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WELDING

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The invention relates to rods or the like for metal-depositing operations, such as fusion welding. Rods prepared in accordance with the invention may be used in either the arc process or the blowpipe process.

The difficulty most often encountered in fusion welding is in depositing the metal in a clean and homogeneous condition and in securing a firm bond with the metal on which the deposit is made. It is sometimes desirable to add to the metal as it is deposited a constituent not already present, or to increase the content of a constituent already present, but as a general rule it is preferable to produce a rod of such composition that the introduction of elements during the welding operation will be unnecessary. Successful welding then becomes merely a question of depositing the metal in suitable physical condition and of preventing or controlling the loss of constituents therefrom, as by oxidation, while the metal is molten.

According to the present invention, the welding rod or the like is provided with a coating partially or completely enclosing it, the composition of the coating being such that a slag of molten manganese silicate will be formed during the welding or other depositing operation. The addition to the deposited metal of chemical elements present in the coating is not precluded, and in general will occur, at least to a small extent, but the principal purpose of the coating is to produce a slag blanket which will prevent or diminish the loss of chemical elements from the deposited metal, prevent or diminish absorption by the metal of atmospheric and combustion gases, and promote the deposition of the metal in a clean, sound, and homogeneous condition without unduly taxing the skill of the welder.

In addition to the primary object of providing a blanket of molten manganese silicate I may also provide auxiliary slag constituents efficacious in dissolving oxidation products formed from the deposited metal, and in some cases I may also incorporate in the coating reducing and degasifying agents to counteract the effect of gases which, in spite of the slag blanket already referred to, come into contact with the molten metal.

The invention may be embodied in a rod having a coating of manganese silicate applied thereto in any suitable way as by powdering it, mixing the powder with a binder such as dilute alcoholic shellac, immersing the rod in the mixture, and then withdrawing the rod and allowing the adherent material to harden. The manganese silicate may more or less closely approach the composition represented by the formula $MnO.SiO_2$, but an excess of either manganese oxide or silica may be present.

Instead of preformed manganese silicate the coating may contain material adapted to react at the temperature of the metal-depositing operation to produce manganese silicate. This is the preferred form of the invention as it permits one operation to be dispensed with. The coating may contain for example an oxide ore of manganese and any finely divided form of silica. As in the case of the preformed silicate the proportions may be such that $MnO.SiO_2$ or a more basic or acidic silicate will be formed.

Under some conditions it is desirable to replace the manganese oxide with a composition containing manganese in unoxidized condition, such as manganese metal or a manganese alloy. The greater portion of the manganese present in the coating will usually be oxidized during the depositing operation and the oxide formed will be immediately available for the formation of manganese silicate. Unoxidized manganese when present in the coating produces a strongly deoxidizing condition to which the molten metal is subjected and this favors the deposition of sound metal.

Likewise the silica may be replaced by unoxidized silicon, either as commercially pure elemental silicon or as a silicon alloy. Silicon, as is well known, is a powerful deoxidizing agent, and its oxidation product (silica) will combine with any manganese oxide present to form the desired silicate.

I prefer to have manganese present in the coating in both oxidized and unoxidized form, and also prefer to have both unoxidized

silicon and silica. Desirable reducing conditions are thus established while a blanket of manganese silicate slag is produced more promptly and abundantly than when preformed manganese oxide and silica, or their equivalent, are absent. By having both manganese and silicon present in unoxidized form the reducing conditions referred to may be maintained without disturbing the balance between manganese oxide and silica. If only one of these elements were present in unoxidized form it will be apparent that the proportion of its oxide present would increase as the oxidation of the element in situ progressed. An advantageous proportion of silicon to manganese in the unoxidized portion of the coating material is about one weight to three.

The unoxidized manganese and silicon can be supplied as a single alloy which may contain in addition to these elements any others which are desirable or harmless. For example an alloy of manganese, silicon, and magnesium may be used, the powerful degasifying action of magnesium being thus brought into play.

