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Letters Patent No. 84,053, dated November 17, 1868.

IMPROVEMENT IN THE MANUFACTURE OF IRON AND STEEL.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that we, FRANCIS ELLERSHAUSEN, of Ellershause, in the Province of Nova Scotia, (recently of Montreal,) Dominion of Canada, AUGUSTUS E. STAYNER, of Halifax, Province of Nova Scotia, aforesaid, and ADOLPH GUZMAN, of the city of New York, and State of New York, have invented a new and useful Improvement in the Manufacture of Iron and Steel; and we do hereby declare the following to be a full, clear, and exact description thereof.

The nature of our invention relates to the production of iron in a new and useful condition, suitable for the general purposes of the manufacture of iron and steel, and combining the advantages of improved quality and diminished cost.

To enable others skilled in the art to make use of our invention in the manufacture of iron and steel, we will proceed to describe our method of operation, and the results attained thereby.

Our process consists substantially in mixing together cast-iron and an oxide or oxides in such manner and in such proportions as to produce a solid (as distinguished from a fluid) mass, one, and either, of them being in a solid condition, and the other of them in a fluid state, by reason of heat applied to it previously to such mixing.

We shall, in this specification, describe more particularly our process as applied to the treatment of melted cast-iron with solid oxide.

We use cast-iron, either taken directly from the blast-furnace, or remelted; and for the oxidizing-agent, iron-ore, crushed or pulverized, may be most conveniently employed, although we do not desire to restrict ourselves to the use of any particular oxide. The mixing may be effected in any suitable receptacle or mould, of such dimensions as will give to the resultant mass the desired shape and size. An ingot-mould in two pieces, united and held together by bands, will answer the purpose.

In the bottom of this mould we first place a small quantity of iron-ore, so that the mixing may commence as soon as the melted cast-iron is introduced. We then pour into the mould a stream of liquid cast-iron, and, simultaneously therewith, a stream of finely-crushed or powdered ore, keeping the flow of each as steady as possible, and stirring them constantly with a tool, (preferably made of wood,) so as to effect an intimate admixture. Care must be taken that there shall be fully enough ore for the operation. It will be

found that on this admixture the liquid cast-iron instantly becomes pasty, and then solid, so that as the materials are poured in and mingled, a solid (as distinguished from a fluid) mass is built up until the mould is full. Removing the full mould, and supplying a fresh one continuously, the operation is kept up until the whole of the cast-iron has been operated on.

On opening these moulds, by removing the rings and wedges by which the sections are held together, the mass formed therein is turned out. This mass is a loose, spongy ingot, from which the excess of ore which has not combined with the cast-iron will shake out.

To the material thus formed we have given the name of "pig-bloom," if cast in a mould or other such receptacle, and preserved in the shape thus acquired; but if the ingot be broken up small, or if this material be formed in such a manner as to consist of smaller pieces, flakes, granules, plates, or scraps, then we call it "pig-scrap."

This "pig-bloom," and "pig-scrap," will be found to be mechanical mixtures or conglomerates, consisting of particles or grains of cast-iron, of ore, of perfectly-converted wrought-iron, and of still other particles of various intermediate conditions. But if there have been tolerable skill and care exercised in mixing, the mass will be converted into a condition so nearly akin to that of wrought-iron that it will only need the judicious application of heat to resume and complete the chemical operations, which, having been commenced in the process of mixing, were arrested by the cooling of the mass, in order to perfect the conversion of the cast-iron and the ore into wrought-iron, by the combination of the carbon of the carburet with the oxygen of the oxide. In fact, this part of the after-treatment is conducted as if the result of the mixing of the ore with the cast-iron were already pure wrought-iron, because the heating which is given to it during the further working, will supply all the conditions required for actually producing wrought or malleable iron.

It will also be found, in practice, that this "pig-bloom" and "pig-scrap" are capable of enduring, without damage, a very great exposure to heat, both in intensity and duration, and thus the impurities can be sweated out of the metal to an extent which is not possible by the old methods of iron-metallurgy, or at least not without great expense.

