METHOD AND APPARATUS FOR ACCOMPLISHING AN UNDERWATER WELD JOINT.

Priority: 14.08.84 FI 843199

Date of publication of application: 27.05.87 Bulletin 87/22

Publication of the grant of the patent: 13.06.90 Bulletin 90/24

Designated Contracting States: BE FR IT

References cited:
FR-A-2 031 728
SE-B- 414 718
US-A-3 023 303
US-A-3 532 950
US-A-4 092 632
US-A-4 069 408

Proprietor: OY GSS GENERAL SEA SAFETY LTD
Merikatu 1
SF-00140 Helsinki (FI)

Proprietor: NIINIVAARA, Juhani Ensi Kyösti
SF-45610 Koria (FI)

Proprietor: MÄKELÄINEN, Hannu, Kalervo
Evakkotie 75 L6
SF-90100 Rovaniemi (FI)

Inventor: NIINIVAARA, Juhani
SF-45610
Koria (FI)

Inventor: MÄKELÄINEN, Hannu
Evakkotie 75 L6
SF-90100 Rovaniemi (FI)

Representative: Tiedtke, Harro, Dipl.-Ing. et al
Patentanwaltsbüro Tiedtke-Bühling-Kinne-
Grüpe-Pellmann-Grams-Struif-Winter-Roth
Bevariaring 6
D-8000 München 2 (DE)

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

Description

The invention relates to a method and apparatus for accomplishing an underwater weld joint, preferably for fixing anodes controlling the corrosion of the underwater parts of offshore constructions, in which method that surface of the support to which the element to be welded is to be fastened is first cleaned, whereafter the welding apparatus is secured to the support for the welding operation, and which apparatus comprises cleaning and fastening means for cleaning that surface of the support to which the element is to be welded and for securing the apparatus to the support.

Underwater welding operations have increased intensely owing to the fact that various off-shore hardening or have been used in the offshore and, especially that marine drilling for oil has increased. One of the most significant problems with such off-shore constructions is the attack of corrosion, which, if uncontrolled, will destroy the construction to be useless in a very short time. Attempts have been made to solve this problem, even with good success, by fixing corrosion-controlling anodes to the underwater parts. Thereby a new problem has presented itself, the replacement of the corroded anodes with new ones, since underwater welding is very expensive and difficult to carry out.

Known in the art is the so-called habitat-chamber welding method used in underwater repair operations, which method has also been used for fixing said corrosion-controlling anodes. This known method is based on supporting the object to be repaired or the corrosion-controlling anode to be fixed into a special chamber wherein the diver carried out the necessary welding operations. Although said habitat-chamber welding method strives at fulfilling the quality requirements set for the welding by different classification societies, it has the disadvantage of being very expensive both in running cost and in investment, since it employs a large and complicated construction and additionally always requires a diver to be present. Owing to the expenses of the habitat-chamber welding method, efforts have already long been made to develop wet welding methods, whereby the quality requirements set by the classification societies could be fulfilled. The greatest hindrance to success of these wet welding methods has been the hardening of the material in the underwater, whereby so-called hydrogen-cracks are formed which may grow with time and break the steel. For this reason, e.g. “Det Norske Veritas” has prohibited all welding methods not fulfilling the very high requirements for the welding quality set by this classification society.

An example of prior art is shown in FR—A—2 031 729 on which the preambles of claims 1 and 5 are based and which discloses an apparatus for accomplishing an underwater weld joint. The apparatus comprises a cover which is to be placed on the element to be welded and which encloses a non-rotating electrode. Another welding apparatus of this type is disclosed in US—A—4 069 408. However, both these known apparatuses have the above-mentioned drawbacks and fail to solve existing problems related to underwater welding, as discussed by way of introduction.

The object of the present invention is to improve, accelerate and facilitate underwater welding as well as to eliminate the disadvantages and weaknesses of all the previously known underwater welding methods and apparatus.

This and other objects stated in the following description are achieved by means of a method for accomplishing an underwater weld joint, using a welding electrode, wherein an element to be welded is brought onto a surface of a support to which the element is to be fixed and wherein the element is placed on the support and wherein a junction to be welded between the support and the element is insulated from the ambient water by disposing a protecting cover tightly against the element.

