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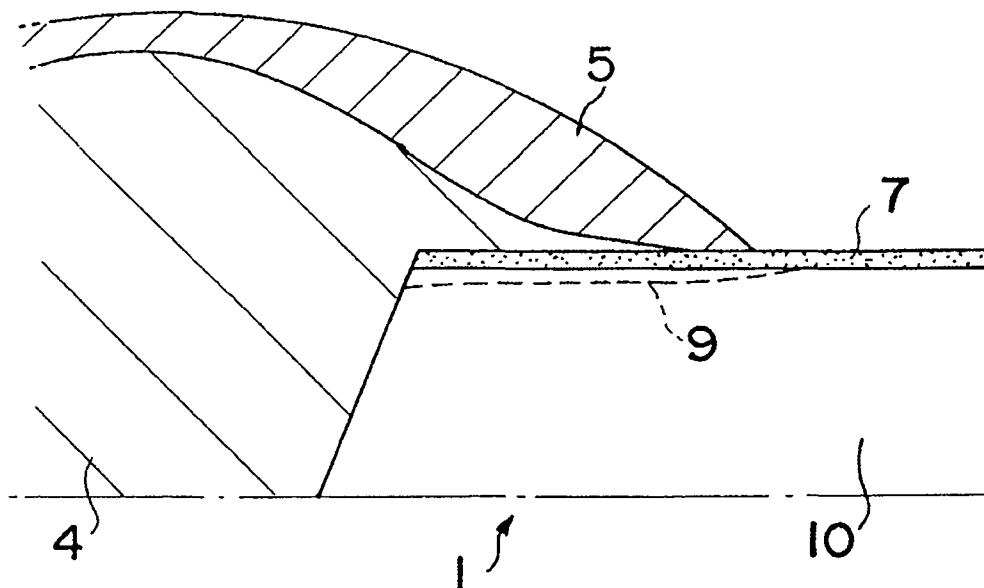
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(54) Title: THERMITE WELDING LUG



(57) Abstract: A lug used for thermite welding, characterized in that a metal to be dispersed into a molten metal of the thermite is coated onto at least a surface of an iron lug that contacts the molten metal. Since the molten metal and coated metal disperse during thermite welding, they enter the surface of the iron lug to form a solid solution, thus increasing the area of fusion.

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THERMITE WELDING LUG

5 TECHNICAL FIELD

The present invention relates to a lug used in thermite welding and a thermite welding method using said lug, more specifically to a lug capable of improving the welding strength between the lug and a metal to be thermite welded, and a welding method using said lug.

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BACKGROUND ART

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Thermite welding is a welding technique in which a mixed powder of aluminum and copper oxide (or iron oxide) is ignited and burned near the surface of a base metal, wherein the heat generated by the chemical reaction causes the copper (or iron) and a portion of the base metal to melt and fuse together. This welding technique is particularly often used in the field of railroads, such as to electrically connect separated railway rails by weld together a cable formed by attaching copper lugs on both ends of a cable consisting of copper or the like known as a bonding cable with the surface of a railway rail by means of a welded portion composed of thermite material.

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The thermite welding method consists specifically in the following. First, the above mixed powder forming the thermite material is loaded into a crucible together with an ignition material, then a connecting cable is placed on a welding portion on the surface of a railway rail. The ignition material is ignited to induce combustion in the crucible, thus melting the copper (or iron), and the melted copper (or iron) is directed to the welding portion. Finally, the molten copper (or iron) is cooled, upon which a welded portion with an external shape that is the same as the inside of the welding portion is fused to the railway rail in such a manner that it covers a portion of the connecting cable.

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Conventionally, when electrically joining railway rails by means of bonding cables, the bonding cables are copper, so it is customary to use copper welding lugs to connect the bonding cables. The step of attaching the welding lug to a bonding cable

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is performed by inserting a bonding cable into a sleeve portion formed on the end of the welding lug and crimping the sleeve portion. However, while copper has the property of being highly ductile and malleable and is therefore capable of being easily crimped or molded, stresses can reside in the crimped portions where the bonding cable has been crimped, and for example, after thermite welding on railway rails, the crimped portions may be cracked or damaged by vibrations generated by the passage of trains. Therefore, the use of iron lugs instead of copper lugs has been tried in recent years in order to achieve sufficient strength as not to cause cracks or damage due to vibrations even if there are stresses due to crimping. A conventional method is described in JP 2005-14008A.

Fig. 3 is a top view of an iron lug 10 having a conductor cable 2 inserted inside and electrically connected, welded with copper thermite. During thermite welding, the molten copper of the thermite material, upon being poured, normally flows from a central portion toward the outside so as to cover the iron lug 10, and the welded portion 3 is formed by cooling and hardening from the boundary surface with the iron lug 10. During the process of forming the welded portion 3, the molten copper 4 flows to cover the iron lug 10, and includes an area on the boundary surface which is fused by the heat of welding in a dispersed, solid solution state. The peripheral area 5 of the welded portion 3 is the area where hardening began before the flow of the molten copper 4 was completed, and the area indicated by the boundary surface 6 is not fused with the iron lug 10. Therefore, the welded portion 3 has areas that are not fused with the iron lug 10, so that the fused area is not adequate, thus causing problems in terms of the welding strength.

