

PATENT SPECIFICATION

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(54) METHODS OF ARC WELDING IN A SUPERATMOSPHERIC ENVIRONMENT

(71) We, BOC LIMITED, of Hammer-smith House, London W6 9DX, England, an English company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to a method of arc welding in a chamber where there is a gaseous environment at superatmospheric pressure. The method is particularly intended for use under water. In particular it relates to an improvement in or modification of the invention according to our Cognate co-pending applications nos 9245/76, 53715/76 (Serial No 1539917).

Our co-pending Cognate applications nos 9245/76, 53715/76 (Serial No 1539917) describe a method of arc welding in a chamber in which there is gaseous environment at superatmospheric pressure, in which method weld metal is deposited from a consumable, flux-cored arc-welding wire containing at least one strong deoxidiser (as hereinafter defined) and in which method the arc struck between the welding wire and the work to be welded is shielded by a gas mixture comprising at least one inert gas (as hereinafter defined), and one or both of oxygen and an oxygen-containing gas which under the action of the arc decomposes to liberate oxygen or which reacts with the strong deoxidiser(s). By making possible the creation of correctly balanced chemical conditions at the arc/molten pool, the proportion of oxygen or oxygen-containing gas (or both) in the shielding gas produces sound welds despite any deleterious effect that the superatmosphere pressure might have on the metallurgical and mechanical properties of the weld metal.

Our co-pending Cognate applications nos 9245/76, 53715/76 (Serial No 1539917) de-

scribe using a shielding gas mixture containing from 1 to 4.2% by volume of oxygen at 5 bars. We have found that shielding gas mixtures containing from 1% to 6% by volume of oxygen are suitable for use in the method according to our Cognate co-pending applications nos. 9245/76, 53715/76 (Serial No 1539917) at pressures up to at least 20 bars when the shielding gas is provided as a moving stream surrounding the welding wire as it emerges from the welding torch. Indeed, such relatively large proportions of oxygen improves the wetting of the work being welded by the pool of molten weld metal.

According to the present invention, a method of arc welding in a chamber in which the pressure is greater than 3 bars, comprises the step of depositing weld metal from a consumable, flux-cored arc welding wire containing at least one strong deoxidiser (as hereinafter defined), the arc struck between the welding wire and the work to be welded being shielded by an annular stream of shielding gas comprising from 1% to 6% by volume of oxygen and a balance of at least one inert gas (as hereinafter defined).

The term "strong deoxidiser" is used herein to indicate a metal whose reaction with oxygen is considerably more exothermic than that between iron and oxygen. For the avoidance of doubt, manganese and silicon although used extensively in welding electrodes as deoxidisers are not classified herein as "strong deoxidisers". The following metals are classified herein as strong deoxidisers; magnesium, aluminium, zirconium, titanium, barium and lithium.

Metals such as calcium are, theoretically speaking, suitable for use as "strong deoxidisers" but tend to react so readily and so violently with oxygen or moisture that the difficulties in storing them, handling 90

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them, and manufacturing an electrode incorporating them, renders their use as "strong deoxidisers" either hazardous or inconvenient or both. For some metals, for example calcium, it has been alleged that some of the difficulties mentioned in the preceding sentence may be reduced by forming an alloy of the metal with, typically, iron.

10 Preferred strong deoxidisers are aluminium and magnesium.

Flux-cored welding wires containing strong deoxidisers are commercially available and may be used. It is notable that such welding wires containing strong deoxidisers are, we believe, examples of the class of welding electrodes termed "self-shielding" or "in-air" welding electrodes. Although it has been proposed to use "strong deoxidisers" in flux-cored welding wires we believe that no such welding wire has hitherto been used with an externally supplied shielding gas. It may thus be said that the method according to the present invention makes use of welding wires of the "self-shielding" or "in-air" type with an externally-supplied shielding gas.

Preferred electrodes for use in conjunction with the method defined hereinbefore are sold under the registered trade mark "Innershield". Innershield 203M and Innershield 203 Ni electrodes are particularly suitable for use in the method.

Self-shielding electrodes sold under the trade mark "Fabshield" are also suitable. However, it is possible to make up a flux-cored electrode especially for use in the method hereinbefore defined.

Such an electrode could be unsuitable

for arc welding without an external shielding gas at atmospheric pressure.

By the term "inert gas" as used herein is meant a gas which does not react chemically with any constituent of the welding wire and does not adversely affect the metallurgical properties of the weld metal. The preferred inert gas is argon. Helium may, however, be used as an inert gas in addition to, or instead of, argon, though this is not preferred. Also one or more "noble" gases such as Krypton and Xenon may if desired be used instead of or in addition to argon or helium.

WHAT WE CLAIM IS:—

1. A method of arc welding in a chamber having a gaseous environment in which the pressure is greater than 3 bars comprising the step of depositing weld metal from a consumable flux-cored arc welding wire containing at least one strong deoxidiser as hereinbefore defined, the arc struck between the welding wire and the work to be welded being shielded by an annular stream of shielding gas comprising from 1% to 6% by volume of oxygen and a balance of at least one inert gas as hereinbefore defined.

2. A method as claimed in claim 1, in which the pressure in the chamber is up to 20 bars.

3. A method of arc welding in a chamber having a gaseous environment in which the pressure is greater than 3 bars substantially as hereinbefore described.

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