

UNITED STATES PATENT OFFICE.

WINFIELD S. POTTER, OF NEW YORK, N. Y.

PRODUCTION OF WROUGHT SHAPES OF MANGANESE STEEL.

1,018,367.

Specification of Letters Patent.

Patented Feb. 20, 1912.

No Drawing.

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To all whom it may concern:

Be it known that I, WINFIELD S. POTTER, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Production of Wrought Shapes of Manganese Steel; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the production of wrought shapes of manganese steel by pressing, forging, or otherwise working under conditions hereinafter described, cast shapes of that metal.

It has particularly for its object a system of casting, working, heat-treating, and rapid cooling after working, in such manner that the whole manufacture is rapid and especially economical for the production of wrought shapes of irregular contour.

I have found that whereas large cast ingots of manganese steel cannot be worked very satisfactorily at initial temperatures below 1025° C. or thereabout, in accordance with methods heretofore proposed, the metal may nevertheless, by employing a suitable procedure hereinafter described, be brought into a sufficiently homogeneous and reliable condition for working at these lower temperatures. Furthermore, I have found that the metal may be brought to so close an approach to uniformity of distribution of its constituents by the procedure herein described, that the resulting worked and subsequently quenched product is sufficiently tough and reliable for many useful purposes.

In the preferred form of my invention, I realize the desired conditions for effectively working the metal by carrying on that procedure while the cast shape is still hot from the heat of casting. That is to say, after the manganese steel has been poured into the mold, the extent and the rate of cooling is so regulated that, as the metal cools from the heat of casting, the falling temperature is arrested at an average for the entire mass of about 950° C. to 1025° C., corresponding to a surface temperature of say 750° C. to 1050° C. Or the casting may be taken from the mold before it has fallen to the average temperature of 950° C. to 1025° C. (say at 1200° C.), and permitted to cool down and

be equalized in the heating furnace to the temperature for subsequent working. In either event, the casting is taken from the heating furnace and is immediately brought into a wrought condition, by pressing, forging, rolling, or otherwise working as may be necessary to bring it to the desired shape and dimensions.

By arresting the cooling within the range of temperatures above specified, the separations and the irregularities of composition usually occurring when the casting is permitted to cool to lower temperatures (as, for instance, below 750° C. or thereabout, or to atmospheric temperatures, are avoided, and the time of heating necessary to correct these irregularities in order to bring the metal to a condition suitable for working is correspondingly greatly reduced. When the casting has cooled to an intermediate degree as, for example, a temperature in some of its portions between 750° C. and 950° C., a longer time will be required to bring the metal into the condition suitable for working, than when the cooling is arrested while all parts of the casting still have temperatures above 950° C. Accordingly, it is a characteristic advantage of my preferred practice that the sequence of operations is so rapidly conducted that the finished shape may be obtained, in some cases, in as short a time as half an hour from the time of casting; especially when the cast shape is of compact and relatively symmetrical form, so that its cooling from the heat of casting may be readily controlled and so that in cooling it may be brought to a nearly uniform temperature throughout its mass. It is also a characteristic advantage of my invention that if the exigencies of practice make it convenient or necessary to hold the cast shape in the heating furnace beyond the time necessary for equalizing the temperatures throughout the mass, it may be retained therein without impairing (and, in some respects, even improving) its condition for working.

As an illustration of my preferred practice, I may instance the production of a railroad coupler knuckle of manganese steel: A railroad coupler knuckle may be cast as one of several castings, poured in multiple and one above the other, or say two in a mold and the molds ranged six high. When the castings have frozen throughout and have cooled in their outer portions to say

750° C. to 1050° C. the interior temperatures being still at say 1050° C. to 1150° C., the castings are removed from the molds and placed in a heating furnace having a temperature of from 950° C. to 1025° C. In the heating furnace they are held at the furnace temperature until of uniform temperature throughout. It is not necessary to retain them in the heating furnace for more than a few minutes after equalization, but, if delays in the mill or other exigencies make it desirable or convenient to retain them in the furnace for a longer period, they may be retained therein (for example, as long as two hours) without detriment to their condition for the subsequent working step of the operation, and even to some advantage, inasmuch as their longer detention in the furnace for not more than say two hours is favorable to the more complete absorption and re-solution of such segregations as have occurred during the freezing and interrupted cooling.

From the equalizing furnace, the cast manganese steel knuckles may be transferred to a die actuated by a hydraulic press and are brought by pressing and forging into a fine-grained state. Where the shape of the pressed casting permits, it may be reversed in the die and further pressed, or it may be passed on, while still at the working heat or after being re-heated thereto, to one or more additional dies and further pressed until it receives the desired form, whereupon the fins and sprue may be cut and trimmed from the finished shape. The resulting forged knuckle may then be quenched in water or otherwise rapidly cooled, or if it has fallen in temperature below say 800° C. it may be re-heated to between 800° C. and 1075° C. in its different portions and quenched, or it may be brought to a uniform temperature throughout between say 975° C. and 1025° C. for a short time, (as, for example, 10 minutes) and may then be quenched or rapidly cooled to below 420° C. or thereabout.