DISCLOSURE OF THE INVENTION

In order to solve the above problems, the present invention has the purpose of offering an iron lug that increases the fused area between the iron lug and the molten copper of the thermite material by thermite welding after pre-coating the iron lug with a metal, thus improving the welding strength, and a thermite welding method using said iron lug.

(1) In order to achieve the above purpose, the lug for thermite welding of the present is such that a metal to be dispersed into a molten metal of the thermite is

coated onto at least a surface of an iron lug that contacts the molten metal.

(2) Furthermore, in order to achieve the above purpose, the metal to be coated onto the lug for thermite welding of the present invention is preferably copper or nickel.

5 (3) Furthermore, in order to achieve the above purpose, the thermite welding method of the present invention comprises a step of coating a surface of an iron lug with a metal to be dispersed into a molten metal of a thermite material, a step of positioning the coated lug at a predetermined welding position, and a step of allowing molten metal of the thermite material to flow into a welding position for dispersing the
10 molten metal of the thermite material and the coated metal to form a fused portion between the molten metal of the thermite material and the iron lug.

(1) The lug of the present invention is such that the metal dispersed in the molten metal of the thermite material is coated onto at least the surface of the iron lug contacting the molten metal, so the pre-coated metal and the molten metal disperse
15 due to the heat of welding and widely disperse into the surface of the iron lug at the time of thermite welding to form a solid solution, as a result of which the welding strength can be improved by the formation of a wide welding area as compared with the case where thermite welding with an iron lug is performed without a coating.

(2) In the lug according to one embodiment of the present invention, the coated
20 metal is copper or nickel, which have good affinity with the copper in the thermite material in terms of their melting points and the like, thus being easily dispersed and promoting solid solution into the iron lug, and improving the welding strength.

(3) The thermite welding method according to another embodiment of the present invention comprises a step of coating the surface of the iron lug with a metal
25 that disperses in the molten metal of the thermite material, so as in paragraph (1), the pre-coated metal and the molten metal disperse due to the heat of welding and widely disperse into the surface of the iron lug at the time of thermite welding to form a solid solution, as a result of which the welding strength can be improved by the formation of a wide welding area as compared with the case where thermite welding with an iron
30 lug is performed without a coating.

BRIEF DESCRIPTION OF THE DRAWINGS

[Fig. 1] Fig. 1 is a cross section of a lug according to the present invention.

[Fig. 2] Fig. 2 shows the state of dispersion and solid solution between the lug of the present invention and the molten metal which is the thermite material.

5 [Fig. 3] Fig. 3 is a top view showing copper thermite welding of a conventional iron lug.

BEST MODES FOR CARRYING OUT THE INVENTION

10 An example of a preferred embodiment of the present invention shall be explained below with reference to the drawings. In the drawings, the same constituents shall be designated by the same reference numbers, and their explanations shall be skipped where appropriate.

Example 1

15 Fig. 1 shows a cross section of a lug 1 for thermite welding according to the present invention. This lug 1 has a base portion 10 composed of iron, and has a hole 8 into which a bonding cable consisting of copper or the like can be inserted. Furthermore, a metallic film 7 is formed on the surface of the iron base portion 10 of the lug. The metallic film 7 is chosen from among metals that are compatible with the molten metal of the thermite material and are easily dispersed by the heat of welding,
20 and is preferably chosen from copper or nickel for copper thermite welding.

If the metallic film 7 is copper, then the copper metallic film 7 can be formed on the surface of the iron lug base portion 10 by means of copper cyanide plating. That is, the lug base portion 10 is electroplated in a cyanide bath, thus plating the surface of the iron lug base portion 10 with copper with an extremely high degree of
25 contact.

On the other hand, the coating can also be achieved by non-electric plating or by melt-plating.

The bonding cable 2 is connected in contact with the inner surface of the hole 8 of the lug 1 so as to retain electrical contact, such as by molding after insertion into
30 the lug 1.

Next, as for the thermite welding method, the surface of the iron lug base portion 10 is coated with a metallic film of copper or nickel, then the lug 1 is held in

place at a designated welding position such as on the surface of a railway rail, and a molten metal of a thermite material is allowed to flow in to form a welded portion.

Fig. 2 shows an example of thermite welding similar to that of Fig. 3, after coating the metal iron lug base portion 10 with a metallic coating 7, enlarged at the portion indicated as the boundary surface 6 in Fig. 3.

When thermite welding is performed using the lug 1 of the present invention, the molten metal 4 of the thermite material flows so as to cover a portion of the surface of the lug 1, and is dispersed by the heat of welding with the metal 7 pre-coated onto the iron lug base portion 10. Then, the molten metal 4 enters into the boundary surface between the coated metal 7 and the iron lug base portion 10 to the position indicated by the dashed line designated by the reference number 9, where it fuses with the lug 1. As a result, the area of fusion of the welded portion 3 on the boundary surface between the molten metal 4 and the iron lug base portion 10 increases, as a result of which the welding strength is improved.

