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METHOD OF MAKING CAST METAL INGOTS

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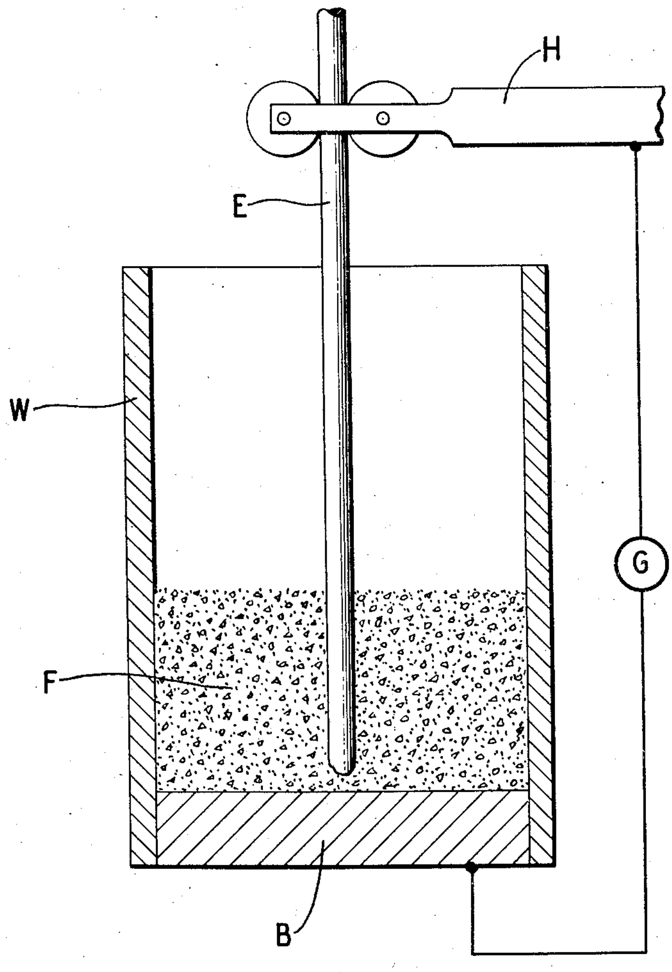

INVENTOR

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METHOD OF MAKING CAST METAL INGOTS

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1 Claim. (Cl. 224—209)

The invention relates to cast metals and has for its principal object the provision of sound cast metal bodies substantially free from shrinkage cavities and pipes.

Molten metal is ordinarily poured or cast into a mold where it cools and solidifies as a cast ingot. In the course of cooling and solidifying, the metal shrinks, forming cavities and pipes in the upper part of the ingot, and certain of the ingredients of the metal tend to segregate and become concentrated in the neighborhood of the cavities. The presence of pipes, cavities, and segregated materials constitutes a defect, and the defective portion—which in some instances amounts to as much as one-third of the length of the ingot—must be cut off and discarded if the best grade of metal is desired.

According to the present invention, the above-described defects of cast metal ingots are substantially eliminated. In general, the method of the invention comprises essentially the electrical heating and deposition of metal within a cavity having a conductive bottom, the deposition being effected under a relatively deep layer of flux.

The accompanying drawing illustrates the method of the invention.

The procedure to be described with reference to the single figure of the drawing is particularly adapted for making relatively small castings, although it is not limited thereto. In this procedure, a mold cavity is formed from an electrically conductive bottom member B and side walls W, the latter being conductive or nonconductive, as desired. A layer of unbonded comminuted flux F is placed on the bottom B of the cavity, and the electrode E is inserted in the flux, the electrode being supported in any convenient manner, as by a holder H. Electric current is passed between the electrode and the conductive bottom, as shown, metal is deposited from the electrode onto the bottom, and a casting of deposited metal is thereby built up progressively, a pool or blanket of fused flux being maintained on the molten deposited metal.

A wide variety of voltages and current densities may be used, and the best conditions of voltage, current, and electrode diameter will depend largely on the required composition, amount, and temperature of the metal to be added. In general, much heavier currents should be used than are customary in, for instance, ordinary open arc welding operations. For example, in a typical instance suitable conditions are attained by the use of thirty to fifty volts and a current of 1000 amperes through an electrode having a diameter of one-quarter inch, or a current of 2000 amperes through a three-eighths inch diameter electrode. Either alternating or direct current may be used.

The composition of the flux F is important, because, although a large number of materials can be used for the purpose; all suitable fluxes must be substantially free from substances which would evolve gases during the operation. Thus, decomposable carbonates, oxides which will react with constituents of the electrode, ingot, or flux to evolve gases, water, and similar substances, should be absent. Prefusion of the flux is an excellent way to drive off or stably fix undesirable constituents. The prefused flux may be comminuted for convenience in use.

The melting point of the flux is preferably slightly lower than that of the metal ingot. The flux should also be a nonconductor when cold and a high resistance conductor when molten.

Silicates of the alkaline earth metals are entirely suitable for use as the flux. Other materials may be added, for instance silicates of the alkaline metals and of iron and manganese, as well as alumina and fluorspar. An example of a suitable flux is one containing, by proximate analysis, about 30% CaO, 9% MgO, 56% SiO_2, and 5% Al_2O_3.

A blanket or layer of unfused flux F is maintained above the molten flux on the molten metal, of a depth sufficient to smother, submerge, or suppress the open arc which would otherwise be observed between the electrode E and the ingot. The melting, deposition, and coalescence of metal proceed with little or no external evidence of heating, despite the heavy currents used. Because the heating region is hidden under the flux blanket, it is impossible to observe whether or not a special type of arc is formed, but it is probable that there is no arc, as the term arc is usually interpreted.

I have observed that metal deposited under a layer of flux in the manner described above is remarkably homogeneous, clean, and sound.

I claim:

Method of producing a shaped, homogeneous, sound, and clean metal body which comprises placing a layer of unbonded, comminuted, substantially nongassing flux consisting chiefly of silicates on the bottom of a mold having a conductive bottom; inserting an end of a fusible bare metal electrode deep into said flux layer but out of contact with said conductive bottom; passing between said electrode and said bottom sufficient electric current to melt progressively successive portions of the electrode and to deposit within the mold the metal so melted, in an amount sufficient to form said body; maintaining a pool of fused flux over said deposited metal; and maintaining a deep blanket of unfused flux over the said pool and the melting end of the electrode; such electric current being maintained at an amperage so great, upwards of 1000 amperes per one-quarter inch of electrode diameter, that an open arc would be formed in the absence of the said blanket of unfused comminuted flux, and the last-mentioned blanket being effective to completely smother such open arc.

JAMES M. KEIR.