can be seen from the Figure those two male components 3, 4 are assembled by means of a sleeve 6. On each side the sleeve has a female housing 7, 8 whose thread 9, 10 corresponds to the thread 11 and 12 respectively of each of the male components 3 and 4. The thread, which is not represented in details, is here a tapered thread, the loaded side of which will advantageously be a side with a negative angle of inclination.

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In its central zone 13 the sleeve 6 is of a rotationally symmetrical cylindrical shape which permits the ends 1, 2 that are also cylindrical of the male components to engage therein at each side.

At its end 1, 2 each male component 3, 4 comprises a tubular internal zone 14, 15 which here corresponds to the internal wall of the tube constituting the component. That tubular internal zone is prolonged by an annular surface 16, 17 of general radial orientation and which is disposed in frontal relationship at each end 1, 2. The annular surface, in its 5 portion which is disposed towards the external side of the component comprises a flat surface 16.1, 17.1 produced by a generatrix formed by a segment of a straight line which is perpendicular to the axis X1-X1.

Figure 2 shows the joint of Figure 1 in the tightened screwed condition.

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The surfaces 16.1 and 17.1 are then in abutment contact, which may be of more or less sealing nature.

In order for the joint to be perfectly centred, provided on the sleeve on each side of the 15 central cylindrical portion and before the beginning of the threaded zone is a centring shoulder 18, 19 to which there corresponds a corresponding shoulder 20, 21 on each of the male components, those shoulders being so designed that, when the annular surfaces 16.1, 17.1 are in abutting contact, at least one of the shoulders 20, 21 of the male components is not in contact with the corresponding shoulders 18, 19 of the sleeve 6. Here 20 only the centring shoulders 19, 21 are in abutting contact.

As from the point 16.2, 17.2, the annular surfaces 16, 17 have a slope with respect to the geometrical natural prolongation of the generatrix of the abutment surface 16.1, 17.1, before going to rejoin their respective tubular internal zone 14, 15. Thus the surfaces 16.3, 25 17.3 are here of a general conical shape with an axis X1-X1 which is prolonged by a rounded portion 16.4, 17.4.

The generatrices of the surfaces 16.3, 17.3 form an angle α_1 and α_2 with the common plane which is perpendicular to the axis X1-X1, α_1 here being equal to α_2 .

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An epoxy layer 22, 23 is deposited prior to the first screwing operation on the internal surface of each male component 3, 4 and covers it carefully in order to protect it from corrosion. That layer extends over the tubular internal zone 14, 15 and extends beyond the above-defined point 16.2, 17.2 over a part of the abutment contact surfaces 16.1, 17.1.

It will be appreciated that the layer is not shown to scale in the Figure in order better to bring out the description in this respect.

5 It will be seen from Figure 2 that the progressive opening zone 24 formed by the conical surfaces 16.3, 17.3, when the joint is screwed tight, is at least partially filled by the protective layers 22, 23 which are crushed against each other in the upper part of the V-shape of the opening before regaining their original structure in the lower part of the V-shape.

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The layer 22, 23 has also been crushed in the abutment contact zone 16.1, 17.1 and partially urged into the opening of the V-shape.

By way of example the layer may be of a thickness in its general part of the order of
15 0.15 mm.

If the angles α_1 and α_2 are 10° the total opening angle X_4 , from the initial point 16.2, 17.2, is then 20°

20 For L, the length over which the layers of the two components will be in contact or compression and will fill the opening 24, that gives a minimum value of 0.15 mm (thickness)/ $0.174(\sin 10)$, that is to say 0.86 mm.

In fact a part of the protective layer having been compressed in the opening 24, the
25 value of L will in practice be greater than 0.86 mm and it may attain for example 1 mm.

Thus, the thickness H1 between the tubular internal zone 14, 15 and the inflection point 16.2, 17.2 of the surface 16, 17 may be given a value of the order of 1.5 mm, which makes it possible to ensure a connection to the zones 14, 15 under good conditions and to retain
30 in practice a thickness H2 in respect of the abutment contact surface 16.1, 17.1, that is sufficient to ensure satisfactory operation of the joint without plasticisation of the abutment surfaces when screwing takes place.

It is noted that such a joint structure may be screwed together and unscrewed a certain number of times while guaranteeing protection from corrosion under good conditions.

