UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN COMPOUNDS AND PROCESSES FOR REFINING IRON AND STEEL.

Specification forming part of Letters Patent No. **188,078**, dated March 6, 1877; application filed February 21, 1877.

To all whom it may concern:

Be it known that I, JOHN EDWIN SHERMAN, now of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Compound and Process for Refining Iron and Steel, of which the following is a full, clear, concise, and exact description, sufficient to enable all skilled in the art to practice the same.

The principal defects inherent in iron as ordinarily produced are two, known to iron-workers as "cold-short" and "red-short," the first being used to indicate that the metal is brittle and rotten when cold, the other that it is brittle and rotten when hot. Certain mechanical defects produced by the imperfect union of contiguous portions of the iron, and known to iron-workers as "cold-shuts," are also very common.

An ingot or other mass of iron, practically free from each of these defects, ranks very high, as to quality, among practical iron-workers, and the main object of my invention is to produce such metal cheaply, and with as little departure from the methods of manufacture now well-known as is practicable.

In order to more clearly describe my improvement in the art, I will first give a concrete illustration of its working in the Martin-Siemens furnace, so called.

The "charge," (or the metal used, usually several tons,) consists of pig-iron or cast-iron, scrap, and wrought-iron, and the quality of the product has heretofore depended wholly upon the quality of the iron making up the charge.

Old iron railroad-rails, for instance, on account of their cheapness, might be used very profitably, but for the fact that they are made up of a mixture of cold-short and red-short iron, and consequently the use of old iron rails, even as a small part of the wrought-iron of the charge, will produce an inferior product, and the product cannot practically be rolled if as much as one-tenth of the whole charge be old iron rails, while, if the iron be treated by my process sixty per cent., and even more, of the charge may be old iron rails, and yet the quality of the product be excellent.

The charge is inserted in the usual way in practicing my invention; but when the metal commences to expand to a boil, or when it is ready to receive the spiegel, I add the following mixture, viz: for each ton of metal in the charge, iodide of sodium, four hundred grains; bromide of sodium, four hundred grains; chloride of ammonium, eight hundred grains; and sulphuret of antimony, two hundred grains. The immediate effect of inserting this mixture is to greatly increase the fluidity of the molten metal, and it will be found that the metal is no longer either cold-short or red-short, and that the ingots produced are almost wholly if not entirely free from cold-shuts, and in addition that the metal is very uniform.

As an example, a charge of one ton of foundry pig-iron, (whether good or bad quality,) and the balance (five tons, when the total charge is six tons) of cheap material, such as old iron rails, for example, will, if treated as above described, produce a product at least equal to, if not better, than that produced by substituting Lake Superior blooms, or other wrought-iron of equal quality, and charcoal pig, for the cheap material. In this example the use of my invention greatly cheapens the cost of the product, and yet does not at all impair its quality.

The best mode of applying the chemicals above named now known to me, is to mix the ingredients above named with about the same amount of common salt, and make the whole mixture into a package, using a paper or other wrapper for convenience of handling. This package is then put into a sheet-iron box or other-like receptacle, which box is secured upon the end of a long iron rod, by which the box and its contents are forced down into and to the bottom of the molten metal. The purpose of this is to allow the ingredients to get well into the molten metal before they are decomposed, and the only purpose of the salt (apart from the chlorine evolved) is, so far as I can form any opinion satisfactory to myself, to make the action of the heat slower, the sheet-iron box also aiding in this.

My invention, is not, of course, confined to the charge above mentioned, as I have found by practical use that it improves greatly every charge which I ever knew to be used; but, of course, the better the quality of the charge the less the improvement, excepting

only as to the matter of uniformity of product, the improvement in this respect being substantially the same whether the materials for the charge be of a good or an inferior quality. Neither is my invention capable of use only in the Martin-Siemens or other reverberatory furnaces, but may be used with great advantage in the Bessemer converter, the puddling-furnace, and in crucibles; in fact, in any furnace where iron or steel is produced.

In the Bessemer converter the mixture should be added when the metal expands to a boil, as in the Martin-Siemens, and may be applied in the same way, or may be introduced in the form of powder with the blast. A very inferior quality of pig-iron may be used in the Bessemer process if my invention be practiced, and yet the product be equal to that produced without my process from the best quality of pig-iron.

In the puddling-furnace the mixture is best introduced in the same way, and at the same time, as above described, and with the same results.

In the crucible, the mixture is put in at the time of charging, but the sheet-iron vessel is not desirable.

In the blast-furnace, the mixture may be applied from time to time as the furnace is tapped, by being blown through the blast-pipes.

In the foundry, the mixture may be put in the ladle before the molten metal, or added after the metal is put in.

My invention, as will now be clear, relates to the improvement of the quality of the metal, and consequently in practicing my invention in the manufacture of steel, the steps subsequent to the addition of my mixture are the same as if my invention was not practiced, for although the quality of the steel produced is superior, this is solely because the quality of iron converted into steel has been greatly improved.

The gist of my invention consists in the treatment of iron with iodine, bromine, and chlorine in connection with each other. I have practically found that several other iodides, bromides, and chlorides may be used, and I have also used free iodine with good results; but, while so far as I can discover, the sodium has no effect, I yet prefer to use the iodine and bromine in the form of iodide and bromide of sodium, and the chlorine in the form of chloride of ammonia or chloride of sodium, or both.

In the Martin-Siemens furnace I always use the mixture above given, and have found practically that any material departure from it will deteriorate it somewhat; the antimony, however, is not strictly essential, but it is highly desirable, as I have found upon repeated experiments that it improves the product.

I do not claim the use of iodine or bromine alone; but

What I claim as my invention is—

1. The process of treating iron with iodine, bromine, and chlorine, in connection with each other, substantially as described, whereby the defects above named (cold-short, red-short, and cold-shuts) are cured.

2. The composition for treating iron, consisting of a mixture of iodide, bromide, and chloride salts, as above described, and substantially in the proportions specified.

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