Summary of the invention

EmbodimentsThe object of the invention seekis to obviate some of said drawbacks with known solutions by providing a method and device which give less moments in the connection.

This need is met with a method and device as defined in the attached claims.

According to the invention the method for laying a pipeline on the seabed comprises the step of attaching an end of the pipeline to a structure. The end of the pipeline is to be connected to another pipeline or other structure on the seabed. According to the invention the method then comprises lowering the structure with the pipeline to the seabed, allowing the pipeline end to pivot relative the structure, measuring the inclination of the pipeline end relative to a horizontal plane, preparing / modifying a pipe spool such that one end is given the same inclination of that end as the pipeline end and connecting the pipe spool to the pipeline, such as to reduce the bending moments in the connection.

The pipe spool may be modified by arranging the pipe spool to cause practically no vertical forces in the connection to the pipeline, thereby reducing the bending moments in the connection. One possible way of arraigns the pipe spool to cause practically no vertical forces is for instance to arranging at least one part of the pipe spool to be resting on a surface after connection. The surface may be the seabed or surface of a structure positioned on the seabed, for instance a part of the structure whereto the pipeline is attached. The pipe spool may be U-shaped, or W-shaped, to provide the pipe spool to rest on surface. Another possible solution is to arranged the pipe spool such that it have no gravity forces when positioned in the water. The gravity forces of the pipe spool may be counteracted by buoyancy forces of the pipe spool or of means attached to the pipe spool as it is submerged in water.

By allowing the pipeline end to pivot relative the structure when laid on the seabed, the moment between the pipeline and the structure is kept at a minimum as the pipeline is given the most natural shape. As the structure is positioned on the seabed and the pipeline end is attached to but allowed to pivot relative the structure, a longitudinal axis of the pipeline at the pipeline end will normally form an angle other than zero with a horizontal plane. This horizontal plane may be mainly parallel to the seabed. The angle will vary dependent on the height difference between the position of the rest of the pipeline and the point where the end of the pipeline is connected to the structure. The angle may also depend on the orientation of the seabed around the point of connection. By having the pipeline end pivoting relative the structure, there is achieved a situation where the most of the pipeline will naturally rest on the seabed and thereby with minimum moment in the connection between the pipeline and the structure. This in contradiction to previous solutions where the pipeline end has been fixed relative the structure, and where a

According to another aspect the method may comprises forming the pipe spool with a curvature, and at least one part adapted to be resting on the seabed. Having the pipe spool resting on the seabed, will unload the system with most of the weight of the pipe spool, which weight if not resting on the seabed, will induce moments in the system. Also the curvature of the pipe spool which may be formed as a U-shape will prevent excessive moments in the system as it will be more adapted to handle thermal expansions and contractions.

According to the invention there is also provided a pipeline installation device. The device comprises a foundation structure adapted for positioning on the seabed, a top structure attached to the foundation structure, where the top structure having means for the attachment of a pipeline. According to the invention at least one side of the top structure is arranged to be movable relative the foundation structure. The top structure comprises guiding means for guidance of an adapted pipe spool as the adapted pipe spool is to be connected to a pipeline end attached by the means for attachment of the pipeline.

By having the pipeline end connected to a top structure which has at least one degree of freedom relative a foundation structure, which is fixed relative the seabed, the moments in the connection is reduced.

According to an aspect the at least one side of the top structure may be arranged to be pivotal relative the foundations structure. The pivot axis may in one embodiment be arranged to be mainly transverse to a longitudinal axis of the pipeline. This will result in that a pipeline end connected to the top structure would be allowed to move in a plane mainly perpendicular to the seabed. There will during use be variations in/from this as the seabed in not a level surface. This will give the pipeline end one degree of freedom.

According to another aspect the top structure may be attached to the foundation structure with connection means, arranged such that the top structure pivots relative the foundation structure in a first state of the connection means and is prevented from pivoting in a second state of the connection means.

The connection means may have several configurations. One possible solution is to have the top structure connected to the foundations structure with hinge means, allowing pivotal movements and in addition to the hinge means have locking means. The locking means when activated will prevent the top structure from pivoting. The locking means may be configured such that it may lock the top structure from pivoting in one or several positions.