The protective layer 22, 23 which is deposited prior to the first screwing operation may not cover the whole of the conical surfaces 16.3, 17.3 or extend beyond the points 16.2, 17.2, as described above. The important consideration is that the layers 22, 23 are brought into contact, preferably in compression, in the opening zone 24 when the joint is screwed together so that the metal is not exposed and subjected to corrosion by virtue of the flowing fluid.

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It will be appreciated that angular surfaces will be avoided at the connection of the conical surfaces 16.3, 17.3 to the tubular internal zones 14, 15, which angular surfaces can cause rupture of the layer 22, 23. A rounded configuration as illustrated in Figure 1 or Figure 2 at 16.4, 17.4 or a chamfer such as at 44, 45 in respect of which the connecting angles have been smoothed off by sand blasting as shown in Figure 4 may for example be used.

Figure 3 shows an alternative configuration of Figures 1 and 2.

The joint which is shown in its central part in Figure 3 involves the same basic structure as the joint in Figure 1 but here the progressive opening zone 24 is not symmetrical.

Instead of distributing the opening in a V-shape at the two ends of the male components 1, 2, this opening is provided solely at a single end, in this case the end 1, by making the corresponding surface 16.3 at an angle α_3 to the plane which is perpendicular to the axis X1-X1, angle which value is substantially equal to $\alpha_1 + \alpha_2$.

In this case the annular surface 17 of the end 2 is flat and perpendicular to the axis X1-X1. It will be appreciated that care will be taken to check the connecting zones connecting the annular surfaces 16 and 17 to the tubular internal zones 14, 15 in order to avoid sharp angles.

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Such an embodiment as shown in Figure 3 has the advantage of simplifying manufacture for one of the components of the joint, in this case being the component 4 which is not modified in comparison with its usual shape.

- 5 Such an arrangement is a particularly attractive proposition when the slope of the annular surface in the abutment contact zone 16.1 is conical and involves an angle such as that shown in Figure 4 for the male component.

Figure 4 shows in a greatly enlarged form an embodiment of a joint 30 in the
10 assembled condition comprising a male component 31 which is screwed into a female housing 32 formed by the female component 33, the male thread 34 and the female thread 35 corresponding to each other and only the part representing the assembly of the two components being shown in section in respect of the part above axis X2-X2 of the joint.

- 15 The basic structure of the joint 30 corresponds for example to a joint as described in European patent No. 0 488 912 B2, although that detail is in no way limitative.

Figure 4 can be applied to the situation where the female component 33 represents, with its housing 32, one side of a sleeve having a flange or collar portion, of which only one
20 side is shown, the other side which is not shown being at the right of the Figure. Figure 4 can also be applied to the situation where the joint is of the integral type, in which case the component 33 is the female component which is provided at the end of a tube that is generally of great length, which is not represented and which is disposed to the right of the Figure.

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As Figure 4 diagrammatically shows, this arrangement again has the annular surfaces 36, 37 which prolong the tubular internal zones 38, 39, a protective layer 40, 41 being deposited as described with reference to Figures 1 to 3. The end of the male component 31 comprises a male contact surface 36.1 which is tightened by screwing against a
30 corresponding female contact surface 37.1 of the female housing 32 of an assembly sleeve or a housing of the female end of a tube portion. Those two abutment surfaces have a contact generatrix X3-X3 that is inclined at about 5° to 35° with respect to a plane which is perpendicular to the axis of the joint. The opening zone 42 comprises a total opening angle α_4 of about 10° and the thickness of the protective layer 40, 41 is such that, in the screwed

state, the opening of the V-shape is filled in respect of the major part thereof as far as the point indicated at 43 by the partially compressed layers. Under those conditions the value of H3 is for example of the order of 2.5 mm, having regard to the thickness necessary for affording the connection to the zones 38, 39. As in the case of the foregoing examples, the
5 connecting portion connecting the annular surfaces 36, 37 to the tubular internal zones 38, 39 is provided by means of curves which are of sufficient radii or, as illustrated, advantageously by means of chamfers at about 45°.

Under those conditions excellent adhesion of the protective layer is found to occur,
10 even after a plurality of screwing-unscrewing operations. It is noted in particular that a layer which adheres to the metal is maintained in the opening zone 42, even in the vicinity of the abutment surfaces 36.1, 37.1, in spite of the expulsion of a part of that layer when it is subjected to the crushing effect produced by the metal walls of the opening zone.

