UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING FINISHED SHAPES FROM MANGANESE STEEL.

939,164. Specification of Letters Patent. Patented Nov. 2, 1909.

No Drawing. Original application filed May 8, 1906, Serial No. 315,831. Renewed January 31, 1907, Serial No. 355,136. Divided and this application filed September 22, 1909. Serial No. 518,929.

To all whom it may concern:

Be it known that I, WINFIELD S. POTTER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Methods of Producing Finished Shapes from Manganese Steel, of which the following is a specification.

Manganese steel is material which may be given great toughness, hardness and resistance to abrasion by subjecting it to suitable heat treatment. It is therefore especially suited for the production of rails for railways. Heretofore, however, it has been found impossible to roll manganese steel into rails or other shapes, on account of the fact that the metal lacks cohesion when hot, so that the cast ingot is crushed into pieces instead of being elongated when subjected to the action of rolls. Such rails as are now in use are therefore produced by casting the metal in molds.

The present invention relates to a method of producing finished shapes from manganese steel, whereby an ingot may be made sufficiently coherent to elongate without crushing in the rolling or shaping thereof.

The method, generally stated, consists in heating the ingot, preferably in successive stages, up to a high temperature, cooling the heated ingot to a lower temperature, and rolling it, preferably in two stages, the ingot being first heated to a low temperature and subjected to the action of roughing and compressing rolls, and then heated to a high temperature and rolled to finished shape, with an intermediate re-heating, if necessary. The rolled product is then quenched, from a suitable temperature, to give it the requisite toughness.

The preferred complete mode of procedure is as follows: An ingot is cast, large end downward, in a mold of the usual form, the molten steel being preferably introduced into the mold through a fire-brick runner to decrease piping. The ingot is then slowly and evenly heated, preferably standing on end, and in a reducing atmosphere, for example, to a temperature between 735° C. and 930° C., and specifically to about 870° C. The temperature is then rapidly raised to from 995° C. to 1065° C., specifically to about 1040° C., at approximately which temperature the metal becomes tender and is liable to crack if further heated rapidly, and from this point, the metal is slowly heated to the maximum temperature permissible, between 1065° C. and 1260° C., specifically to about 1205° C. This high temperature gives a uniform molecular structure to the steel, removing segregation and apparently causing the particles of steel to weld together or firmly cohere. The hot ingot is now subjected to an annealing treatment by being cooled. This cooling is preferably effected in a non-oxidizing atmosphere, the temperature being first slowly reduced to avoid rupture, and then quickly lowered until recrystallization is complete, which occurs at between 650° C. and 705° C. This annealing step is of especial importance, cooperating with the high temperature previously used to produce even crystallization, high cohesion and uniform structure. The annealed ingot is now re-heated to a low temperature, sufficient to enable it to be rough rolled and compressed, dependent on the size of the ingot and power of the rolls, and ranging from 870° C. to 1065° C. or upward. The initial rolling is preferably effected by Gothic rolls, the reduction in the first few passes being very slight, for example, one-quarter of an inch in the first two passes on each side, for a twelve inch ingot. The bloom is now re-heated to the maximum temperature, that is, to the temperature to which it was originally heated, say from 1065° C. to 1205° C. and rolled to finished shape. In re-heating, the ingot should lie on its side and should be turned through an angle of 180° several times to insure even heating. The rails should be sawed to length and punched for fish-plate bolts while hot from the rolls. The rails are now subjected to a quenching operation, either direct from the rolls if sufficiently hot, or after re-heating. The rails should be arranged base downward in the re-heating furnace and should thence be drawn into a suitable rack capable of being submerged in water.

The above described method is not claimed herein, as such forms the subject-matter of a pending application filed by the applicant on the 8th day of May, 1906, and bearing

Serial No. 315,831, renewed Jan'y 31, 1907, Serial No. 355,136, and of which this forms a divisional application.

The process above described is capable of modification, hereinafter set out and specifically claimed, as follows: The ingots may be taken direct from the molds to a soaking pit, wherein their temperature will become equalized. The slow preliminary heating to a temperature between 735° C. and 930° C., as heretofore mentioned, may then be omitted; for example, if the ingot is taken direct from the mold with its center say at a temperature of from 1300° C. to 1200° C., and having a skin temperature of say 1000° C. to 900° C., it may be placed in the soaking pit wherein the temperatures will be equalized, for example, at 1205° C. preferably not above 1260° C., and as the mass is relatively coherent at this temperature, and has not been permitted to crystallize, it is obvious that the cooling or annealing step may be omitted.

In some instances, and especially with small ingots, the initial rough rolling may be omitted, the ingots being rolled to a finish in one heat, the cooling or annealing step being omitted as above described, the ingot in such instance being taken direct from the mold to the soaking pit wherein its temperatures become equalized, and is then taken to the rolls. This necessitates exact heating, accurate rolls and slight reductions in the first few passes, for example, one-eighth inch in a four inch ingot at a temperature of 1095° C., using rolls with a Gothic pass. On the other hand, the reduction of large ingots to small shapes, especially to thin sheets, may necessitate intermediate re-heating of the bloom during the shaping.

The cooling of the ingot for annealing, and that of the finished product for toughening, may be effected by subjecting the metal to the action of steam. In general, however, it is preferred to anneal either in the heating furnace or in the air, and to quench in water. Small ingots may be annealed by quenching in water.

While the reduction of the ingots by means of rolls only, has been described, it will be understood that a hammer or press may be employed, if preferred.

I claim:—

1. The method of producing finished shapes from manganese steel, which consists in slowly heating the ingot hot from the heat of casting, from a temperature between 995° C. and 1065° C. to the maximum temperature, and until the temperatures of the ingot are equalized, then slightly reducing said ingot and then shaping it.

2. The method of producing finished shapes from manganese steel, which consists in slowly heating an ingot while still hot from the heat of casting, from a temperature approximating 1040° C. to approximately 1205° C., maintaining the heat until the temperatures of said ingot are equalized, and then shaping.

3. The method of producing finished shapes from manganese steel, which consists in slowly heating an ingot while still hot from the heat of casting, from a temperature approximating 1040° C. to approximately 1205° C., maintaining the heat until the temperatures of said ingot are equalized, then subjecting the ingot to slight reductions, and then shaping it.

4. The method of producing finished shapes from manganese steel, which consists in arresting the cooling of the ingot while still hot from the heat of casting, at a temperature above 735° C., then immediately re-heating, and subsequently shaping it.

5. The method of producing finished shapes from manganese steel, which consists in arresting the cooling of an ingot or body of metal, from the heat of casting by heating the same to a temperature not above 1260° C., and subsequently shaping the same, the metal being slowly heated at temperatures above 1040° C.

6. The method of producing finished shapes from manganese steel, which consists in arresting the cooling from the heat of casting by heating the same in a furnace to a temperature not above 1260° C., lightly working the same, and then shaping it.

7. The method of producing finished shapes from manganese steel, which consists in arresting the cooling of the metal, hot from the heat of casting, at a temperature above a red heat, heating said body slowly at temperatures above 1040° C., arresting the heating at a predetermined temperature not above 1260° C. and subsequently shaping the body of metal.

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

WINFIELD S. POTTER.

Witnesses:
PARKER COOK,
M. VAN NORTWICK.