April 29, 1930. A. G. CRUM 1,756,054

PROCESS OF WELDING

Filed Feb. 12, 1927

Fig. 1

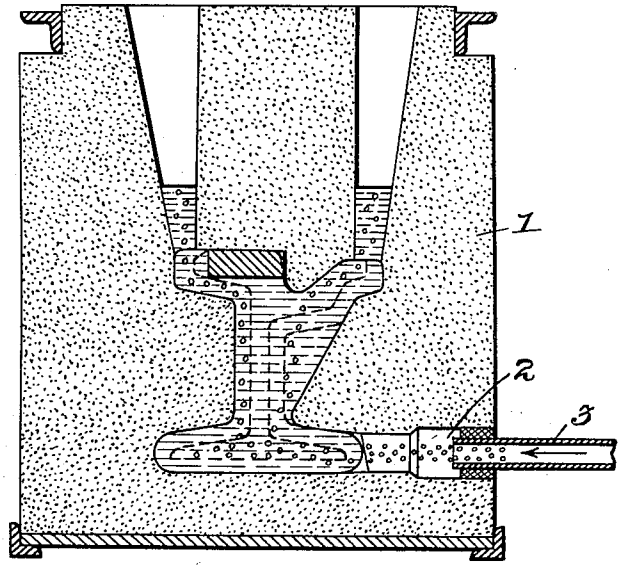
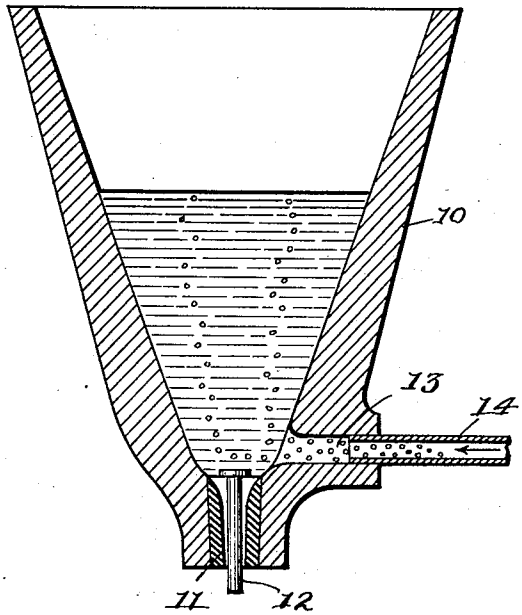


Fig. 2



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UNITED STATES PATENT OFFICE

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PROCESS OF WELDING

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The invention relates to the superheating of metal to be used in various applications, more particularly for effecting the welding of metal parts usually enclosed in a mold, as, for example, the formation of welded rail joints. To this end, the method comprises the superheating of molten metal by passing into and through the molten mass a gas which reacts exothermically with the metal or with the impurities therein, the molten metal, which is thereby brought to a degree of substantial and material superheat, when applied to welding operations, engages with the parts to be welded, as, for example, by teeming the superheated molten metal into a mold enclosing the parts to be welded, or, in the alternative, the molten metal may be first teemed or poured into the mold enclosing the parts to be welded and the molten metal brought to the desired degree of superheat by passing a gas of the character indicated into the mold and into the molten metal therein.

Means for carrying out the invention are shown in the accompanying drawings, in which:—

Fig. 1 is a transverse sectional elevation of a mold for welding railway rails, provided with means for supplying the gas to the molten metal within the mold.

Fig. 2 is a sectional elevation of a crucible provided with a gas supply inlet.

In carrying out the invention, metal, such as steel or iron, is preliminarily melted in any suitable apparatus, after which the molten mass is brought to the desired degree of superheat by passing into the mass a gas which will react exothermically either with the metal or the impurities therein; in the case of steel or iron, the preferred gas being oxygen or chlorine, which is supplied to the molten bath in sufficient quantities to effect the desired degree of superheat. Under certain circumstances, it may be found desirable to add to the molten bath, before the latter is superheated, certain impurities, such as manganese, carbon, silicon, aluminum, etc. which readily combine with the particular gas used to effect the superheating, the reaction between the gas and the impurities producing a large element of the superheating effect and thereby saving or conserving the portions of iron or steel which would otherwise be burned with the gases.

In utilizing the highly superheated molten metal, such as iron or steel, for effecting the welding of metal parts, such as the ends of railway rails, the parts to be welded are enclosed in a mold of the usual character and the molten metal brought into intimate contact with the enclosed parts. This latter operation may be effected by superheating the molten iron or steel in a crucible or other suitable receptacle, by providing the same with a nozzle, preferably located near the lower portion of the crucible or receptacle, through which oxygen or other suitable gas is injected into the molten metal until the desired degree of superheat is reached, after which the highly superheated molten metal is poured or teemed into the mold, where it effects the welding of the metal parts in the usual manner. In the alternative, the molten metal may be first teemed or poured into the mold containing the parts to be welded, which mold is provided with a nozzle near its bottom, through which the oxygen or other suitable gas is injected into the molten metal in the mold, thereby quickly raising the metal to the necessary degree of superheat to effect the welding of the parts within the mold.

