

UNITED STATES PATENT OFFICE.

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INGOT.

987,857.

Specification of Letters Patent.

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To all whom it may concern.

Be it known that I, ROBERT B. CARNAHAN, Jr., of Middletown, Butler county, Ohio, have invented certain new and useful Improvements in Ingots, of which the following is a specification.

My present invention comprehends a new article of manufacture represented by a rolling-mill or bloomery ingot with a degasified slagless body, crystalline in structure and with an iron content of at least 99.80 per cent., the sulfur, phosphorus, carbon, manganese and silicon aggregating not over .14 per cent. Sheets, plates, bars or other forms are readily rolled or forged from this ingot and possess the following characteristics:—

First:—Tensile strength somewhat higher than high grade iron.

Second:—Ductility somewhat greater than high grade iron.

Third:—Density somewhat greater than ordinary iron.

Fourth:—Will galvanize more satisfactorily than any commercial iron known to me.

Fifth:—Resists all corroding agents to an extraordinary degree, being in this respect vastly superior to any commercial steel known to me, and equal to the very highest grades of Swedish charcoal iron.

Sixth:—Forges and rolls with facility at temperatures considerably lower than high grade charcoal iron and very much lower than steel, thereby avoiding the scaling incident to the employment of high temperatures. The material is especially adapted for smooth sheets comparatively free from scale, being, it is believed, superior in this respect to any iron or mild steel known to the art.

Seventh:—Substantially proof against internal electrolysis.

Eighth:—Welds perfectly with a flux, but without a flux it welds less perfectly than charcoal or puddled iron without a flux.

Ninth:—The product well lends itself to use in making crucible steel, being superior to ordinary iron and much more economical than charcoal iron.

Tenth:—The microscope has detected no slag in the body of the ingot or in the finished product.

Eleventh:—It combines in a most re-

markable degree the most valuable qualities of commercial mild steel and the most valuable qualities of the best commercial iron with apparently none of the many undesirable qualities of either.

The improved ingots lend themselves to economical manufacture from comparatively low priced material by methods characterized by regular certainty of results.

The improved ingots may be produced as follows:—First. Use pig iron or cast iron or molten iron or other iron reduced from the ore and preferably that whose phosphorus and sulfur and silicon do not aggregate over 3.05 per cent. Second. In using a basic open-hearth furnace I have in cases substituted iron or steel melting stock, or mixed scrap, to the extent of 50 per cent. Third. Employ a high powered furnace capable of what might be termed a particularly "fierce" action. Fourth. Use iron ore to reduce carbon and manganese, and lime, or limestone to reduce sulfur and phosphorus. Fifth. Melt and refine the charge and bring it to a temperature of at least 2,850 deg. F. and to an analysis, by bath test, showing that sulfur, phosphorus, manganese, carbon and silicon do not in the aggregate exceed .14 per cent. Sixth. Tap the melted hot charge into a ladle or other receptacle with a degasifying agent, say aluminium. Seventh. Pour into ingot molds while still at high temperature, say not below 2,775 deg. F.

The poured ingots will be found free from slag thus far detected by the microscope in the hands of a professional metallographist. The heads of the ingots involved at the end of a pouring may show a trifle of slag but this is harmless and drops off in the heating and working of the ingot and never enters the worked product.

I have above referred to a temperature of 2,850 deg. F. for the bath, and this is correct as far as I have been able to ascertain from the most reliable authorities and literature. In practice, the correct temperature may be determined by stirring the bath with an iron rod one and one-eighth inches in diameter for one minute and a quarter. If about eighteen inches of the rod has been melted off and if the fluxed rod-end has a glassy appearance the temperature is cor-

rect. A more rapid or slower cutting away of the rod indicates that the bath is too hot or too cold.

I claim:—

- 5 As a new article of manufacture a rolling mill or bloomery ingot with a degasified slagless body, crystalline in structure and containing at least 99.80 per cent. of iron

and containing not over .14 per cent of sulfur, phosphorus, carbon, manganese and silicon taken in the aggregate. 10

ROBERT B. CARNAHAN, JR.

Witnesses:

M. S. BELDEN,
L. L. HALE.