UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING MANGANESE STEEL.

No. 812,811. Specification of Letters Patent. Patented Feb. 20, 1906.

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To all whom it may concern:

Be known that I, WALTER BRINTON, a citizen of the United States, residing in High Bridge, in the county of Hunterdon and State of New Jersey, have invented certain new and useful Improvements in Processes of Treating Manganese Steel, of which the following is a specification.

This invention relates to the treatment of manganese steel, and more particularly relates to an improvement in the method of toughening such steel, the object being to give the article to be toughened a preparatory treatment after the same has been forged, rolled, or cast into the desired shape and before the final step of toughening such article, the present method being an improvement upon that described in Patents No. 572,891, dated December 8, 1896, and No. 731,540, dated June 23, 1903, granted to R. A. Hadfield. Under the processes set forth in said patents the cast article is placed in a cold furnace and then slowly heated up to a predetermined temperature and then comparatively rapidly heated. I have found, however, that by permitting the casting to become cold—that is, arrive at that point where there is an absence or substantial absence of heat—it is not practicable to successfully treat and perfect heavy manganese-steel castings by such process, whereas by the present method of treating manganese-steel castings I have been able to successfully treat and perfect a single casting weighing as much as eight and one-half tons, which, as just stated, it is not practicable to do under the processes set forth in said Hadfield patents. I have also found that my method gives superior results with the smaller-size castings. The present improvement, therefore, while particularly well adapted for the treatment of heavy castings or of those of intricate design and by means of which such heavy castings can be safely as well as successfully treated is also well adapted for the treatment of various sizes of castings or of other manganese-steel products, the invention being applicable not only to castings, but to forgings and rolled shapes when formed of manganese steel.

To commence the operation of toughening manganese steel with cold castings or forgings or to begin the reheating thereof with a cold furnace is not only inadvisable, but is injurious and dangerous to the steel, since I have found that the castings, forgings, or other manganese-steel articles to be treated should never become cold after the commencement of manufacture until after the final toughening process has been accomplished. In other words, the article should not be permitted to enter that critical period of rest where there is an absence or a substantial absence of heat therefrom, but, on the contrary, it should be so heated as to retain or preserve therein a part of its original heat. By maintaining in the casting a certain percentage of heat, determinable from the character of the work and the size of the casting, and thus preventing it from becoming cold, the liability of the casting to shrinkage strains and consequent cracking is largely eliminated, so that a superior and more perfect article is obtained. On the other hand, when the casting or forging is permitted to become cold after it has been cast, forged, or rolled before reheating for toughening dangerous internal strains set up, causing cracks, and therefore rendering the finished product valueless and dangerous for all purposes. In light and small castings of simple design a much less degree of their original heat need be retained than is necessary in larger and more complicated castings, while articles of the heaviest character are required to retain a still greater degree of heat to insure against internal strains and result in a perfectly-treated casting, and therefore the variation in degrees of heat for different characters of castings will be determined, according to the character and size of the castings, by the operator in charge of the process, the essential object of the present invention being to prevent the manganese-steel product from entering a period of rest where there is a substantial absence of its original formative heat—that is, its casting, forging, or rolling heat.

In carrying out this improved method of toughening manganese-steel articles, whether cast, forged, or rolled, if it is a casting which is to be treated after the casting has remained undisturbed in the mold a sufficient length of time to become solidified or, in other words, has reached the point where its strength is sufficient to retain its own weight without warping, it is released and freed from any parts of the mold which would have a tendency to retard the contraction and shrink-

age, which begins very soon after casting. After having been released and freed from all binding influences the casting, or, if the article be a forged or rolled one, is so treated as to retain therein a sufficient amount of heat, its original casting, forging, or rolling heat, as the case may be, to prevent the same from becoming cold, such amount of heat being determined according to the size, character, and design of the casting. This may be done in one way by covering the product with sand or preferably placing the product in a pit specially prepared for the purpose where drafts of air are entirely excluded, whereby the process of shrinkage and contraction is largely retarded, while all parts of the casting are kept at a uniform temperature throughout until they have cooled down to the right degree of heat for the final toughening, which degree of heat necessarily depends, as stated, upon the character, size, and design of the casting. It may range between a point about 100° Fahrenheit—that is to say, above normal atmospheric temperature—and substantially 1,000° Fahrenheit. Should there still remain sand or cores to be removed from the casting before it is recharged for toughening, the work of removing the same must be done quickly, so as not to allow the casting to be exposed for any time to air-drafts. After the product, whether it be a casting, forging, or rolled article, has reached a predetermined degree of heat, depending upon the size, character, and design of it, it is placed in a furnace which has been previously heated to the same, or substantially the same, temperature as the casting. By this method of procedure the steel product is never permitted to become cold, so that the metal is not permitted to reach a point of rest where there is an entire absence of heat before final toughening, and which has been found is the cause of tense and dangerous contractions and strains, this being due to the too rapid cooling of the casting, thus causing a too rapid shrinkage or contraction thereof. The present improved method prevents this too rapid cooling and consequent rapid shrinkage or contraction, permitting the casting to cool gradually and uniformly, keeping all parts of the casting at a uniform temperature until it has cooled down to the right degree of heat for the final toughening. The casting or other product is then heated up to a predetermined point preparatory to the final toughening operation, and I have found that by this method of treatment this heating step even from its commencement may be comparatively rapid. After it has reached a predetermined high temperature now well known in the art—as disclosed, for instance, in the Hadfield patents hereinbefore referred to—varying according to the size, shape, character, and external conditions of the casting, it is removed and immersed in a cooling-bath of brine-water, although other means may be used for rapidly cooling the casting. By this method I have found that dangerous strains are eliminated. Rapid heating to the required degree for toughening can be applied without danger of injury to the steel, while large castings of the most difficult design can and have been successfully made which could not have been made if the casting had been permitted to become cold or attempted to be treated from a cold furnace.