15 It will be seen that, in these different embodiments of the joint according to the invention, the basic combination of a protective layer with a progressive opening zone adjacent to an abutment zone prevents corrosive fluids from passing towards the subjacent metal and maintains the integrity of the protective layer.

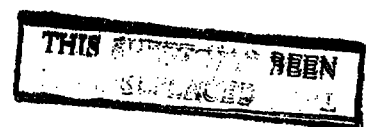
20 Numerous alternative configurations may be adopted in comparison with the examples set forth and the description, which still fall within the area protected by the invention. It is possible in particular to use all types of thread which are known in the production of threaded joints such as for example simple threads, step-type threads, conical threads or cylindrical threads.



CLAIMS

1. A threaded joint (5) for tubes comprising two tubular components (3, 4), each component being provided with a thread (11, 12) and comprising a tubular internal zone (14, 15) which is prolonged by an annular surface (16, 17), a layer (22, 23) covering the tubular internal zone (14, 15) of each component (3, 4) and at least a fraction of the radial
5 extent of the annular surface (16, 17), assembly of the two components being carried out by screwing at least one male threaded component (3) into a female threaded housing (7), characterised in that in the screwed state both annular surfaces (16, 17) are in abutment contact along a common generatrix over an external part (16.1, 17.1) of their surface, the generatrices of the annular surfaces (16.3, 17.3) forming towards the interior of the joint,
10 from an initial point (16.2, 17.2), a progressive opening (24) and then rejoining the tubular internal zone (14, 15) of their respective component (3, 4), the opening (24) being at least partially filled by the protective layers (22, 23) which are in contact of the two components.
2. A joint according to claim 1 characterised in that in the opening zone (24) the
15 axial distance between the two generatrices (16.3, 17.3) increases progressively from the initial point (16.2, 17.2), the generatrix (16.3) of at least one component departing from the natural geometrical prolongation of the common generatrix (16.1, 17.1).
3. A joint according to one of claims 1 and 2 characterised in that the protective
20 layer (22, 23), prior to the first screwing, covers a part of the abutment zones (16.1, 17.1) of each component beyond the initial point (16.2, 17.2).
4. A joint according to one of claims 1 and 2 characterised in that the protective
layer (22, 23), prior to the first screwing, covers a zone which stops in the vicinity of the
25 initial point (16.2, 17.2).
5. A joint according to one of claims 1 to 4 characterised in that the opening (24) has an angle (X) at the initial point (16.2, 17.2) of between 5 and 30°.
- 30 6. A joint according to one of claims 1 to 5 characterised in that the opening (24) is in the shape of a V, the opening angle (X) being distributed equally (α_1 , α_2) or unequally (α_3) between the generatrices (16.3, 17.3) of the two components.

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7. A joint according to one of claims 1 to 6 characterised in that the protective layer (22, 23) is a plastic layer based on a polyepoxide.
8. A joint according to one of claims 1 to 7 characterised in that its two components are male components which are provided with external threads and which engage into the housings provided with female threads corresponding to the external threads, housings provided at the two ends of a coupling sleeve permitting in the screwed state the abutment of the annular surfaces (16, 17) over a part (16.1, 17.1) of their surface.
9. A joint according to one of claims 1 to 7 characterised in that it comprises a male component provided with an external thread and a female component provided with an internal thread corresponding to the external thread, the female component serving as an assembly housing, the annular surfaces (36, 37) coming into abutment over a part (36.1, 37.1) of their surface in the interior of the female component (33).
10. A joint according to claim 9 characterised in that the joint is an integral joint, the female component being provided at the end of a tube of usual length.
11. A joint according to claim 9 characterised in that the female component forming the housing is provided on an end of a coupling sleeve of which the second end which is provided with a housing identical to the housing of the first end permits assembly of another tube provided at its end with a component identical to the male component, the two housings being separated by a flange portion of which the internal wall constitutes the tubular internal zone.
12. A joint according to one of claims 8 to 11 characterised in that it comprises at least one metal-metal sealing surface between male component and female housing.
13. A joint according to one of claims 1 to 12 characterised in that the opening zone (24, 42) is connected to the tubular internal zone (14, 15 - 38, 39) of each component by a chamfer or a rounded portion.



14. A joint according to one of claims 1 to 13 characterised in that the layer (22, 23) is a layer which is intended to protect the joint from corrosion.
15. A joint according to one of claims 1 to 13 characterised in that the layer (22, 23) is a
5 layer which is intended to reduce the pressure drops in the flowing fluid.