As an alternative to hinge means, the connection means may comprise an abutment part of the top structure, which abutment part abut against a surface part of the foundation structure, there the abutment part and the surface part are configured

CLAIMS

1. Method for laying pipelines ~~(1)~~ on the seabed comprising the steps of;
attaching an end ~~(2)~~ of the pipeline ~~(1)~~ to a structure,
lowering the structure ~~(10, 20)~~ with the pipeline ~~(1)~~ to the seabed,
when on seabed allowing the pipeline end ~~(2)~~ to pivot relative the structure ~~(10, 20)~~,
measuring the inclination of the pipeline end ~~(2)~~ relative to a horizontal plane,modifying a pipe spool ~~(5)~~ such that one end is given the same inclination of the end as the pipeline end ~~(2)~~,
connecting the pipe spool ~~(5)~~ to the pipeline ~~(1)~~,
such as to reduce the bending moments in the connection.

2. Method according to claim 1, wherein it comprises arranging the pipe spool ~~(5)~~ to cause practically no vertical forces in the connection to the pipeline ~~(1)~~.

3. Method according to claim 1 or 2, wherein it comprises arranging at least one part of the pipe spool ~~(5)~~ to be resting on a surface after connection.

4. Method according to one of the preceding claims, wherein it comprises locking the pipeline end ~~(2)~~ in the inclined position before measuring the inclination, and releasing the locking of the pipeline end ~~(2)~~ after the pipe spool ~~(5)~~ is connected to the pipeline ~~(1)~~.

5. Method according to one of the preceding claims, wherein it comprises the step of actively pivoting the pipeline end ~~(2)~~ to the inclined position.

6. Method according to one of the claims 1 to 4, wherein it comprises allowing the pipeline end ~~(2)~~ to pivot by its own weight.

7. Method according to one of the proceeding claims, wherein it comprises the steps of removing an end unit, connected to the end of the pipeline, after the pipeline end ~~(2)~~ has rested in the inclined position.

8. Method according to one of the proceeding claims, wherein it comprises allowing the pipeline end ~~(2)~~ to be shifted along the structure.

9. Method according to one of the proceeding claims, wherein it comprises forming the pipe spool ~~(5)~~ with a curvature, and at least one part adapted to be resting on the seabed.

10. Pipeline installation device, comprising a foundation structure ~~(20)~~ adapted for positioning on the seabed, a top structure ~~(10)~~ attached to the foundation

structure ~~(20)~~ and having means for attachment of a pipeline ~~(1)~~, and where at least one side of the top structure ~~(10)~~ is arranged to be movable relative to the foundation structure ~~(20)~~, characterized in that the top structure ~~(10)~~ comprises guiding means ~~(15)~~ for guidance of an adapted pipe spool ~~(5)~~ as the adapted pipe spool ~~(5)~~ is to be connected to a pipeline end ~~(2)~~ attached by the means for attachment of the pipeline ~~(1)~~.

11. Device according to claim 10, characterized in that the pipeline ~~(1)~~ is connected to an arm of the top structure ~~(10)~~.

12. Device according to one of the claims 10 or 11, characterized in that the top structure ~~(10)~~ is attached to the foundation structure ~~(20)~~ with connection means, arranged such that the top structure ~~(10)~~ pivots relative the foundation structure ~~(20)~~ in a first state and is prevented from pivoting in a second state.

13. Device according to one of the claims 10 to 12, characterized in that the top structure ~~(10)~~ is arranged to be movable along the foundation structure ~~(20)~~.

14. Device according to one of the claims 10 to 13, characterized in that the means for attachment of a pipeline ~~(1)~~ comprises a swivel ~~(16)~~, allowing the device to rotate about a longitudinal axis of the pipeline to be connected to the device.

15. Device according to one of the claims 11 to 14, characterized in that the connection means comprises jacking means ~~(14)~~ for pivoting the end of the top structure ~~(10)~~ relative the foundation structure ~~(20)~~.

16. Device according to one of the claims 11 to 15, characterized in that at least a part of the connection means are removable attached to the top structure ~~(10)~~.