The making of the pig-bloom, or pig-scrap, in the manner described, affords a convenient and very efficient means of obtaining the good effects of such mate-

rials as are known to be beneficial, either as detergents or as alloys, in some of the operations of iron-metallurgy, (as in the crucible,) but which have wholly or partially failed to assist in the blast-furnace, the refinery, the bloomery, the puddling-furnace, or the Bessemer converter. By combining such materials with the pulverized ore, they enter into intimate mechanical admixture with the mass of the pig-bloom or pig-scrap during the process of "mixing," before described, and being thus imprisoned in the mass, and subjected for a long time to a heat too great for them to endure as solids, they must either escape as fluids or gases, or else become chemically incorporated with the iron.

Instead of "mixing" by pouring the streams of finely-crushed ore and of fluid cast-iron simultaneously into a mould, the same result, substantially, may be reached by scattering the cast-iron on a bed of ore, or by delivering it on a moving surface, upon which ore may be placed before or after the metal is deposited; or, indeed, a variety of methods may be devised whereby to bring the fluid cast-iron and the solid ore into a contact sufficiently intimate to produce a conglomerate of the character hereinbefore described.

The method of operation may also be varied by employing the oxide or oxides in a melted state, and the cast-iron, granulated or otherwise finely divided, in a solid as distinguished from a fluid state, mixing them in such manner as to produce the conglomerate desired.

Iron-ore, or oxide of iron, has been described as the oxidizing-agent in our process, but we do not confine our invention to the use of that material, as other oxides may be used in combination with or in lieu of it.

We are aware that the removing of the carbon of cast-iron to a greater or less degree, by means of oxides, is not new, and that the mixture of solid oxides with fluid cast-iron is performed in the puddling-furnace, and in other operations; but this is done under other conditions, and with different results. But the novelty of our process consists in the mixing of solid oxides into and among fluid cast-iron, or of fluid oxides with solid cast-iron, granulated or minutely subdivided, in such a manner and in such quantity as to produce a solid conglomerate of the two substances, and also in effecting this mixture, and producing the resulting pig-bloom or pig-scrap, without the application of other heat than that of the fused cast-iron or oxide, as the case may be, thus dispensing with the use of a fur-

nace for any part of the process of mixing after the melting of the cast-iron or oxide, whichever of them is used in a fused condition.

It will be found that the material thus produced may be used in like manner as any wrought-iron of similar shape, so that when raised to a welding-heat, the pig-bloom, manufactured as hereinbefore described, may be pressed, squeezed, hammered, rolled, or worked in any of the methods employed in the treatment of wrought-iron, and with like results, excepting that the article of wrought-iron produced by our process is superior in quality to that obtained in the ordinary way.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. As a new article of manufacture, pig-bloom, or pig-scrap, being a conglomerate of cast-iron, oxides, wrought-iron, and particles of matter more or less nearly approaching one or other of those substances, produced by admixing, and bringing in contact with fluid cast-iron, oxidizing-substances in a solid state, in such a manner and in such quantity as to produce a solid condition of the mass.
2. The mixing of cast-iron with an oxidizing-agent, one or other of which is rendered fluid by heat applied previously to such mixing.
3. The production of wrought-iron from cast-iron, by mixing with the latter, while fluid, a sufficient amount of oxidizing-material to produce a solid condition of the mass.
4. The production of wrought-iron from oxides of iron, by mixing the latter with molten cast-iron to such an extent as to produce a solid conglomerate of the two.
5. The employment of detersive agents and useful alloys by mingling them, or either of them, with the oxides used in the process hereinbefore described, so that they shall become part of the conglomerate, and have such intimate contact and connection with the mass as to produce their proper chemical effects when it is afterwards subjected to the action of heat.

In testimony whereof, we, the said FRANCIS ELLERSHAUSEN, AUGUSTUS E. STAYNER, and ADOLPH GUZMAN, have hereunto set our hands.

FRANCIS ELLERSHAUSEN.
AUGUSTUS E. STAYNER.
ADOLPH GUZMAN.

Witnesses:

W. BAKEWELL,
A. S. NICHOLSON.