Patented Dec. 15, 1925. 1,565,755

UNITED STATES PATENT OFFICE.

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METHOD OF TREATING INGOT MOLDS.

No Drawing. Application filed May 27, 1924. Serial No. 716,180.

To all whom it may concern:

Be it known that I, WILLIAM HAIG RAMAGE, a citizen of the United States, residing at Girard, in the county of Trumbull, State of Ohio, have invented certain new and useful Improvements in Methods of Treating Ingot Molds, of which the following is a specification.

The present invention relates broadly to metallurgy, and more especially to a method of treating ingot molds, and the ingot mold resulting from the treatment.

Heretofore in the art of manufacturing ingot molds it has been the practice after the molds were cast and sufficiently cool to be safely handled to strip the ingot molds from the core bar and flask, allowing as much molding sand as possible to remain on the mold, and then the hot molds were stacked in a pile known as a "hot pile". The molds in the hot pile were permitted to gradually cool, after which they are lifted from the pile and shipped to their destination. It is the practice in some plants to permit the core bars to remain in the ingot molds until the molds are cool in order to further facilitate the cooling gradually, but this treatment ties up equipment and is not satisfactory. This custom of the prior art in making a "hot pile" is intended to permit the molds to cool off gradually and thereby become annealed to relieve any stresses or internal strains which may have developed during the molding operations and crystallizing of the metal on freezing. It will appear that the molds placed in the hot pile first were those which were removed last, and that the molds which were placed last in the hot pile were those which were removed first. The ascending heat currents over the hot pile causes a draught of cold air toward the hot pile which strikes the molds on the outside of the pile and subjects them to the most severe cooling conditions. It will be observed that from this old procedure it is impractical and impossible to subject each mold to the same heat treatment consequently no two molds will come out of the pile in exactly the same annealed condition. This old practice furthermore tends to permit the carbon to precipitate out as laminar or plate form of carbon, and when such molds are subjected to the heat of molten steel, in the use of the molds in casting ingots, the molten steel tends to bite into the wall of the mold and absorbs the laminar or plate graphite, thus shortening the useful life of the mold. Furthermore, the sand which sticks to the molds under the old practice becomes contaminated with iron particles and general foreign matter so that a considerable portion of this sand is lost. It also frequently happens that the sand will tend to fuse to the sides or inner walls of the molds and therefore a workman is required to go over all the molds to be sure that all of the sand is free from the mold walls. Since the matrix portion is formed by the inner walls of the mold, the most important surfaces are the least accessible.

The present invention comprises a method of treating ingot molds to overcome the difficulties of the known prior art, to effect economies and to produce a novel and better ingot mold. Broadly, the present method comprises stripping the molds from the molding sand, completely cleaning all surfaces of the molds, chilling the surfaces slightly, and then enclosing the molds in a chamber having heat insulating walls so that the heat given out by the hot molds will be conserved and will produce an atmosphere in which the molds are very slowly cooled by substantially uniform radiation from all surfaces thereof, it being understood that if the remaining or residual heat in the molds is not sufficient to complete the annealing operation, that additional heat may be introduced into the chamber to obtain the desired result.

While the present method may be carried out in different specific ways, the preferred procedure is to pick up the molds by the stripping lugs, or in any other convenient way, as soon as the molds are sufficiently cooled to permit handling without injury to the molds. The core bar is removed from the mold, and when the mold is stripped from the sand of the flask, the mold is plunged into a water bath or other cooling liquid. The water or cooling liquid penetrates through the sand adhering to the surfaces of the mold both interior and exterior, and forms steam which literally blows or blasts the sand from the metal, so that the mold comes out of the bath entirely cleaned

of sand. The plunge of the mold in the cooling liquid is of short duration and the mold is then carried to a suitable annealing oven having heat insulating walls, and which may comprise a closed chamber in which suitable openings are provided for the introduction and removal of molds. The molds may be arranged in the annealing oven in any convenient manner, but preferably each mold is set vertically upon its own base or bottom. Usually the residual heat of the molds is sufficient to perform the annealing operation, but under other conditions, it is desirable to add sufficient heat to the annealing chamber to raise the temperature of the molds to the critical point, which is that temperature which will release the stresses and strains set up in the mold during the preceding treatments. After the mold has been subjected to the annealing operation for a sufficient period of time to completely release the stresses and strains set up in the mold, the heat is allowed to gradually radiate and dissipate so that the mold is gradually cooled down, after which the mold is ready for disposal as an article of commerce.

The result of the foregoing method is that the sand which is removed by the cooling fluid is clean sand, and where a water bath is used it falls to the bottom of the bath as clean washed sand. This cleaned sand may be removed therefrom by a traveling conveyor or otherwise so that the sand is saved in its best condition for reuse. This effects a considerable economy. The subjecting of the hot mold to the cooling fluid produces a dense fine grained surface on the mold which surface effectively resists the cutting action of hot steel when the mold is in use. It appears that the majority of carbon in the metal of the mold, which is usually pig iron or blast furnace iron, remains in combined form and the graphite which is precipitated out appears to assume the spheroidal form of graphite. This tends to produce a condition of greater tensile strength in the mold and, as previously stated, tends to close the grain of the metal near and at the surface so as to produce a very smooth surface which is extremely desirable in the matrix portion of the mold in that it reproduces a similar smooth surface on ingots cast in these new molds. The annealing of the mold apparently does not destroy or change the carbon condition and does not destroy or change the hard smooth fine grained surface produced by the chill, although it does permit the stresses and strains in the mold to be equalized, so that the final product is an ingot mold having substantially uniform stress conditions throughout, or, in other words, a mold which is under neutral tension. This method of treatment not only results in an economy in manufacture, but produces a better, stronger, and longer lived ingot mold of novel characteristics.

