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R. A. HADFIELD.

MANUFACTURE OF MANGANESE STEEL RAILS OR SHAPES.

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Fig: 1.

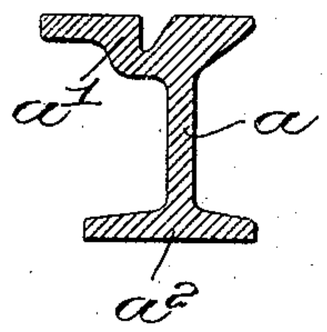
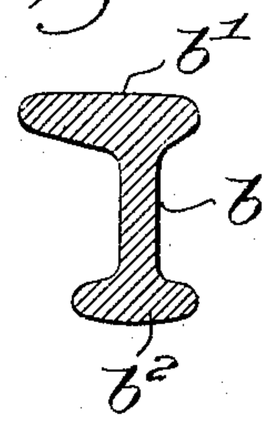


Fig: 2.



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No. 791,189. Patented May 30, 1905.

UNITED STATES PATENT OFFICE.

ROBERT A. HADFIELD, OF SHEFFIELD, ENGLAND.

MANUFACTURE OF MANGANESE-STEEL RAILS OR SHAPES.

SPECIFICATION forming part of Letters Patent No. 791,189, dated May 30, 1905.

Application filed August 19, 1903. Serial No. 169,960.

To all whom it may concern:

Be it known that I, ROBERT A. HADFIELD, a subject of the King of Great Britain, residing at Sheffield, York county, England, have invented an Improvement in Manufacture of Manganese-Steel Rails or Shapes, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

Owing to certain peculiar and valuable properties of what is technically known as "Hadfield's manganese steel," it is very desirable to produce therefrom rolled or forged rails for steam or electric surface roads or railways; but hitherto it has been found impractical to do so by any of the methods of procedure now employed in the treatment of carbon steel. Either the ingots made by such methods are too piped or hollow, so that it is impossible to produce therefrom sound blooms or billets, or the steel falls to pieces through improper heat treatment.

My present invention has for its object the production of a novel process for manufacturing manganese-steel rails or "shapes," as they are termed, in a practical, satisfactory, and commercial manner.

The novel features of my invention will be fully described in the subjoined specification, and particularly pointed out in the following claims.

Figure 1 is a cross-section of a rail used on electric surface roads, and Fig. 2 is a similar view of the blank form in which such rail may be formed.

In carrying out my invention the Hadfield manganese steel made in the usual manner is while fluid cast into ingots of the desired shape formed either in iron or sand molds or a combination of both; but in all cases I provide a large shrinking or feeding head in the top of the ingot-mold. I prefer to form such feeding-head in sand and the ingot proper in an iron ingot-mold of usual construction. Preferably the upper portion of the ingot-mold is made of larger cross-sectional area than the bottom portion, because then the latter chills more quickly and the upper larger portion feeds better and obviates improper contraction of the ingot. Usually ingots are cast with the smaller section uppermost; but this is a great mistake and highly objectionable in dealing with steels which pipe or settle as much as my manganese steel—*i. e.*, the Hadfield manganese steel hereinbefore referred to. By forming the head in sand, as I prefer, I am enabled to provide for the proper feeding of the whole ingot as the steel cools and shrinks. This upper portion of the mold is also usually covered over with charcoal in order to maintain the feeding action as long as possible. The ingot-casting so made is consequently as a whole quite sound, and after the upper or sand-molded portion is cut off a perfectly sound and pipeless ingot remains, from which can be obtained a perfectly sound billet or bloom wherefrom is rolled the rail or shape bars with the desired profile or cross-sectional contour. Even if the bloom or billet be sound it is highly important that a proper heat treatment be employed or the finished product will be unsatisfactory.

I will now specify such a heat treatment as I have found will give satisfactory results.

The billet from the ingot made as herein described is preferably first cooled down and then placed in a heating-furnace of any suitable character and gradually heated up to a temperature of about 800° centigrade. It is then heated as quickly as possible until its temperature is raised to a higher degree, from about 875° to 1,050° centigrade, a temperature of about 950° centigrade being best suited for the purpose. The billet is then taken from the furnace and rolled or otherwise worked into the desired section. Thereafter, either before being cooled down or afterward, the rail or other shape so produced is reheated slowly to about 800° centigrade, then quickly heated to between about 875° to 1,050° centigrade, (according to the qualities desired in the product,) preferably to about 950° centigrade, and quenched as rapidly as possible in a cooling medium. Water as the cooling medium has been found to give the best results.

A rail or other bar shape produced in accordance with my invention as just described is exceedingly tough and possesses very high durability. In fact, if the process has been carefully carried out the product possesses grreater combined toughness and hardness than any other known steel.

