In fact, the only known technique, to some extent, is to use very high strength materials (for example exotic steel alloys at relatively high cost) at the expense of limitations in terms of toughness, corrosion resistance, other manufacturing issues and, of course, limited wall thickness. Currently the forging/casting thickness limitation is a showstopper for large diameter vessels and high-pressure applications.

It is an object of the present invention to overcome these disadvantages from the prior art.

Summary of the invention

The object is achieved by providing a fluid swivel according to claim 1, for allowing transfer of a fluid across a rotary interface in a swivel rotational central plane between an incoming fluid line and an outgoing product piping; the swivel comprising an inner annular element and an outer annular element, that are located with their adjacent cylindrical surfaces in a close proximity, the inner annular element and the outer annular element defining in the swivel rotational central plane a chamber between the adjacent cylindrical surfaces of the inner and outer annular elements for receiving the fluid, wherein the inner annular element of the swivel is arranged with a connecting conduit to be connected to an end of the incoming fluid line which extends through said element into the chamber for supply of the fluid to the chamber, and wherein the outer annular element of the swivel is arranged to be connected to the outgoing product piping and is provided with a primary duct for transport of the fluid from the chamber to the product piping, wherein the swivel comprises a primary outer reinforcing annular wall arranged adjacent to and around the outer peripheral wall of the outer annular element, the primary outer reinforcing annular wall being arranged with upper and lower peripheral centering surface portions enclosing the outer peripheral wall of the outer annular element for contacting and/or registering with said outer peripheral wall above and below the swivel rotational central plane, respectively; the primary outer reinforcing annular wall further being arranged with at least a first central peripheral opening extending along a portion of the periphery of the outer reinforcing annular wall for allowing the primary duct to pass through there.

Thus, the swivel is designed to maintain the forging thickness/casting well below 350 mm and to use several layers to achieve the required wall thickness. However,

mechanical links must be ensured between the outer annular element and the outer reinforcing wall. In fact, the radial expansion of the outer annular element must be

The present invention also relates to a method for manufacturing a toroidal fluid swivel as defined in claim 16, for manufacturing a toroidal fluid swivel for transfer of a fluid across a rotary interface in a swivel rotational central plane between an incoming fluid line and an outgoing product piping; the swivel comprising an inner annular element and an outer annular element, that are located with their adjacent cylindrical surfaces in a close proximity, the inner annular element and the outer annular element defining in the swivel rotational central plane a chamber between the adjacent cylindrical surfaces of the inner and outer annular elements for receiving the fluid, wherein the inner annular element of the swivel is arranged with a connecting conduit to be connected to an end of the incoming fluid line which extends through said element into the chamber for supply of the fluid to the chamber, and wherein the outer annular element of the swivel is arranged to be connected to the outgoing product piping and is provided with a primary duct for transport of the fluid from the chamber to the product piping, the method comprises arranging a primary outer reinforcing annular wall adjacent to and around the outer peripheral wall of the outer annular element; arranging the primary outer reinforcing annular wall with an upper and lower peripheral centering surface portions enclosing the outer peripheral wall of the outer annular element for contacting and/or registering with said outer peripheral wall above and below the swivel rotational central plane, respectively, and arranging the primary outer reinforcing annular wall further with at least a first central peripheral opening extending along a portion of the periphery of the outer reinforcing annular wall for allowing the primary duct to pass through there.

Advantageous embodiments are further defined by the dependent claims.

Brief description of drawings

The invention will be explained in more detail below with reference to drawings in which illustrative embodiments of the invention are shown. It will be appreciated by the person skilled in the art that other alternative and equivalent embodiments of the invention can be conceived and reduced to practice without departing from the true spirit of the invention, the scope of the invention being limited only by the claims.

Figure 1 shows a first perspective view of a sector of a swivel outer part according to an embodiment of the invention;

Figure 2 shows a second perspective view of a sector of a swivel outer part of Fig. 1;

Figure 3 and 4 show a detailed view of a sector of a swivel outer part of Fig. 1;