It is sometimes desirable to add to the coating an auxiliary flux. Borosilicate glass, for example, is in the molten condition an active solvent for oxides which may be formed from the deposited metal during welding. It takes up chromium oxide with great avidity and is found to be a valuable addition to the coating of a chrome-iron welding rod. Sodium borosilicate glass may be made by fusing borax with silica. Two weights of crystallized borax to one of silica gives a good glass, but the proportions may be varied in either direction. Instead of using a preformed glass, borax, preferably previously dehydrated, and silica may be added to the coating, as the heat of the welding operation will bring about a reaction between them.

Example I

In a specific experiment low carbon steel rods containing not more than 0.10% carbon and not more than 0.15% manganese were coated with a mixture constituted as follows:

Material	Parts by weight
Manganese ore	35
Silica flour	20
Ferromanganese	27
Ferrosilicon	8

The manganese ore contained the equivalent of 73% MnO and 4% SiO_2. The manganese alloy contained 84% Mn and the silicon alloy contained 92% Si. The whole mixture was so proportioned that MnO and SiO_2 were present about as required by the formula $MnO.SiO_2$, and the proportion of unoxidized manganese to unoxidized silicon was about three to one. The rods were used in making oxy-acetylene welds of the single V type. No difficulty was experienced in the welding operation. The average tensile strength of the welds was about 55000 pounds per square inch whereas 45000–47000 per square inch is considered average strength for welds made in the same way with uncoated rods of the same composition. The weld metal had a manganese content of 0.23%.

Example II

In another experiment standard steel electrodes were coated with the mixture described above and used for making welds electrically. The strength and ductility of the welds were decidedly better than when the same electrodes were used without the coating.

Example III

Chrome-iron wires one-eighth inch in diameter and containing 26% chromium were coated with a large variety of mixtures falling within the present invention and tested on electrical welding using 100 amperes at 60 volts. The results were very satisfactory. Excellent results were given by wires coated with the following mixture:

Material	Parts by weight
Manganese ore	35
Silica	20
Mn-Si alloy	35

The manganese ore had the composition given under Example I. The manganese-silicon alloy contained Mn 58%, Si 18%.

Example IV

The procedure of Example III was repeated using the coating mixture of Example I. The results were as satisfactory as in Example III.

Exampe V

The procedure of Example III was repeated using a coating containing equal parts of silica flour, sodium borosilicate glass and a manganese-magnesium-silicon alloy. The glass was made by fusing two weights of crystallized borax with one weight of silica. The alloy had approximately the following composition:

	Per cent
Magnesium	8.5
Manganese	46.3
Silicon	32.8
Iron	7.0
Carbon	0.4

The results were satisfactory but inferior to those of Examples III and IV.

Example VI

The procedure of Example III was repeated using a coating containing:

	Parts
Silica flour	90
Mg-Mn-Si alloy	10

The alloy was the same as in Example V and the results were of the same kind as those obtained in Example V.

The foregoing description refers specifically to rods or electrodes having an external coating of slag-forming materials. A hollow rod containing the slag-forming materials as a core is the equivalent of the externally coated article, and may be regarded as an internally coated rod. The appended claim is intended to embrace all rods or the like wherein an elongated metal member and an elongated body of slag-forming material are so juxtaposed that additional slag or flux is automatically supplied as the extremity of the metal member is fused away.

The compositions described herein for coating welding rods or electrodes can also be used, though usually not so advantageously, in forms other than a coating or core. They may, for example, be used in the form of powder into which the hot rod or electrode may be dipped, or they may be applied to the weld in any other suitable way. The use in welding of the compositions claimed in the appended claim is included in my invention, whether or not the composition is applied to the rod as a coating.

This application is a continuation-in-part of an application filed by me on September 22, 1925, Serial No. 57,944.

I claim:

The process of welding ferrous metals which comprises fusing the metal and depositing the same under a molten slag containing manganese silicate, and introducing into said fused slag an unoxidized element of said silicate at such a rate that the deposited metal is effectually degasified and the fluidity of the slag is not destroyed.

In testimony whereof, I affix my signature.

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