As an example of this method of heat treatment a cast manganese-steel bar one inch thick, three inches wide, and two feet long would be allowed to cool gradually until it reached about 150° Fahrenheit, when it would be placed in a furnace previously prepared at about the same degree of heat and heated up to a high temperature, now well understood in the art of toughening manganese steel, and then quickly cooled.

I claim as my invention—

1. The process herein described of toughening manganese-steel castings, consisting in heating a heated casting beginning with the furnace in a heated state, applying the heat until the casting has reached a predetermined temperature, and finally plunging the casting in cold water.

2. The process herein described of toughening manganese-steel castings, consisting in retaining in the casting a portion of its original casting heat, then heating such casting beginning with the furnace in a heated state, and applying the heat rapidly until the casting has reached a predetermined high temperature, and then finally plunging the casting in cold water.

3. The process herein described of toughening manganese-steel castings, consisting in checking the cooling of and retaining in the casting a portion of its original casting heat, then heating such casting beginning with the furnace in a heated state substantially corresponding to the temperature of the casting when the cooling thereof is checked, and then finally cooling the casting.

4. The process herein described of toughening manganese-steel castings, consisting in checking the cooling of and retaining in the casting a portion of its original casting heat, then rapidly heating such casting beginning with the furnace in a heated state substantially corresponding to the temperature of the casting when the cooling thereof is checked, and then finally plunging the casting in cold water.

5. The process herein described of toughening manganese-steel castings, consisting in heating them beginning with the furnace in a heated state and with the casting in a heated state, then heating such casting up to a predetermined point, and then finally cooling it.

6. The method of treating manganese steel which consists in maintaining in the steel a part of its formative heat by checking the

cooling process at a predetermined point above normal atmospheric temperature thereby to retain therein a certain part of its original high heat determined by the size and design of the article, then heating such article up to a predetermined high temperature, and then rapidly cooling the same.

7. The method of toughening manganese steel which consists in checking the cooling of and maintaining in the article after it is cast, forged or rolled into its final finished shape for use as a manufactured article of commerce a predetermined amount of its casting, rolling or forging heat less than that originally present in the article and varying according to the size, character and design of the article, then heating such article from or substantially from the point where the cooling was checked up to a predetermined point, and then rapidly cooling the same.

8. The method of toughening manganese steel which consists in checking the cooling of and maintaining in the article after it is cast, forged or rolled into its final finished shape for use as a manufactured article of commerce a predetermined amount of its casting, forging or rolling heat less than that originally present in the article and varying according to the size, character and design of the article, then rapidly heating such article from or substantially from the point where the cooling was checked up to a predetermined point, and then rapidly cooling the same.

9. The method of treating steel having therein a predetermined percentage of manganese which consists in retaining therein a part of its original formative heat by checking the cooling of the steel before it reaches normal atmospheric temperature, then heating said steel up to a predetermined temperature substantially above a forging temperature, and then quickly cooling it.

10. The method of treating steel having therein a predetermined percentage of manganese which consists in retaining therein a part of its original formative heat by checking the cooling of the steel at a point above normal atmospheric temperature, then placing it in a heated furnace and rapidly heating it up to a predetermined temperature and then cooling it.

11. The method of treating steel having therein a predetermined percentage of manganese, which consists in maintaining in the article after it is cast or formed a certain amount of its casting or formative heat less than that originally present and ranging from a point above normal atmospheric temperature to a point about 1,000° Fahrenheit according to the size and design of the article, then placing the same in a heated furnace, then rapidly heating the article up to a predetermined high temperature, and then rapidly cooling it.

12. The method of toughening manganese steel, which consists in maintaining in the article after it is cast or formed a certain amount of its casting or formative heat less than that originally present in the article and ranging from about 150° Fahrenheit upward according to the size, character and design of the article, then placing the same in a heated furnace, then heating said article up to a predetermined temperature above a forging temperature and then quickly cooling the article.

13. The method of toughening manganese steel, which consists in first casting the steel into its final finished shape, then permitting the same to solidify to a point where it can be handled, then treating the article by covering it with sand to check the cooling thereof and maintain therein a part of its original temperature, determined by the size, character and design of the article and ranging above normal atmospheric temperature and below substantially 1,000° Fahrenheit, then placing the article in a furnace heated to a temperature substantially corresponding to the temperature remaining in the article and heating the same rapidly up to a predetermined high heat, and then immersing the article in water.

WALTER BRINTON.

Witnesses:
JACOB STRUBLE,
PERCIVAL CHRYSTIE.