According to the invention, this method is characterized in that during the welding operation the welding electrode which rotates about a longitudinal axis, is led against edges of an opening extending through the element and allowing passage of the electrode towards the support, that a sealing element of flexible material, preferably a spacer ring of rubber, is disposed between the element and the support to form an interspace insulated from the ambient mass of water, between the element and the support, that the preferably cup-shaped protecting cover is pressed onto a free surface of the element brought onto the support, on top of the junction to be welded, to be in a sealed relationship with the element and to enclose the junction to be welded from the ambient mass of water within the interior of the protecting cover, that the interior of the protecting cover is emptied of water prior to the welding operation, and that a guide bushing for the welding electrode is provided in the protective cover, said bushing having a gasket for the sealed inlet of the welding electrode.

The objects are also achieved by means of an apparatus for accomplishing an underwater weld joint between an element and a surface of a support, using a welding electrode, which apparatus comprises at least one protecting cover disposed in the interior of the welding apparatus whereby the interior of the cover for insulating the junction to be welded between the support and the element from the ambient mass of water, at least for the duration of the welding operation, as at least one welding electrode which rotates about its longitudinal axis and extends through a wall of the cover in a sealed relationship with said wall.

According to the invention, this apparatus is characterized in that it further comprises drive means for conducting welding current to the welding electrode and for rotating and leading the welding electrode against the edges of an open-
ing which extends through the element and allows passage of the welding electrode, during the welding operation, that a head edge of the protective cover disposed against the element is furnished with a gasket, that the interior of the protective cover is connected to a subatmospheric source through an outflow member in the wall of the protective cover, that the wall of the protective cover is provided with an outflow member, preferably a pressure valve, opening at a predetermined pressure, and that a guide bushing for the welding electrode is provided in the protective cover, said bushing having a gasket for the sealed inlet of the welding electrode.

Further features of the invention are stated in the accompanying claims.

The primary advantage of the invention is that the apparatus is small-sized and is of a far simpler construction and considerably cheaper than the apparatus used with the earlier known habitat-chamber welding method. A further advantage of the invention is that it can be used totally without a diver; the present invention may be used for a previously undetermined period. Owing to the small size, simple construction and faster set-up, significant savings are thus obtained both in investment and running costs.

The following is a more detailed description of the invention by means of preferred embodiments with reference to the accompanying drawings, wherein:

Figure 1 shows the welding apparatus according to the invention in a partial cross-section, said apparatus being secured to an unmanned diving apparatus, and

Figure 2 shows a partially cross-cut side view of the welding apparatus according to a preferred embodiment of the invention.

In the example shown in Figure 1, the welding apparatus 20 according to the invention has been secured to a remote-controlled unmanned diving apparatus 100 by which the welding apparatus is moved in the water from one welding spot to another. Firstly, that surface of the support 3, said support being in this exemplary case an under-water leg of an oil ring, against which the element 1, which in this exemplary case is a corrosion-controlling anode, is to be welded is cleaned, and after cleaning the welding apparatus is secured to the object to be welded. For carrying out these operations, the welding apparatus 20 has cleaning and fastening means 21 articulated to the remote-controlled diving apparatus 100 by means of hydraulically movable lever arms 101 and 102. In this preferred example, the cleaning and fastening means consists of discs 21 preferably of rubber-based material and rotated by a hydraulic motor 103, said discs grinding the surface 2 to be under the element 1 to be fully clean and generating, when rotating near the surface 2 of the support 3, a powerful subatmospheric pressure, whereby the welding apparatus 20 is firmly secured in place owing to the suction effect produced by the subatmospheric pressure.

After the securing of the welding apparatus 20 is in place, the element 1 to be welded is brought onto the support 3, and the junction between the support 3 and the element 1 is insulated from the ambient mass of water. For bringing the element 1 to welded in place, the welding apparatus 20 comprises placing means 22, which in this exemplary case shown in Figure 1 consist of hydraulically movable shears 22 fastened to diving apparatus. For insulating the junction to be welded, the welding apparatus 20 comprises a cup-like protecting cover 9 which can be transported by means of hydraulically movable lever arms 104, 105, said protecting cover being pressed tightly about the junction to be welded, against the free top surface 8 of the element 1 to be welded.

