Trondheim-office:
Vestre Rosten 81
N - 7075 Tiller
Norway
Phone +47 7285 7300
Fax + 47 7285 7301
curo@curo.no
www.curo.no
NO 936 803 911 MVA

Oslo-office:
Kjeller Teknologipark
Phone + 47 7285 7310

Erland Smemo*
Per G. Berg*
Thor Saether*
Ferdinand Männle

**European Patent Attorneys*

Patentstyret
Postboks 4863 Nydalen
0422 Oslo

Patentavdelingen

7 August 2019

Norwgian patent application no. NO 20180975 - OceanTech Innovation AS

We are referring to the Office Action dated 7.2.2019.

The examiner states that the present invention according to claims 1-3 lack novelty and that claims 4-5 lack inventive step.

Discussion of novelty and inventive step

D1 - US 4720213 A
The examiner has referred to D1 as the closest prior art and states that D1 discloses all the features of claims 1-3. The applicant respectfully disagrees with the interpretation of D1 made by the examiner, as will be elaborated below.

In D1 is disclosed an apparatus where a U-shaped main body is provided with pairs of arms for clamping onto a tubular member and thus be tightly engaged with the tubular member, i.e. the pairs of arms fix the apparatus and thus main body to the tubular member at this position.
The main body is formed by a series of longitudinally spaced apart plates which are of inverted U-shape and connected to one another by lateral bracings.

Accordingly, the attachment assembly of D1 is not movable in circumferential direction of the subsea structure.

The apparatus of D1 further comprises a carrier formed by U-shaped frames mounted on each end of the main body for rotation about the main body by means of flanges and corresponding grooves in end plates of the main body.

The rotation about the main body is controlled by means of the carrier being provided with partial rings connected to inner side of the mentioned U-shaped frames by means of spaced apart bolts that form

teeth that is drivingly engaged by pinion gears mounted in on the main body. By operation of the pinion gears controlled rotation of the carrier about the main body is achieved.

Accordingly, the carrier of D1 is not arranged for rotation 360 degrees around the tubular member, but is only movable the length of the partial rings around the main body fixed to the tubular member, which are limited due to the required opening of the frames of the carrier, which will have to be at least the diameter of the tubular structure, to enable the attachment of the apparatus to the structure.

Accordingly, the present invention as claimed in claim 1 is novel by the feature that the attachment assembly with the inspection probe holder assembly is arranged movable in circumferential direction of the subsea structure. As thoroughly explained above, the corresponding features of D1 provides a fixation of the main body to the tubular member, and wherein an additional carrier will have to be provided to enable limited rotation about the fixed main body. As explained above, the solution of D1 is thus not capable of providing a 360 degrees rotation about the tubular member.

In the present invention, there are no such limitations, as the attachment assembly is capable of rotating 360 degrees about the tubular member and thus perform a continuous inspection of a weld by a continuous movement.

It is not possible to perform a continuous inspection of a weld 360 degrees around the tubular member as one will first have to rotate the carrier in one direction, stop the inspection, rotate the carrier in the opposite direction and resume the inspection.

The apparatus of D1 further suffer from many parts required to perform rotation of the carrier in relation to the main body. Further, as both the main body and carrier are U-shaped this would result, if there arises an error when the carrier is rotated in relation to the main body, the apparatus will be locked to the tubular member due to the carrier will block the opening in the main body. As described in column 3, lines 19-29 of D1 this would require the use of a diver. If the apparatus is positioned in the splash zone of maritime construction, divers cannot be used as this will be too dangerous for a diver due to the high sea forces in this area.

A further disadvantage with D1 is that it requires the use of a ROV both for positioning at the tubular structure, and to power the apparatus. This will limit the use of the apparatus to applications substantially beneath the water surface, as ROVs cannot be used in the splash zone due to high sea forces.

Another disadvantage with D1 is that uses manipulator arms to for moving devices for inspection of the weld, which due to the size of the main body and carrier will have to extend long in longitudinal direction of the apparatus to able to gain access to the weld to be inspected. This will result in a long arm that will exposed to sea forces that will result in that a precise control of the device inspecting the weld will be impossible. Further, due to a number of joints required for the arm to be controllable, the controlling will be complex. A further drawback by using manipulator arms is that small movements of the carrier will result in large movements of the devices arranged to the manipulator arms, making high accurate inspection impossible.

In the present invention the inspection probe will be arranged to an inspection probe holder assembly that will bear against the tubular member (as shown in Figures 1 and 2) and will thus provide a stabilized platform for the inspection probe. Further, the inspection probe holder assembly is movable in longitudinal direction of the attachment assembly by means of at least one shaft, i.e. there will be no movable joints that will affect the control of the inspection probe. One will at all time have a desired controllable and known position of the inspection probe holder assembly in relation to the attachment assembly.

Further, due to the many components and parts there is a high risk of mechanical failure for the apparatus in D1 in the harsh environment subsea.

Accordingly, D1 fails to disclose essential features of the present invention and is further burdened with substantial disadvantages.

As correctly stated by the examiner, D1 further fails to disclose essential features to achieve how an inspection probe can be moved with high accuracy for inspection of welds, as D1 fails to disclose how such a high accuracy inspection is to be performed and the means to achieve this.

Accordingly, D1 fails to provide a subsea weld inspection tool as disclosed in the present invention.