In Fig. 1, there is shown a typical mold 1 enclosing the ends of the rails to be welded, the mold cavity being substantially filled with molten metal, which is brought to the necessary degree of superheat, within the mold, to effect the welding, by a suitable gas introduced into the body of the molten metal by way of an inlet passage 2 formed in the mold, which connects with a pipe 3 leading to a supply of the gas.

The apparatus shown in Fig. 2 is a crucible 10, such as commonly employed in the alumino-thermic process, having a pouring vent 11 in its bottom, controlled by a displaceable valve or stopper 12, which may be knocked out of position by a blow delivered from below, or which may be melted by and taken up by the superheated metal in the

crucible. Opening into the crucible near the bottom is an inlet duct or passage 13, into which is fitted a supply pipe 14 by means of which the gas is delivered to the molten metal in the crucible.

While it might appear that the superheating of a molten metal bath by means of a gas, of the character indicated, passed into the molten bath, would impair the character of the metal by reason of the formation of reaction products between the gas and the metal, or the impurities in the metal, nevertheless, in actual practice, it has been found that such conditions do not result, as the superheated metal is so highly fluid that the impurities immediately rise to the top of the bath and may be readily separated therefrom. Even in the application of the method involving the superheating of the molten metal in the mold surrounding the parts to be welded, any impurities inherent in the original molten metal or formed as reaction products, when the gas is introduced into the molten metal, pass out through the risers, leaving the superheated metal which effects the welding practically unimpaired. This inherent characteristic of automatically freeing the superheated molten metal of impurities may be supplemented by adding to the molten metal certain deoxidizers or other reagents, such as manganese, carbon, silicon, aluminum, etc. which will dissolve in the molten metal and will react with the gas, forming compounds which will quickly pass out of the superheated molten metal, resulting from contact between the gas and the molten metal.

The method is particularly efficacious in welding operations, in that it is essentially efficient and economical. For example, in the thermit welding process, the preliminary molten bath may be produced by relatively small amounts of thermit, which serve to merely melt the metal without raising the same to any appreciable degree of superheat, the desired degree of superheat being effected by the supply of gas to the molten metal. Likewise, it is found, in welding rails and the like, that it is not necessary to preheat the interior of the molds to the extent found necessary in the usual practice and the greatly restricted mold spaces are no longer a detriment, when the superheating of the metal is effected in the mold, so that smaller gaps between the parts to be welded and collars surrounding the same may be employed without impairing the strength and homogeneity of the weld.

It has been proposed heretofore to superheat molten steel for welding sections together, the superheating being carried out in a furnace before applying the superheated steel to a welding mold. The present invention involves certain obvious advantages over this method, in that the degree of superheat applied may be accurately regulated, irrespective of the character or quantity of steel employed, by commensurately regulating the supply of gas to the body of molten metal in the furnace or crucible, and also has the decided advantage of avoiding the rapid erosion of the furnace or crucible, which inevitably occurs when superheated iron or steel is produced by any of the well known methods.

In the preferred practice of the invention, pure oxygen is employed as the gas to induce the superheat, as this gas will have less cooling effect and will produce fewer impurities in the superheated metal.

When applying the welding method, according to the present invention, a gap may be provided between the ends of the parts to be welded, as in the well known thermit process, but, since the necessary degree of superheat can be maintained for any desired length of time, such gap is not necessary, as the superheated steel will gradually fuse the parts together even without a gap. In fact, the degree of superheat can be so controlled that the molten steel will heat the parts to a welding temperature, so that they may be pressed together, and a simple and effective butt weld will result.

It will be understood that the superheating of the metal, as described herein, refers to a temperature induced in the molten metal considerably higher than that required to melt the metal, the ultimate heat in the case of iron and steel, when used for welding purposes, being largely in excess of the melting temperature of these metals and, in some cases, approximating the degree of heat produced by the thermit process.

While oxygen is preferable as the superheating agent, it will be understood that the invention is not limited to the use of this particular gas, as other gases will produce similar effects, such, for example, as chlorine, which will combine with iron and steel exothermically with the production of relatively high heat; and hydrogen, which will combine with certain elements of the steel, such as carbon, with an evolution of a large amount of heat.

What I claim is:

1. The method of welding by superheated molten metal, which comprises preliminarily melting the metal, superheating the same by passing a gas which will react exothermically with the metal into the molten mass, and bringing the superheated metal into engagement with the parts to be welded.

2. The method of welding by superheated molten ferrous metal, which comprises preliminarily melting the metal, superheating the same by passing oxygen into the molten mass, and bringing the superheated metal into engagement with the parts to be welded.

3. The method of welding, which comprises pouring molten metal into a mold surrounding the parts to be welded, and superheating

the molten metal in the mold by passing a gas which combines exothermically with the metal or the impurities therein into the molten mass.

4. The method of welding, which comprises pouring molten ferrous metal into a mold surrounding the parts to be welded, and superheating the molten metal in the mold by passing a gas which combines exothermically with the metal or the impurities therein into the molten mass.

5. The method of welding, which comprises pouring molten ferrous metal into a mold surrounding the parts to be welded, and superheating the molten metal in the mold by passing oxygen into the molten mass.

In testimony whereof I affix my signature.

ABRAM G. CRUM.