To achieve good sealing, the head edge 12 of the protecting cover 9 which is to abut the element 1 to be welded is provided with a gasket 13.

Alternatively the protecting cover 9 may be fastened beforehand, e.g. by welding, onto the surface of the element 1 to surround the junction to be welded.

For secure and fully sealed insulation of said junction from the ambient mass of water, a spacer ring 6 of suitable elastic material, preferably rubber, is disposed between the element 1 to be welded and the support 3, to form an insulated interspace 7. To facilitate the fitting, the spacer ring 6 has been fastened in advance, e.g. by gluing to the surface of the element 1 which is to abut the support 3.

An opening 5 for the welding electrode 4 has been made by boring in the element 1 at the junction to be welded, said opening extending substantially perpendicularly to the surface 2 in the support 3.

As can be seen from Figures 1 and 2, the welding electrode 4 has been arranged to protrude in a sealed manner through the wall of the protecting cover 9, wherein the drive means 23 rotating the welding electrode 4 and pressing it downwards has been fastened to that part of the welding electrode 4 which protrudes from the protecting cover 9. In this exemplary case, the drive means 23 comprises gripping means 24 consisting of hydraulically movable jaws 26, 27 and fixed to that part of the welding electrode 4 which protrudes from the protecting cover 9, as well as a rotating means 25 which is preferably a hydraulic motor and which is connected in a non-rotating manner to the hydraulically movable jaws 26, 27 and which is furnished with a screw feeder 28 for the welding electrode, said screw feeder feeding the welding electrode forward at a speed substantially corresponding to the speed of consumption of the welding electrode, as well as with current-conducting carbons 29 for conducting the welding current to the welding electrode 4.

As can be seen from Figures 1 and 2, that part of the welding electrode 4 which lies within the interior of the protecting cover 9 as well as the opening 5 for the welding electrode 4 have been formed to match one another, to taper conically
downwards towards the support 3. Owing to this kind of shaping as well as rotating movement of the welding electrode 4, all welding slag will be pushed upwards into the protecting cover 9, and no slag inclusions weakening the weld joint will be formed.

To achieve a high-standard welding result, the interior 10 of the protecting cover must be free from water prior to the commencing of the welding operation. To fulfil this requirement, according to one embodiment of the invention the wall 11 of the protecting cover 9 is provided with an outflow member 14 connected preferably either to a vacuum source or a suction device. By means of this outflow member 14, the interior 10 of the protecting cover 9 can be evacuated of water and also of the welding gases formed during welding operation. According to another embodiment, a suitable filler, such as gas, polyurethane foam or welding flux, may be injected into the interior 10 of the protecting cover 9 to be pressed in place, either through the open head edge 12 or through an outflow member, preferably a pressure valve 15, disposed in the wall 11 of the protecting cover 9 and opening at a predetermined pressure, to evacuate water from said interior prior to the commencing of the welding operation. In the latter case, the outflow member 15 is also used to evacuate gases formed in connection with the welding operation from the interior 10 of the protecting cover 9. When the protecting cover 9 has been fastened in advance permanently to the element 1 to be welded, the penetration of water into the interior 10 of the protecting cover 9 can be prevented most simply in that the opening in the element 1 is covered with a suitable covering material, e.g. molten resin. According to the preferred embodiment of the invention, the protecting resin has been applied to the element 1 to that surface of the spacer ring 6, fitted coaxially with the opening 5, which is to abut the support 3. Also in this exemplary case, the wall 11 of the protecting cover 9 is provided with an outflow member 15 of the type shown in Figure 2 for the evacuation of the welding gases during the welding operation.