CLAIMS

1. A lug used for thermite welding, characterized in that a metal to be dispersed into a molten metal of the thermite is coated onto at least a surface of an iron lug that contacts the molten metal.

2. A lug as recited in claim 1, characterized in that the coated metal is copper or nickel.

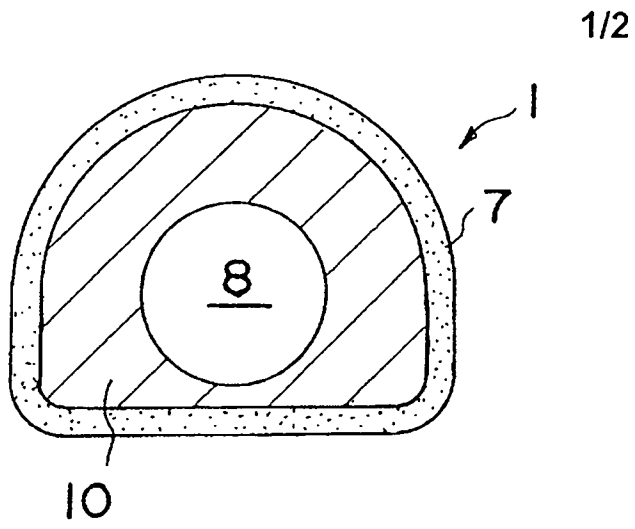


FIG. 1

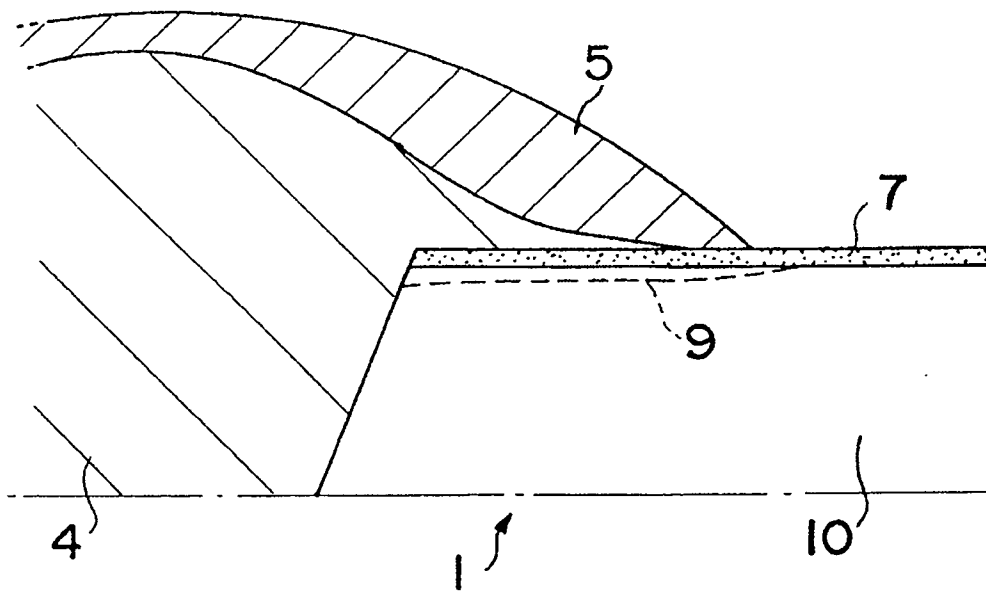


FIG. 2

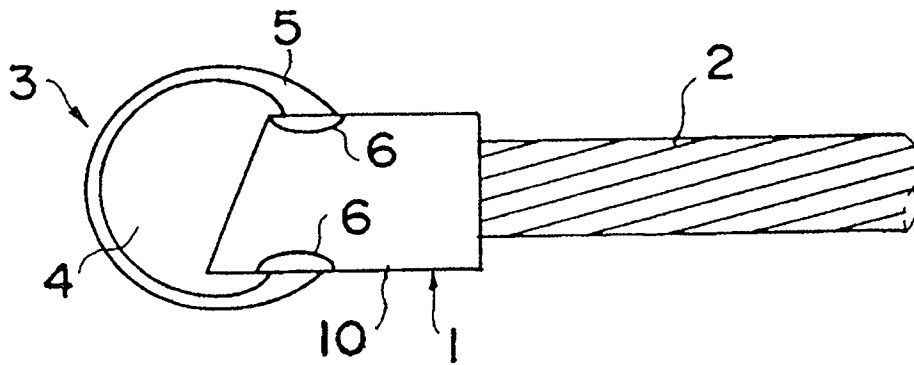


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/006774

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B23K23/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 B23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005 014008 A (FCI ASIA TECHNOLOGY PTE LTD) 20 January 2005 (2005-01-20) cited in the application abstract	1,2
Y	GB 116 657 A (KOHLER CONRAD [CH]) 20 June 1918 (1918-06-20) the whole document	1,2



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2007/006774

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2005014008	A	20-01-2005	NONE	
GB 116657	A	20-06-1918	NONE	