PATENT SPECIFICATION

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(One Complete Specification Left under Section 91 (2) of the Patents and Designs Acts, 1907 to 1932).

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COMPLETE SPECIFICATION

An Improved Electric Welding Composition

We, UNION CARBIDE AND CARBON RESEARCH LABORATORIES, INC., of 30, East 42nd Street, New York, State of New York, United States of America, a corporation organized and existing under the laws of the State of New York aforesaid, (Assignees of LLOYD THEODORE JONES, HARRY EDWARD KENNEDY and MAYNARD ARTHUR ROTERMUND, all of 105, Tunnel Road, Berkeley, Alameda, California, United States of America, and all Citizens of the United States of America) do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an improved electric welding composition.

Among the various ways in which electrical energy has been converted into heat for the welding of metals, the arc process (which itself takes several forms) is the most generally practised. A typical example of arc-welding is its use to join the abutting edges of steel plates. In the metal-arc variation of the arc process, molten metal, provided by the melting of a metal wire or rod of suitable composition, is introduced between the abutting edges of the plates, and the latter are fused sufficiently to permit the added metal to coalesce with the metal of the plates, so that, on cooling, a structurally strong bond results. The requisite heat is developed, as the term "arc process" implies, by maintaining either a direct current or an alternating arc between the parts to be welded, connected to one side of the power line, and the wire or rod used to supply the molten metal, connected to the other side of the power line. The abutting plate edges are usually bevelled to form a trough for receiving the molten metal, thereby facilitating coalescence of the added metal with the plates throughout the thickness of the latter.

In metal-arc welding it is customary to protect the freshly deposited molten metal with a blanket of molten metal compounds (usually compounds of the alkali or alkaline earth metals), and the material used for forming this blanket is called the "flux". The usual method of providing a flux blanket on the weld is to encase the welding rod or wire (usually referred to as the electrode) in an adherent sheath of solid flux, and this gives rise to further difficulties. The sheath is fragile as a rule and is, moreover, non-conductive when cold, so that electrical connection must be made with the electrode at points bared for that purpose, and at variable distances from the weld, thereby imposing an additional burden on the automatic regulating devices used in machine welding.

In our Applications Nos. 5619/34 and 5620/34 (Serial No. 433,723), from which these Applications are divided out, we claim a process for depositing molten metal from a metal electrode on to a metallic body, and particularly a process for electric welding, which comprises depositing on said body a mass of unbonded, finely-divided material which is electrically conductive when molten, is composed chiefly of fusible silicates, and contains no substantial amount of uncombined iron oxide or of substances which would evolve deleterious amounts of gas during welding; contacting, and preferably submerging, an end of said electrode in said mass; melting a portion of said mass near said electrode to increase the electrical conductivity of said portion; and generating welding heat by passing an electric current from said electrode through said mass to said body.

The present invention consists of an electric welding composition comprising finely-divided unbonded material which consists principally of one or more fusible silicates amounting to about 75% to 99% of the composition, the balance comprising substantial amounts of a halide such as an alkaline earth metal fluoride and/or alumina, and the composition being substantially free from uncombined iron oxide and from substances which would

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evolve deleterious amounts of gas during welding. The said material is preferably substantially anhydrous and its electrical conductivity increases as its temperature is increased. A major proportion of the fusible silicate or silicates may consist of one or more alkaline earth metal (including magnesium) silicates, and the substance constituting the remainder of the composition comprises a small proportion of a halide such as an alkaline earth metal fluoride, and/or a small proportion of alumina (about 1—8%).

The conductive melt formed by our resistive composition doubtless performs the protective functions of a flux, but it is much more than a flux, viz. an electric resistance of desired properties, and many compositions which are satisfactory fluxes for arc welding are unsuitable for our process according to Applications Nos. 5619/34 and 5620/34 (Serial No. 433,723).

We have had excellent results with a material comprising mainly a silicate corresponding closely to the composition represented by the formula $RO.SiO_2$ where R stands for calcium or magnesium but silicates which are more acid or more basic are also suitable. We have also used manganese silicates, especially in conjunction with other silicates. The calcium and magnesium silicates are cheap and entirely satisfactory. When more fluidity is desired, the more acid silicates may be used, but we prefer to control the fluidity by additions of a halide salt, such as an alkaline earth metal halide, especially fluorspar. Good results have been obtained by adding about 5% of alumina and about 6% of fluorspar to an alkaline earth metal silicate or silicates; the composition may then comprise calcium silicate, magnesium silicate, calcium fluoride and moderate amounts of alumina, wherein the calcium silicate is present in predominant proportion. Also moderate amounts of boron-compounds such as borax or boric acid, and of iron silicates may be present.