Claims

1. A fluid swivel for allowing transfer of a fluid across a rotary interface in a swivel rotational central plane between an incoming fluid line and an outgoing product piping; the swivel comprising an inner annular element and an outer annular element, that are located with their adjacent cylindrical surfaces in a close proximity, the inner annular element and the outer annular element defining in the swivel rotational central plane a chamber between the adjacent cylindrical surfaces of the inner and outer annular elements for receiving the fluid, wherein the inner annular element of the swivel is arranged with a connecting conduit to be connected to an end of the incoming fluid line which extends through said element into the chamber for supply of the fluid to the chamber, and wherein the outer annular element of the swivel is arranged to be connected to the outgoing product piping and is provided with a primary duct for transport of the fluid from the chamber to the product piping,
wherein the swivel comprises a primary outer reinforcing annular wall arranged adjacent to and around the outer peripheral wall of the outer annular element, the primary outer reinforcing annular wall being arranged with upper and lower peripheral centering surface portions enclosing the outer peripheral wall of the outer annular element for contacting and/or registering with said outer peripheral wall above and below the swivel rotational central plane, respectively;
the primary outer reinforcing annular wall further being arranged with at least a first central peripheral opening extending along a portion of the periphery of the outer reinforcing annular wall for allowing the primary duct to pass through there.

2. Swivel according to claim 1, wherein the peripheral centering surface portions are arranged as a recessed rim with an upper and lower inward edge, arranged to receive the outer peripheral wall of the outer annular element in between the inward edges with an upper edge of the outer peripheral wall fitting the upper inward edge and a lower edge of the outer peripheral wall fitting the lower inward edge.

3. Swivel according to claim 1 or 2, wherein the primary outer reinforcing annular wall further being arranged with one or more additional central peripheral openings extending along a portion of the periphery of the outer reinforcing annular wall for allowing either a second duct or a port to pass through.

4. Swivel according to any one of claims 1 – 3, wherein the primary outer reinforcing annular wall comprises an upper outer reinforcing annular wall portion and a lower outer reinforcing annular wall portion wherein the upper and lower portions are coupled to each other by mechanical joints.

5. Swivel according to any one of claims 1 – 4, wherein the swivel comprises a primary inner reinforcing annular wall arranged adjacent to the inner peripheral wall of the inner annular element, the primary inner reinforcing annular wall being arranged with two peripheral centering surface portions for contacting and/or registering with the inner peripheral wall of the inner annular element, the primary inner reinforcing annular wall further being arranged with a first central peripheral opening along a portion of the periphery of the inner reinforcing annular wall for allowing the connecting conduit to pass through there.

6. Swivel according to claim 5, wherein the primary inner reinforcing annular wall comprises an upper inner reinforcing annular wall portion and a lower inner reinforcing annular wall portion wherein the upper and lower portions are coupled to each other by mechanical joints.

7. Swivel according to claim 5 or 6, wherein additionally the swivel comprises an upper inner sealing ring, an upper outer sealing ring, a lower inner sealing ring and a lower outer sealing ring;
the upper inner sealing ring being mounted on the inner annular element above the swivel rotational central plane; the upper outer sealing ring being mounted on the outer annular element above the swivel rotational central plane with its inner peripheral surface in close proximity with the outer peripheral surface of the upper inner sealing ring;

the lower inner sealing ring being mounted on the inner annular element below the swivel rotational central plane; the lower outer sealing ring being mounted on the outer annular element below the swivel rotational central plane with its inner peripheral surface in close proximity with the outer peripheral surface of the lower inner sealing ring;

wherein the swivel comprises a secondary outer upper reinforcing ring, a secondary outer lower reinforcing ring, a secondary inner upper reinforcing ring and a secondary inner lower reinforcing ring,

wherein the secondary outer upper reinforcing ring is arranged above the swivel rotational central plane and comprises at an inner peripheral surface a secondary peripheral centering surface portion for contacting and/or registering with the outer peripheral wall of the upper outer sealing ring;

the secondary outer lower reinforcing ring is arranged below the swivel rotational central plane and comprises at an inner peripheral surface a secondary peripheral centering surface portion for contacting and/or registering with the outer peripheral wall of the lower outer sealing ring;

the secondary inner upper reinforcing ring is arranged above the swivel rotational central plane and comprises at an outer peripheral surface a secondary peripheral centering surface portion for contacting and/or registering with the inner peripheral wall of the inner outer sealing ring,

and the secondary inner lower reinforcing ring is arranged below the swivel rotational central plane and comprises at an outer peripheral surface a secondary peripheral centering surface portion for contacting and/or registering with the inner peripheral wall of the lower inner sealing ring.