Some of the advantages of my invention may be realized in the treatment of manganese steel castings which have been permitted to cool below 750° C. or which have even been cooled down to atmospheric temperatures. In cooling down to these lower temperatures, the metal has suffered separations and acquired irregularities of composition which considerably exceed in extent and importance those which exist in a casting whose cooling has been interrupted as in my preferred procedure at average temperatures of 950° C. or above. These separations and irregularities of composition in a cast manganese steel blank which has been permitted to fall to below 750° C. cannot be removed by merely raising the temperature of the cast shape to the higher

range of temperatures between 950° C. and 1025° C. On the contrary, the re-heating to be effective to bring the metal at these temperatures into condition for working would be conducted under conditions which I will now specify. The casting, if cold, is first heated slowly to above 420° C. especially if large and of irregular thickness. Then, with a steadily rising temperature it is raised to the intended maximum (between 950° C. and 1025° C.), and is then held for a long period at this maximum, this detention of the metal in the furnace being necessary in order to bring back into solution in the metal the separated carbids, which, at these low heats, require a considerable time for their re-solution to the extent necessary to adapt them for such working. For instance, for steel containing say, 1.20% to 1.40% of carbon, and say 11% to 14% of manganese, the cast shape should be retained in the furnace at the maximum temperature for from one to four hours or more, depending upon the extent to which it has cooled and the rate of cooling which determine the extent of the separating within the mass, of the constituents of the metal; and, for steel containing say 1% to 1.20% of carbon and 11% to 14% of manganese, the cast shape should be retained in the furnace for from half an hour to two hours or more, depending likewise upon the extent to which it has cooled and the rate of cooling; in order to be pressed, forged, or otherwise similarly worked to bring it into the final desired shape with a fine-grained, strong, wrought condition of the metal. After the cast manganese steel shape has been thus pressed, forged, or otherwise worked, after its relatively long period of detention in the furnace, it may then be immediately quenched, or otherwise rapidly cooled; or it may be permitted to cool and then be re-heated to say 1000° C., and then quenched or otherwise rapidly cooled to below 420° C. or thereabout.

In my preferred practice, in order to avoid extreme irregularities of composition in the cast manganese steel blank, and thereby to facilitate the general operation, the casting may be made by using a sand mold for the production of the casting and pouring the metal at a temperature but slightly above its freezing temperature; or, for the same reason, the casting may be made in accordance with the method set forth in my United States Letters Patent No. 967,830, dated August 16th, 1910.

Having thus described my invention what I claim is:

1. The method of producing wrought shapes of manganese steel, which consists in casting a manganese steel shape, arresting the cooling of the cast shape and equalizing the temperature throughout the mass at be-

tween 950° C. and 1025° C.; working the casting to bring it to the desired shape and condition; and finally rapidly cooling; substantially as described.

5 2. The method of producing wrought shapes of manganese steel, which consists in casting a manganese steel shape; arresting the cooling of the cast shape and equalizing the temperature throughout the mass at between 950° C. and 1025° C.; working the casting to bring it to the desired shape and condition; heating to temperatures between 800° C. and 1075° C.; and finally rapidly cooling; substantially as described.

15 3. The method of producing wrought shapes of manganese steel, which consists in casting a manganese steel shape; regulating the rate and extent of cooling of the cast shape from the heat of casting until its temperature is arrested at between 950° C. and 1025° C.; working the casting to bring it to the desired shape and condition; and finally rapidly cooling; substantially as described.

25 4. The method of producing wrought shapes of manganese steel, which consists in casting a manganese steel shape; regulating the rate and extent of cooling of the cast shape from the heat of casting until its temperature is arrested at between 950° C. and 1025° C.; equalizing the temperature throughout the mass at between 950° C. and 1025° C.; working the casting to bring it to the desired shape and condition; and finally rapidly cooling; substantially as described.

35 5. The method of producing wrought shapes of manganese steel, which consists in casting a manganese steel shape; regulating the rate and extent of cooling of the cast shape from the heat of casting until its temperature is arrested at between 950° C. and 1025° C.; equalizing the temperature throughout the mass at between 950° C. and 1025° C.; working the casting to bring it to the desired shape and condition; heating to temperatures between 800° C. and 1075° C.; and finally rapidly cooling; substantially as described.

50 6. In the production of wrought manganese steel shapes from cast manganese steel shapes, the method of bringing the casting into condition suitable for effective working, which consists in arresting the cooling of the mass from the heat of casting at temperatures between 950° C. and 1025° C.; working the casting at these temperatures; equalizing the temperatures of the

worked casting at between 950° C. and 1025° C.; and finally rapidly cooling to below 420° C.; substantially as described.

7. In the production of wrought manganese steel shapes from cast manganese steel shapes the method of bringing the metal into condition for effective working, which consists in heating the cast shape with a steadily rising temperature from 420° C. to the intended maximum between 950° C. and 1025° C.; equalizing the temperature throughout the mass; detaining the cast shape in the equalizing furnace until its irregularities of composition have been sufficiently eliminated for the working required; working the cast shape to final form and condition; and rapidly cooling to below 420° C.; substantially as described.

8. In the production of wrought manganese steel shapes from cast manganese steel shapes, the method of bringing the metal into condition for effective working, which consists in heating the cast shape slowly to 420° C. and with a steadily rising temperature from 420° C. to the intended maximum between 950° C. and 1025° C.; equalizing the temperature throughout the mass; detaining the cast shape in the equalizing furnace until its irregularities of composition have been sufficiently eliminated for the working required; working the cast shape to final form and condition; and rapidly cooling to below 420° C.; substantially as described.

9. In the production of wrought manganese steel shapes from cast manganese steel shapes, the method of bringing the metal into condition for effective working, which consists in heating the cast shape with a steadily rising temperature from 420° C. to the intended maximum between 950° C. and 1025° C.; equalizing the temperature throughout the mass; detaining the cast shape in the equalizing furnace until its irregularities of composition have been sufficiently eliminated for the working required; working the cast shape to final form and condition; heating at temperatures between 800° C. and 1075° C.; and rapidly cooling to below 420° C.; substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

WINFIELD S. POTTER.

Witnesses:

JOHN C. PENNIE,
M. A. BILL.