Having thus described my invention, what I claim is:

1. The method of treating iron castings cast in sand molds, which method comprises removing the casting from the sand mold while the casting is hot; plunging the casting into a chilling bath, and subsequently annealing the casting.

2. The method of treating iron castings cast in sand molds, which method comprises removing the casting from the sand mold while the casting is hot; subjecting the casting to a chilling water bath, and subsequently annealing the casting.

3. The method of treating iron castings cast in sand molds, which method comprises removing the casting from the sand mold while the casting is hot; plunging the casting into a chilling bath, and subsequently annealing the casting in an enclosed atmosphere.

4. The method of treating iron ingot molds cast in sand molds, which method comprises removing the ingot mold from the sand as soon as the ingot mold can be safely handled, plunging the ingot mold into a chilling bath, and annealing the ingot mold.

5. The method of treating iron ingot molds cast in sand molds, which method comprises removing the ingot mold from the sand as soon as the ingot mold can be safely handled, plunging the ingot mold into a chilling water bath, and annealing the ingot mold by its own heat in an enclosed quiescent atmosphere.

6. The method of treating iron ingot molds cast in sand molds which method comprises stripping the core bar from the ingot mold and removing the mold from the sand as soon as the mold can be safely handled; quickly plunging the mold into a chilling bath capable of penetrating masses of sand adhering to the mold; removing the mold from the fluid before the mold has been substantially cooled; and annealing the mold.

7. The method of treating iron ingot molds cast in sand molds which method comprises stripping the core bar from the ingot mold and removing the mold from the sand as soon as the mold can be safely handled; quickly plunging the mold into a chilling fluid capable of penetrating masses of sand adhering to the mold; removing the mold from the fluid before the mold has been substantially cooled; and annealing the mold by preventing rapid withdrawal of the residual heat therefrom.

8. The method of treating iron ingot molds cast in sand matrices, which method comprises stripping the mold from the sand as soon as the mold has cooled sufficiently

to be self supporting; subjecting the stripped mold to a chilling fluid capable of penetrating adhering masses of sand and of forming an expansible gas upon coming in contact with the hot walls of the mold to loosen said adhering masses of sand and then annealing the mold.

9. The method of treating iron ingot molds cast in sand matrices which method comprises stripping the mold from the sand; subjecting the mold to a water bath and removing the mold therefrom before the mold has been substantially cooled; and annealing the mold.

10. The method of treating iron ingot molds cast in sand matrices which method comprises stripping the mold from the sand; subjecting the mold to a water bath; and removing the mold therefrom before the mold has been substantially cooled.

11. The method of treating iron ingot molds; which comprises chilling the surfaces only of the molds after the molds are cast and annealing the molds.

12. The method of treating iron ingot molds; which comprises casting the ingot mold in a non-chill matrix and chilling the surfaces only of the molds after the molds are cast.

13. The method of treating cast iron ingot molds, which method comprises casting the mold in a non-chill mold, and chilling the matrix wall surfaces of the ingot mold for a small depth only after the ingot mold has been cast.

14. The method of treating cast iron ingot molds, which method comprises casting the mold in a non-chill mold, chilling the matrix wall surfaces of the ingot mold for a slight depth only after the ingot mold has been cast, and then annealing the chilled portions.

15. As an article of manufacture a cast iron ingot mold having the metal at and adjacent to the surfaces of the matrix walls of chilled metal of close fine grain and with the metal of the interior of the walls unchilled and of a coarser grained formation.

16. As an article of manufacture an iron ingot mold with the surfaces thereof of chilled metal having a close fine grain, and with the interior metal of the walls unchilled and in substantially neutral stress condition.

17. As an article of manufacture a cast iron ingot mold, having the surfaces thereof of close grained metal with the major portion of the free carbon therein in substantially spheriodal form and with the interior metal in the walls thereof in substantially neutral stress condition.

18. The method of treating ingot molds cast in sand molds, which method comprises removing the ingot mold from the sand while hot and quickly subjecting the ingot mold to a water bath to remove adhering sand therefrom.

19. The method of treating ingot molds cast in sand molds, which method comprises removing the ingot mold from the sand while hot and quickly subjecting the ingot mold to a water bath to permit water to permeate the adhering sand and to remove same by vaporizing the water therein with heat from the ingot mold.

20. The method of removing adhering sand from hot ingot molds, which method comprises quickly subjecting the mold to a water bath, permitting the water to permeate the adhering sand, and driving the sand from the mold by vaporizing the water therein.

New York, N. Y., January 24, 1924.

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