8. Swivel according to claim 7, wherein

the swivel comprises an outer upper spacer ring, an outer lower spacer ring, an inner upper spacer ring and an inner lower spacer ring; each spacer ring having an inner centering surface portion at its inner peripheral edge and an outer centering surface portion at its outer peripheral edge;

the outer upper spacer ring being intermediate the primary outer reinforcing annular wall and the outer annular element and between the secondary outer upper reinforcing ring and the swivel rotational central plane;

the outer lower spacer ring being intermediate the primary outer reinforcing annular wall and the outer annular element and between the secondary outer lower reinforcing ring and the swivel rotational central plane;
the inner upper spacer ring being intermediate the primary inner reinforcing annular wall and the inner annular element and between the secondary inner upper reinforcing ring and the swivel rotational central plane;
and the inner lower spacer ring being intermediate the primary inner reinforcing annular wall and the inner annular element and between the secondary inner lower reinforcing ring and the swivel rotational central plane.

9. Swivel according to claim 7, wherein
the swivel comprises an outer upper spacer ring, an outer lower spacer ring, an inner upper spacer ring and an inner lower spacer ring; each spacer ring having an inner centering surface portion at its inner peripheral edge and an outer centering surface portion at its outer peripheral edge;
the outer upper spacer ring being intermediate the secondary outer upper reinforcing ring and the upper outer sealing ring, and above the primary outer reinforcing annular wall and the swivel rotational central plane;
the outer lower spacer ring being intermediate the secondary outer upper reinforcing ring and the lower outer sealing ring, and below the primary outer reinforcing annular wall and the swivel rotational central plane;
the inner upper spacer ring being intermediate the secondary outer upper reinforcing ring and the inner upper sealing ring, and above the primary inner upper reinforcing annular wall and the swivel rotational central plane;
and the inner lower spacer ring being intermediate secondary inner lower reinforcing ring and the inner lower sealing ring, and below the primary inner lower reinforcing annular wall and the swivel rotational central plane.

10. Swivel according to any one of the preceding claims, wherein the outer reinforcing annular wall and/or the inner reinforcing annular wall is manufactured from a material selected from a group comprising steel, steel alloys and composites.

11. Swivel according to any one of claims 8 – 10, wherein the spacer rings may be manufactured from a material selected from the group comprising steel, steel alloys and composites.

12. Swivel according to claim 10 or 11, wherein the steel comprises forged steel, rolled steel plate and cast steel.

13. Swivel according to any one of the preceding claims, wherein the primary duct either is a nozzle or comprises a nozzle shaped portion.

14. Swivel according to according to any one of the preceding claims, wherein additionally between the outer annular element of the swivel and the associated outer reinforcing ring a secondary annular chamber is created inbetween the centering surface positions, the secondary annular chamber being arranged for coupling to a hydraulic system arranged for injecting hydraulic fluid into said secondary annular chamber.

15. Swivel according to according to any one of the preceding claims, wherein additionally between the inner annular element of the swivel and the associated inner reinforcing ring a further annular chamber is created inbetween the centering surface positions, the further annular chamber being arranged for coupling to a hydraulic system arranged for injecting hydraulic fluid into said further annular chamber.

16. Method for manufacturing a toroidal fluid swivel for transfer of a fluid across a rotary interface in a swivel rotational central plane between an incoming fluid line and an outgoing product piping; the swivel comprising an inner annular element and an outer annular element, that are located with their adjacent cylindrical surfaces in a close proximity, the inner annular element and the outer annular element defining in the swivel rotational central plane a chamber between the adjacent cylindrical surfaces of the inner and outer annular elements for receiving the fluid, wherein the inner annular element of the swivel is arranged with a connecting conduit to be connected to an end of the incoming fluid line

which extends through said element into the chamber for supply of the fluid to the chamber, and wherein the outer annular element of the swivel is arranged to be connected to the outgoing product piping and is provided with a primary duct for transport of the fluid from the chamber to the product piping,

the method comprising:

arranging a primary outer reinforcing annular wall adjacent to and around the outer peripheral wall of the outer annular element;

arranging the primary outer reinforcing annular wall with an upper and lower peripheral centering surface portions enclosing the outer peripheral wall of the outer annular element for contacting and/or registering with said outer peripheral wall above and below the swivel rotational central plane, respectively

arranging the primary outer reinforcing annular wall further with at least a first central peripheral opening extending along a portion of the periphery of the outer reinforcing annular wall for allowing the primary duct to pass through there.