As can be seen from Figure 2, the material thickness of the welding mass in the conical part of the welding electrode 4 is constant, and its height is preferably dimensioned to correspond to the thickness of the element 1 to be welded in each case. Thanks to this construction, the weldability of the weldable material will be enhanced and the welding result will fulfill the present quality requirements, and the protecting cover 9 fastened permanently in advance need not be removed for inspection.

In order to reach certainty of the fact that the welding electrode 4 will pass precisely into the opening 5 in the element 1 to be welded, the wall 11 of the protecting cover 9 is provided with a bushing guide 30 for the welding electrode 4, said bushing having a gasket for the sealed inlet of the welding electrode 4 into the interior 10 of the protecting cover 9.

Regarding the operation of the apparatus, it may further be stated that a diving apparatus 100 or a diving robot will independently fetch the anodes to be fastened from a cage lowered in the water, said cage containing a large number of anodes, and bring them to be fastened to the work objects. All operations of the apparatus can be monitored by means of a monitor 107 fastened to the diving apparatus and provided with an illumination device 106. The diving apparatus may also be provided with an ultracamera checking also the quality of the welding done through the protecting cover 9, and thus it is possible for the monitoring persons, if necessary, to follow the fastening of each anode, as the apparatus is working under water.

It may further be stated that the necessary number of hydraulic pumps are provided in the diving apparatus 100, for working the lever arm of the welding apparatus as well as the hydraulic motor 103, and a source of welding current is also provided in the diving apparatus, from which source the welding current is conducted through the rotating means 25 to the welding electrode 4. In this exemplary case, the source of welding current is earthed through the shear 22 to the element 1 to welded.

The invention has been described in the foregoing merely by means of some preferred embodiments thereof. This is by no means intended to limit the invention to relate merely to said exemplary cases, but, as is apparent to the man skilled in the art, the invention may be varied to substantial degree within the scope of the inventive concept defined in the appended claims. It will be specially emphasized that the welding apparatus does not presuppose the use of an unmanned diving apparatus, but it can also be applied to a diver or to a manned diving carrier.

Claims

1. A method for accomplishing an underwater weld joint using a welding electrode (4), wherein an element (1) to be welded is brought onto a surface (2) of a support (3) to which the element (1) is to be welded, wherein the element (1) is placed on the support (2) and wherein a junction to be welded between the support (3) and the element (1) is insulated from the ambient water by disposing a protection cover (9) tightly against the element (1), characterized in that during the welding operation the welding electrode (4) which rotates about its longitudinal axis is lead against edges of an opening (5) extending through the element (1) and allowing passage of the electrode (4) towards the support (3); that a sealing element (6) of flexible material, preferably a spacer ring of rubber, is disposed between the element (1) and the support (3) to form an interspace (7) insulated from the ambient mass of water, between the element (1) and the support (3); that the preferably cup-shaped protecting cover (9) is pressed onto a free surface (8) of the element (1) brought onto the support (3), on top
of the junction to be welded, to be in a sealed relationship with the element (1) and to enclose the junction to be welded from the ambient mass of water within the interior (10) of the protecting cover (9); that the interior (10) of the protecting cover (9) is emptied of water prior to the welding operation; and that a guide bushing (30) for the welding electrode (4) is provided in the protecting cover (9), said bushing having a gasket for the sealed inlet of the welding electrode (4).

2. A method according to claim 1, characterized in that before the protecting cover (9) is pressed tightly against the element (1), the welding electrode (4) is disposed in the protecting cover (9), and the interior (10) of said protecting cover is filled with a suitable medium, preferably polyurethane or welding flux.

3. A method according to claim 1 or 2, characterized in that the welding electrode (4) is disposed in advance within the protecting cover (9), that the protecting cover (9) is permanently fixed to the element (1), and that the opening (5) provided in the element (1) for the welding electrode (4) is closed or covered with a suitable material, e.g., protecting resin.

4. A method according to claim 1, 2 or 3, characterized in that gases formed during the welding operation are evacuated from the interior (10) of the protecting cover (9).