In a specific instance we fused together 50 pounds of calcium carbonate, 9.4 pounds of magnesium oxide, and 40.5 pounds of silica until the reaction was complete. The materials used were of the purest quality used in the ceramic industries. The fused material was cooled and granulated, and to each pound, one ounce of fluorspar was added. The material was then ready for use.

When a weld is to be made between bevelled edges the operation is started by filling the groove with the resistive composition, preferably in powdered or granular form, and a suitable additional quantity of the composition is heaped up along the groove. If the plates are not bevelled the procedure is the same, except that a larger proportion of the composition will usually be above the upper surface of the plates, that is, outside of the seam itself.

The material placed in and on the groove is substantially stable at the welding temperature in the sense that it does not evolve detrimental volumes of gases when brought to that temperature. Thus, if, instead of preformed calcium silicate, a mere mechanical mixture of calcium carbonate and silica were placed in the groove and the weld started, carbon dioxide would be evolved from the calcium carbonate, the development of a conductive melt would be delayed and made irregular, and the finished welding seam would be rendered porous. The resistive composition should also be substantially anhydrous. After the weld is finished, the resistive composition can be collected and reused, any volatile constituents lost, such as halides, being of course replaced.

Our resistive composition gives, in general, a satisfactory degree of "penetration", or melting of the members onto which the deposit is being made. If it is desired to vary the degree of penetration, some control of this feature can be achieved by varying the fusibility and conductivity of the resistive composition. As an example of the possibilities in this direction it may be remarked that fluorspar additions to the silicate compositions often serve to diminish the penetration from an otherwise objectionably high degree. While the effect of the fluorspar appears to be merely to increase the fusibility, it may be much more complex, and we do not restrict ourselves to any particular theory of operation.

Constituents may be added which more or less vary the conductivity or temperature-resistance characteristic of the mass, and such constituents may be neutral or react or alloy with the molten metal. However, chemical reactions between constituents of the mass are substantially completed before the mass is used in welding in order to avoid the presence of substances (such as calcium carbonate) which would cause the evolution of detrimental volumes of gases during welding. Furthermore, it is obvious that variations may be made in the particular proportions and nature of the constituents used in the mass, within the scope of the appended claims with consequent change in the melting point, electric, conductivity and fluidity of the fused mass.

Having now particularly described and

ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

(1) An improved electric welding composition comprising finely-divided unbonded material which consists principally of one or more fusible silicates amounting to about 75% to 99% of the composition, the balance comprising substantial amounts of a halide such as an alkaline earth metal fluoride, and the composition being substantially free from uncombined iron oxide and from substances which would evolve deleterious amounts of gas during welding.

(2) An improved electric welding composition, comprising finely-divided unbonded material which consists principally of one or more fusible silicates amounting to about 75% to 99% of the composition, the balance comprising substantial amounts of alumina, and the composition being substantially free from uncombined iron oxide and from substances which would evolve deleterious amounts of gas during welding.

(3) An improved electric welding composition, comprising finely-divided unbonded material which consists principally of one or more fusible silicates amounting to about 75% to 99% of the composition, the balance comprising substantial amounts of a halide such as an alkaline earth metal fluoride, together with alumina, and the composition being substantially free from uncombined iron oxide and from substances which would evolve deleterious amounts of gas during welding.

(4) An electric welding composition, according to claim 1, 2 or 3, in which said material is substantially anhydrous.

(5) An electric welding composition according to claim 1, 2 or 3, in which a major proportion of the fusible silicate or silicates consists of one or more alkaline earth metal silicates.

(6) An electric welding composition according to claim 3, in which said material comprises calcium silicate, magnesium silicate, calcium fluoride and alumina, said calcium silicate being present in predominant proportion.

(7) An improved electric welding composition substantially as herein described.

Dated the 10th day of May, 1935.

For the Applicants,
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