D2 - GB 2182898 A

In D2 is described a robot that may be arranged to a tubular structure by means of arms and wherein the robot comprises wheel pairs that is driven to rotate the robot about the tubular structure it is attached to.

A manipulator arm is shortly mentioned which may be used to support required cleaning, inspection and/or repair requirement, without any description of how a high accurate inspection of a weld can be performed. There is no disclosure in D2 of an inspection probe holder assembly that is movable in longitudinal direction of the attachment assembly as in the present invention.

D2 solves the drawback of D1 by enabling rotation 360 degrees around the tubular structure, but fails to disclose the feature of providing a stabilized platform for the inspection probe. As mentioned above the use of manipulator arms suffer from substantial disadvantages.

Further, the solution of D2 fails to disclose required vision and accuracy/positioning of the inspection probe to achieve high accuracy inspection of a weld.

Further, a combination of D1 and D2 will not result in a subsea weld inspection tool as claimed in the present invention, as they are both related to the use of manipulator arms to control the inspection probe. Due to the use of manipulator arm for controlling the inspection probe, any movement of the manipulator arm will result in large movements of the inspection probe due to a long arm is required to gain access to the weld, especially at junctures, where low space is available.

Accordingly, D2 fails to provide a subsea weld inspection tool as disclosed in the present invention alone and in combination with D1.

D3 - EP 0547685 A1

In D3 is described a remotely operated apparatus consisting of a support frame that is attached to the structure by means of a suction cup or magnets, designed to hold the support frame in a required position on the surface. Accordingly, the solution of D3 is not related to an attachment assembly that is movable, as disclosed in the present invention. The solution further describes a carriage provided with controllable steering wheels carrying an inspection probe, connected to the support frame by a single arm.

The solution of D3 is accordingly a design having a limited scan length and further requires that the carriage is provided with controllable steering wheels. It further suffers from frequent repositioning of

the entire apparatus to perform a complete scan of a weld due to the support frame is not a movable attachment assembly as in the present invention.

The solution of D3 further requires that the carriage is pressed against the surface of the structure by means of the mentioned arm, propulsion device or magnets.

The solution further requires that the inspection probe is held with an even contact pressure against the weld surface, which is vulnerable for uneven surfaces.

D3 is further suffering from that the arm used between the support frame and the carriage is hinged to the carriage. The hinge will be a weak point that will easily break in the harsh environment. The hinged connection further results in that, due to the arm will push the carriage from a rear end thereof, this will result in that, if the angle of the hinged connection becomes too large, this will push the carriage away from the weld to be inspected, resulting in that the inspection of the weld will fail.

In the present invention, the inspection probe holder assembly is firmly attached to the end of a shaft extending from the attachment assembly, resulting in that there are no such weak point and that the inspection probe holder assembly will always be at a desired and known longitudinal position from the attachment assembly. It will further be more robust and withstand the harsh environment.

Accordingly, the solution of D3 fails to provide a subsea weld inspection tool as disclosed in the present invention alone and in combination with D1, D2 or both.

D4 – WO 2013076541 A1

In D4 is disclosed a system and method for modular portable welding and seam tracking. The solution of D4 is related to devices for tracking a welding tip and is not adapted for inspection of welds in connection with junctures/joints.

The solution is not easily attachable or detachable to a structure as it requires the use of a belt or chain to be arranged enclosing the structure to move a cart in circumferential direction thereof. Accordingly, D4 fails to disclose an attachment assembly as claimed in the present invention. It further fails to disclose a solution where an inspection probe holder assembly is movable in longitudinal direction of the attachment assembly. In D4 the inspection probe is movable in transversal direction of the cart.

Accordingly, the solution of D4 is only suitable circumferentially extending (circular) welds.

Accordingly, the solution of D4 will not solve the above discussed drawbacks of the cited publications D1-D3.

Amendment of the claims

Claim 1 has been amended by reciting details of the attachment assembly and inspection probe holder assembly. Support for the amendment may be found, among others, in page 5, line 23 – page 6, line 22. The amendments more clearly recites the distinguishing features between the present invention and the cited prior art.

A new claim 2 has been included with support from, among others, page 6, lines 10-12.

A new claim 4 has been included with support from, among others, page 6, lines 10-17.

A new claim 6 has been included with support from, among others, page 6, lines 18-22.

A new claim 9 has been included with support from, among others, page 5, line 23 – page 6, line 3.

A new claim 10 has been included with support from, among others, page 6, lines 4-5.

A new claim 11 has been included with support from, among others, page 5, line 23 – page 6, line 3.

A new claim 12 has been included with support from, among others, page 9, lines 9-12.

The examiner will appreciate that the amended claims are attached in both tracked and clean versions.

Final comments

As discussed above there are substantial differences between the cited prior art publications and the present invention. As mentioned above, amended claim 1 is novel over the cited prior art publications. As no combination of the cited prior art publications will guide a skilled person to arrive at the present invention without considerable inventive effort, the present invention according to the amended claim 1 also possess inventive step.

The amended dependent claims also describe features that are not found or disclosed in the cited prior art publications.

The applicant requests postponement for amending the description and drawings until the patentability and wording of the claims have been decided.

Based on the above stated and the attached amended claims the applicant respectfully request a new assessment of novelty and inventive step.

Best Regards

Erland Smemo

Encl.