In some cases the casting instead of an ingot may be a blank having approximately the general configuration of the desired product in order to reduce the amount of work required and the cost thereof in forging or rolling a billet down to the desired section. Such blanks may be cast in any suitable length—cast horizontally or vertically—in sand or chill molds or combinations thereof. For example, in producing a girder-rail for street-railroads (see Fig. 1) having a web *a*, head *a'*, and base a^2 I may cast a blank of approximately the cross-section shown in Fig. 2, wherein the portions *b b' b²* will when rolled produce the web, head, and base, respectively, of the girder-rail shown in Fig. 1. I may cast the blank very nearly to the desired finished section, so that the final rolling or other similar treatment will be comparatively slight—*i. e.*, in some cases it may be nearly sufficient to finish the casting, which necessarily is not smooth, in order to give it smooth working surfaces. I may also cast the web and lower portions of the rail to the finished size, or nearly so, and roll or squeeze out that portion of the rail which is to be exposed above ground and which will be subjected to wear and tear.

In any of the cases mentioned the heat treatment for toughening is carried out in the manner hereinbefore described.

Rails and shape-bars are thus obtained smooth and free from surface imperfections, thus avoiding entirely or practically entirely the expensive grinding or other finishing steps now necessary.

The ingots may be made of manganese steel compounded with ordinary steel by any of the methods now practiced in producing what are known as "compound ingots."

The ingot or blank (I refer to those cases when the ingot is partially shaped in the proc ess) when rolled will have its top or wearing portion of manganese steel and the under side of ordinary steel, such an ingot being less expensive to produce.

By the term "heat treatment" hereinafter used in the claims I mean a gradual heating of the article up to a temperature of about 800° centigrade and then a quick heating of the article up to a temperature of about 875° to 1,050° centigrade.

My invention is not restricted to the precise details herein described, nor to the exact temperatures such as herein specified, for various changes or modifications may be made according to circumstances without departing from the spirit and scope of my invention.

Having fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The method of manufacturing manganese-steel rails and shapes, which consists in heat-treating a billet or blank of manganese steel by gradually heating it to about 800° centigrade and then quickly raising the temperature thereafter to about 875° to 1,050° centigrade; immediately working the hot billet or blank into the desired section; reheating the latter first gradually and then quickly as before specified, and quickly quenching it in a cooling medium.

2. The method of manufacturing manganese-steel rails and shapes, which consists in heat-treating a billet or blank of manganese steel by gradually heating it to about 800° centigrade and then quickly raising the temperature thereafter to about 875° to 1,050° centigrade; immediately working the hot billet or blank into the desired section; reheating the latter first gradually and then quickly as before specified, and quickly quenching it in water.

3. The method of manufacturing manganese-steel rails and shapes, which consists in heat-treating a billet or blank of manganese steel by gradually heating it to about 800° centigrade and then quickly raising the temperature thereafter to about 950° centigrade; immediately working the hot billet or blank into the desired section; reheating the latter first gradually and then quickly as before specified; and quickly quenching it.

4. The method of manufacturing manganese-steel rails and shapes, which consists in first gradually and then quickly raising the temperature of a cast manganese-steel billet or blank to about 950° centigrade; immediately working the same into the desired section; first gradually and then quickly raising the temperature of the latter to about 950° centigrade; and quickly quenching it in a cooling medium.

5. The method of manufacturing manganese-steel rails and shapes, which consists in first gradually and then quickly raising the temperature of a cast manganese-steel billet or blank to a final temperature of from 875° to 1,050° centigrade; immediately subjecting the hot billet or blank to the action of rolls to form the desired section; gradually and then quickly raising the temperature of the rolled rail to from 875° to 1,050° centigrade, and quickly quenching it in water.

6. The method of manufacturing manganese-steel rails and shapes, which consists in casting of manganese steel an ingot having a larger area at its upper portion than at its lower portion and provided with a large feeding-head; removing the feeding-head and forming a billet from the lower solid and sound portion of the ingot; heat-treating the billet; immediately working the latter while

hot into the desired section; heat-treating such section, and quickly quenching the same.

7. The method of manufacturing manganese-steel rails and shapes, which consists in casting manganese steel into an ingot-mold having a sand top and providing a large feeding-head for the ingot; separating and forming a billet from the solid portion of the ingot below the sand portion of the mold; heat-treating the billet and immediately thereafter working the same into the desired section; heat-treating such section, and quickly quenching it.

8. The method of manufacturing manganese-steel rails and shapes which consists in casting manganese steel into a blank having approximately the shape of the desired section; first gradually and then quickly heating the same to a final temperature of about 950° centigrade; immediately thereafter subjecting the heated blank to the action of compressing means to finish the surfaces thereof; then gradually and then quickly raising the temperature of the blank to from 875° to 1,050° centigrade, and quickly quenching it in a cooling medium.

9. The method of casting manganese-steel rails which consists in casting a rail-blank of manganese steel with the web and lower portions thereof to finished size; heat-treating the entire rail to raise it to a final temperature of about 950° centigrade; immediately thereafter subjecting the unfinished portion of the rail-blank while hot to compression to finish it, then heat-treating the rail to raise it to a final temperature of about 950° centigrade, and quickly quenching the same in a cooling medium.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT A. HADFIELD.

Witnesses:

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