5. An apparatus for accomplishing an underwater weld joint between an element (1) and a surface (2) of a support (3), using a welding electrode (4), which apparatus comprises at least one protecting cover (9) disposed in tight relationship onto a free surface (8) of the element (1) for insulating the junction to be welded between the support (3) and the element (1) from the ambient mass of water, at least for the duration of the welding operation, and at least one welding electrode (4) which rotates about its longitudinal axis and extends through a wall (11) of the cover (9) in a sealed relationship with said wall (11), characterized in that it further comprises drive means (23) for conducting welding current to the welding electrode (4) and for rotating and leading the welding electrode (4) against the edges of an opening (5) which extends through the element (1) and allows passage of the welding electrode (4), during the welding operation; that a head edge (12) of the protecting cover (9) disposed against the element (1) is furnished with a gasket (13); that the interior (10) of the protecting cover (9) is connected to a subatmospheric source through an outflow member (14) in the wall (11) of the protecting cover (9); that the wall (11) of the protecting cover (9) is provided with an outflow member (15), preferably a pressure valve, opening at a predetermined pressure; and that a guide bushing (30) for the welding electrode (4) is provided in the protecting cover (9), said bushing having a gasket for the sealed inlet of the welding electrode (4).

6. An apparatus according to claim 5, characterized in that the protecting cover (9) is permanently fastened to the element (1).

7. An apparatus according to claim 5 or 6, characterized in that the interior (10) of the protecting cover (9) is filled with a suitable filler material, preferably with polyurethane foam or a welding flux.

8. An apparatus according to claim 5, 6 or 7, characterized in that at least a part of the welding electrode (4) within the interior (10) of the protecting cover (9) is conically formed to taper towards the support (3).

9. An apparatus according to claim 5, 6, 7, or 8, characterized in that the material thickness of the welding mass (17) in the welding electrode (4) is constant.

10. An apparatus according to claim 5, 6, 7, 8 or 9, characterized in that the drive means (23) comprises gripping means (24) grasping that part of the welding electrode (4) which protrudes from the protecting cover (9), as well as rotating means (25) rotating the welding electrode (4) during the welding operation and pushing said electrode against the edges of the opening (5) in the element (1) at a speed substantially corresponding to the consumption of the welding electrode (4).

11. An apparatus according to claim 10, characterized in that the gripping means (24) consists of hydraulically movable jaws (26, 27).

12. An apparatus according to claim 10, characterized in that the rotating means (25) is a hydraulic motor furnished with a screw feeder (28) for the welding electrode (4) and with current-conducting carbons (29) for conducting the welding current to said welding electrode.

Patentansprüche

1. Verfahren zur Ausführung einer Unterwasser-Schweißverbindung unter Verwendung einer Schweißelektrode (4), wobei ein zu schweißendes Element (1) auf eine Fläche (2) eines Trägers (3), an den das Element (1) geschweißt werden soll, geführt wird, wobei das Element (1) an dem Träger (2) festgelegt wird und wobei durch Anordnen einer Schutzhaube (9) dicht gegen das Element (1) eine zwischen dem Träger (2) sowie dem Element (1) zu schweißende Verbindung gegen das umgebende Wasser abgesperrt wird, dadurch gekennzeichnet, daß während des Schweißvorgangs die Schweißelektrode (4), die um ihre Längsachse dreht, gegen die Ränder einer durch das Element (1) sich erstreckenden und einen Durchgang der Elektrode (4) zum Träger (3) hin zulassenden Öffnung (5) geführt wird; daß ein Dichtungselement (6) aus flexiblem Material, vorzugsweise um Abstandring aus Gummizeilen dem Element (1) sowie dem Träger (3) angeordnet wird, um einen gegen die umgebende Wassermasse abgesperrten Zwischenraum (7) zwischen dem Element (1) und dem Träger (3) zu bilden; daß die vorzugsweise topförmige Schutzhülle (9) auf eine freie Oberfläche (3) des auf den Träger (3) aufgebrachten Elements (1) oben über der zu schweißenden Verbindung gepreßt wird, um sich in einer abge-
richtete Lagebeziehung mit dem Element (1) zu
finden und die zu schweißende Verbindung
innerhalb des Innenraumes (10) der Schutzhaube
(9) von der umgebenden Wassermasse abzu-
schließen; daß der Innenraum (10) der Schutz-
haube (9) vor dem Schweißvorgang von Wasser
entleert wird; und daß der in der Schutzhaut (9) eine
Führungsbuchse (30) für die Schweisslektrode (4)
vorgesehen wird, wobei diese Führungsbuchse
mit einer abgedeckten Elektrode der Schweisslektrode (4)
enthält.

