Title: Bend restriction element for restricting the bending range of a conduit

This invention relates to a bend restriction element, hereinafter also briefly referred to as "element", for restricting the bending range of a conduit~~.~~,

wherein the element is modular for forming a tube segment all around ~~the~~ such a conduit through locked interlocking circumferential interconnection, i.e., interconnection in circumferential direction of ~~the~~ such a conduit, of the element with at least one similar such element,

wherein the tube segment is modular for forming an articulated tube around ~~the~~ such a conduit through locked interlocking longitudinal interconnection, i.e., interconnection in longitudinal direction of ~~the~~ such a conduit, of the tube segment with at least one similar such tube segment,

wherein tube segments of the articulated tube can hinge relative to each other about lines which are transverse to the longitudinal direction of ~~the~~ such a conduit, and

wherein the hinging range of said hinging of the tube segments is restricted for said restricting of the bending range of ~~the~~ such a conduit.

Such an articulated tube formed by such bend restriction elements is also referred to as 'bend restrictor'. Such an articulated tube, arranged all around a bendable conduit, such as, for example, an (underwater) pipeline, cable, or the like, prevents kinking, buckling, or other damage to the conduit. Bend restrictors are used, for example, in offshore. In most cases, bend restrictors are only arranged around the conduit portions that are most vulnerable in view of the above contingencies. Applied locally at such portions around a conduit, a bend restrictor thus restricts the local bending range of a conduit. The most vulnerable portions of conduits are often in the vicinity of places where the conduits concerned come out of a hard

CLAIMS

1. A bend restriction element for restricting the bending range of a conduit ~~(10)~~,

wherein the element ~~(1)~~ is modular for forming a tube segment ~~(12)~~ all around ~~the~~ such a conduit through locked interlocking circumferential interconnection, i.e., interconnection in circumferential direction ~~(C)~~ of ~~the~~ such a conduit, of the element with at least one similar such element ~~(2)~~,

wherein said tube segment ~~(12)~~ is modular for forming an articulated tube ~~(100)~~ all around ~~the~~ such a conduit through locked interlocking longitudinal interconnection, i.e., interconnection in longitudinal direction ~~(L)~~ of ~~the~~ such a conduit, of said tube segment with at least one similar such tube segment ~~(14, 16, 18)~~,

wherein tube segments of the articulated tube can hinge relative to each other about lines which are transverse to said longitudinal direction ~~(L)~~ of ~~the~~ such a conduit, and

wherein the hinging range of said hinging of the tube segments is restricted for said restricting of the bending range of ~~the~~ such a conduit,

characterized in that the element ~~(1)~~ is configured such that said locking of said circumferential interconnection of the elements ~~(1, 2)~~ of at least one tube segment concerned ~~(12)~~ of the articulated tube ~~(100)~~ is ensured both by the manner of interlocking of the longitudinal interconnection of the tube segment concerned ~~(12)~~ with a tube segment ~~(16)~~ of the articulated tube situated in the longitudinal direction ~~(L)~~ on one side thereof, and by the manner of interlocking of the longitudinal interconnection of the tube segment concerned ~~(12)~~ with a tube segment ~~(14)~~ of the articulated tube situated in the longitudinal direction on the other side thereof, wherein said respective manners of interlocking are also part of, respectively, ensuring said locking of said circumferential

interconnection of the elements ~~(5, 6)~~ of the tube segment ~~(16)~~ situated on said one side, and ensuring said locking of said circumferential interconnection of the elements ~~(3, 4)~~ of the tube segment ~~(14)~~ situated on said other side.

2. A bend restriction element according to claim 1, wherein the element ~~(1)~~ is configured such that

the tube segment concerned ~~(12)~~, the tube segment ~~(16)~~ situated on said one side, and the tube segment ~~(14)~~ situated on said other side each comprise a mutually similar first portion ~~(31; 41; 51)~~, a mutually similar second portion ~~(32; 42; 52)~~, and a mutually similar third portion ~~(33; 43; 53)~~,

said manner of interlocking of the longitudinal interconnection of the tube segment concerned ~~(12)~~ with the tube segment ~~(16)~~ situated on said one side is realized in that at least the first portion ~~(31)~~ of the tube segment concerned ~~(12)~~ is enveloped all around by the tube segment ~~(16)~~ situated on said one side, and

said manner of interlocking of the longitudinal interconnection of the tube segment concerned ~~(12)~~ with the tube segment ~~(14)~~ situated on said other side is realized in that at least the second portion ~~(32)~~ of the tube segment concerned ~~(12)~~ is enveloped all round by the third portion ~~(53)~~ of the tube segment ~~(14)~~ situated on said other side.

3. A bend restriction element according to claim 2, wherein the element ~~(1)~~ is configured such that

said manner of interlocking of the longitudinal interconnection of the tube segment concerned ~~(12)~~ with the tube segment ~~(16)~~ situated on said one side is realized in that the second portion ~~(42)~~ of the tube segment ~~(16)~~ situated on said one side envelops the first portion ~~(31)~~ of the tube segment concerned ~~(12)~~ all around and also is enveloped all around by the third portion ~~(33)~~ of the tube segment concerned ~~(12)~~, and

said manner of interlocking of the longitudinal interconnection of the tube segment concerned ~~(12)~~ with the tube segment ~~(14)~~ situated on said other side is realized in that the second portion ~~(32)~~ of the tube segment concerned ~~(12)~~ envelops the first portion ~~(51)~~ of the tube segment ~~(14)~~ situated on said other side all around and also is enveloped all around by the third portion ~~(53)~~ of the tube segment ~~(14)~~ situated on said other side.

4. A bend restriction element according to any one of the preceding claims, wherein the element ~~(1)~~ is configured such that said locked interlocking longitudinal interconnection of the tube segments ~~(12, 14)~~ is realized by interlocking of at least radially (i.e., in radial direction R), seen relative to ~~the~~ such a conduit, receding portions ~~(35)~~ and projecting portions ~~(54)~~, respectively, of two respective interconnected tube segments ~~(12, 14)~~.

5. A bend restriction element according to any one of the preceding claims, wherein the element ~~(1)~~ is configured such that

elements ~~(1, 3)~~ adjoining each other in the longitudinal direction ~~(L)~~ of two mutually adjacent segments ~~(12, 14)~~ of the articulated tube ~~(100)~~ are not in line with each other in said longitudinal direction, in that they are situated staggeredly with respect to each other in said circumferential direction ~~(C)~~, and

said staggered situation is maintained in that the element ~~(1)~~ comprises blocking means ~~(36, 37)~~ which at least partly block mutual relative rotation in said circumferential direction ~~(C)~~ of said elements adjoining each other.