2. Verfahren nach Anspruch 1, dadurch gekenn-
zeichnet, daß vor dem dichten Anpressen der
Schutzhautbe (9) gegen das Element (1) die
Schweisslektrode (4) in der Schutzhaube (9)
angeordnet und in den Innenraum (10) der
Schutzhautbe mit einem geeigneten Medium, vor-
zugsweise Polyurethan oder Schweißflümmittel,
gefüllt wird.

3. Verfahren nach Anspruch 1 oder 2, dadurch
gekennzeichnet, daß die Schweisslektrode (4) im
voraus innerhalb der Schutzhautbe (9) angeordnet
wird, daß die Schutzhautbe (9) permanent an dem
Element (1) befestigt wird und daß die in dem
Element (1) für die Schweisslektrode (4) vorgese-
hene Öffnung (5) mit einem geeigneten Material,
beispielsweise schützendes Kunstharz, verschlos-
enen oder abgedeckt wird.

4. Verfahren nach Anspruch 1, 2 oder 3,
dadurch gekennzeichnet, daß während des
Schweißvorgangs gebildete Gasse aus dem Innen-
raum (10) der Schutzhautbe (9) evakuiert werden.

5. Vorrichtung zur Ausführung einer Unterwas-
er-Schweißverbindung unter Verwendung einer
Schweisslektrode (4) zwischen einem Element (1)
und einer Fläche (2) eines Trägers (3), wobei die
Vorrichtung wenigstens eine in dichter Lagebezie-
hung auf einer freien Oberfläche (8) des Elements
(1) angeordnete Schutzhautbe (9), um die zu
schweißende Verbindung zwischen dem Träger
(3) und dem Element (1) gegen die umgebende
Wassermasse mindestens für die Dauer des
Schweißvorgangs abzusperren, und wenigstens
eine Schweisslektrode (4), die um ihre Längs-
achse dreht sowie sich durch eine Wand (11) der
Haube (9) in abgedeckter Lagebeziehung mit
dieser Wand (11) erstreckt, umfaßt, dadurch
gekennzeichnet, daß sie ferner Antriebsanver-
richtung (22) zum Leiten eines Schweissstromes zu
Schweisslektrode (4) und zum Drehen sowie
Führen der Schweisslektrode (4) gegen die Rän-
der einer sich durch das Element (1) erstrecken-
den und einen Durchgang der Elektrode (4) wäh-
rend des Schweißvorganges ermöglichen Öff-
nung (5) umfaßt; daß eine gegen das Element (1)
angeordnete Stirkante (12) der Schutzhautbe (9)
mit einer Dichtung (13) ausgestattet ist; daß der
Innenraum (10) der Schutzhautbe (9) mit einer
unteratmosphärischen Quelle durch ein Auströ-
morgan (14) in der Wand der Schutzhautbe (9)
verbunden ist; daß die Wand (11) der Schutzhaut-
be (9) mit einem Abströmventil (15), vorzugs-
weise einem bei einem vorbestimmten Druck
öffnenden Druckventil, versehen ist; und daß eine
Führungsbuchse (30) für die Schweisslektrode (4)
in der Schutzhautbe (9) vorhanden ist, wobei die
genannte Führungsbuchse eine Dichtung für den
abgedichteten Eintritt der Schweisslektrode (4)
enthält.

6. Vorrichtung nach Anspruch 5, dadurch
gekennzeichnet, daß die Schutzhautbe (9) perma-
nent am Element (1) befestigt ist.

7. Vorrichtung nach Anspruch 5 oder 6, dadurch
gekennzeichnet, daß der Innenraum (10) der
Schutzhautbe (9) mit einem geeigneten Füllstoff,
vorzugsweise mit Polyurethanschaum oder
einem Schweißflümmittel, gefüllt ist.

8. Vorrichtung nach Anspruch 5, 6 oder 7,
dadurch gekennzeichnet, daß wenigstens ein Teil
der Schweisslektrode (4) innerhalb des Innen-
raumes (10) der Schutzhautbe (9) konisch ausge-
bildet ist, um sich zum Träger (3) hin zu verjü-
gen.

9. Vorrichtung nach Anspruch 5, 6, 7 oder 8,
dadurch gekennzeichnet, daß die Materialdicke
der Schweissmasse (17) in der Schweisslektrode
(4) konstant ist.

10. Vorrichtung nach Anspruch 5, 6, 7, 8 oder 9,
dadurch gekennzeichnet, daß die Antriebsanver-
richtung (23) Greiferen en (24), die denjenigen
Teil der Schweisslektrode (4), der von der Schut-
zhautbe (9) herausragt, erfassen, wie auch eine
Drehvorrichtung (25), die die Schweisslektrode
(4) während des Schweißvorgangs dreht sowie
die genannte Elektrode gegen die Ränder der
Öffnung (5) in dem Element (1) mit einer
Geschwindigkeit drückt, die im wesentlichen der
Abschmelzung der Schweisslektrode (4) ent-
spricht, umfaßt.

11. Vorrichtung nach Anspruch 10, dadurch
gekennzeichnet, daß die Greiferen en (24) aus
hydraulisch bewegbaren Klemmbacken (26, 27)
bestehen.

12. Vorrichtung nach Anspruch 10, dadurch
gekennzeichnet, daß die Drehvorrichtung (25)
eine Hydraulikkraftmaschine, mit der eine Schrauben-
zustellvorrichtung (28) für die Schweisslektrode
(4) und mit zylindrischen Kohlen (29) im Leiten
des Schweissstromes zu der genannten Schweiss-
lektrode ausgestattet ist.

Revendications

1. Procédé pour réaliser sous l’eau un joint de
soudure en utilisant une électrode de soudage (4)
selon laquelle une pièce (1) à souder est aménée
sur la surface (2) d’un substrat (3) auquel elle doit
être soudée, selon laquelle la pièce (1) est placée
sur la surface (2) et selon laquelle une jonction qui
doit être soudée, entre le substrat (3) et la pièce
(1) est isolée de l’eau environnante par mise en
place d’un couvercle de protection (9) de façon
etanche vis à vis de la pièce (1), caractérisé en ce
que pendant l’opération de soudage, l’électrode
de soudage (4) qui tourne autour de son axe
longitudinal est amené contre des rebords d’une
ouverture (5) s’étendant à travers la pièce (1) et
permettant le passage de l’électrode (4) vers le
substrat (3); en ce qu’un élément d’étanchéité (6)
en un matériau souple, de préférence une bague
d'écartement en caoutchouc, est placée entre la pièce (1) et le substrat (3) pour former en espace intermédiaire (7) isolé de la masse d'eau environnante, entre l'élément (1) et le substrat (3): en ce que le couvercle de protection (9), de préférence en forme de coupelle, est pressé contre la surface libre (8) de l'élément (1) amené sur le substrat (3), sur le sommet de la jonction à souder, pour être en relation étanche avec la pièce (1) et isoler à l'intérieur (10) de couvercle de protection (9) la jonction à souder de la masse d'eau environnante; en ce que l'intérieur (10) du couvercle de protection (9) est vidé de l'eau avant l'opération de soudage; et en ce qu'un canon de guidage (30) pour l'électrode de soudage (4) est prévu dans le couvercle de protection (9), ce canon possédant une garniture d'étanchéité pour l'entrée étanche de l'électrode de soudage (4).

2. Procédé selon la revendication 1, caractérisé en ce qu'avant d'appliquer le couvercle de protection (9) de façon étanche contre la pièce (1), l'électrode de soudage (4) est mise en place dans le couvercle de protection (9) et l'intérieur de ce dernier est rempli d'un milieu approprié, de préférence du polyuréthane ou un flux de soudage.

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que l'électrode de soudage (4) est placée par avance dans le couvercle de protection (9), en ce que le couvercle de protection (9) est fixé à demeure à la pièce (1), et en ce que l'ouverture (5) pratiquée dans la pièce (1) pour l'électrode de soudage (4) est fermée ou recouverte par un matériau convenable, par exemple une résine de protection.

4. Procédé selon la revendication 1, 2 ou 3, caractérisé en ce que les gaz formés au cours de l'opération de soudage sont évacués de l'intérieur (10) du couvercle de protection (9).

5. Appareil pour la réalisation d'un joint de soudure sous l'eau entre une pièce (1) et une surface (2) d'un substrat (3), mettant en œuvre une électrode de soudage (4), l'appareil comprenant au moins un couvercle de protection (9) en relation d'étanchéité avec une surface libre (8) de la pièce (1) pour isoler la jonction à souder entre la pièce (1) et le substrat (3) de la masse d'eau environnante, au moins pour la durée de l'opération de soudage, et au moins une électrode de soudage (4) qui tourne autour de son axe longitudinal, et s'étend à travers une paroi (11) du couvercle (9) dans un relèvement étanche avec cette paroi (11), caractérisé en ce que cet appareil comporte en outre un moyen d'alimentation (23) pour amener le courant de soudure à l'électrode de soudage (4) et pour la mise en rotation et l'aménée de l'électrode de soudage (4) contre les rebords d'une ouverture (5) qui s'étend à travers la pièce (1) et permet le passage de l'électrode de soudage (4) pendant l'opération de soudage; en ce qu'un rebord de tête (12) de couvercle de protection (9) placé contre la pièce (1) est pourvu d'une garniture d'étanchéité (13); en ce que l'intérieur (10) du couvercle de protection (9) est en communication avec une source de dépression par l'intermédiaire d'un élément d'écoulement (14) dans la paroi (11) du couvercle de protection (9) ; en ce que la paroi (11) du couvercle de protection (9) est munie d'un élément d'écoulement (15), de préférence une soupape de compression s'ouvrant à une pression prédéterminée; et en ce qu'un canon de guidage (30) pour l'électrode de soudage (4) est prévu dans le couvercle de protection (9), ce canon possédant un joint pour l'entrée étanche de l'électrode de soudage (4).

6. Appareil selon la revendication 5, caractérisé en ce que le couvercle de protection (9) est fixé à demeure sur la pièce (1).

7. Appareil selon la revendication 5 ou 6, caractérisé en ce que l'intérieur (10) du couvercle de protection (9) est rempli d'un matériau de remplissage convenable, de préférence une mousse de polyuréthane ou un flux de soudage.

8. Appareil selon la revendication 5, 6 ou 7, caractérisé en ce qu'au moins une partie de l'électrode de soudage (4) à l'intérieur (10) du couvercle de protection (9) est de forme conique dont la pointe est dirigée vers le substrat (3).

9. Appareil selon la revendication 5, 6, 7 ou 8, caractérisé en ce que l'épaisseur du matériau de la matière à souder (17) dans l'électrode de soudage (4) est constante.

10. Appareil selon la revendication 5, 6, 7, 8 ou 9, caractérisé en ce que le moyen d'entraînement (23) comporte un moyen de saisie (24) pincant la partie de l'électrode de soudage (4), qui dépasse du couvercle de protection (9) ainsi qu'un moyen de rotation (25) faisant tourner l'électrode de soudage (4) pendant l'opération de soudage et poussant cette électrode contre les rebords du trou (5) dans la pièce (1) à une vitesse correspondant sensiblement à la consommation de l'électrode de soudage (4).

11. Appareil selon la revendication 10, caractérisé en ce que le moyen de saisie (24) est constitué de mors déplaçables hydrauliquement (26, 27).

12. Appareil selon la revendication 10, caractérisé en ce que le moyen de mise en rotation (25) est un moteur hydraulique équipé d'un extracteur à vis (28) pour l'électrode de soudage (4) et de charbons conducteurs du courant (29) pour conduire le courant de soudage à l'électrode de soudage (4).