

UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN PROCESSES OF MANUFACTURING BESSEMER STEEL.

Specification forming part of Letters Patent No. **187,386**, dated February 13, 1877; application filed June 5, 1876.

To all whom it may concern:

Be it known that we, ROBERT W. HUNT and AUGUST WENDEL, of Troy, in the county of Rensselaer and State of New York, have invented a new and useful Improvement in the Process of Manufacturing Bessemer Steel; and we do hereby declare the following to be a full, clear, and exact description thereof:

Our invention relates to a modification of the manufacture of Bessemer metal, by adding to the charge of melted metal in the converter, and previous to its conversion, solid or unmelted pig-iron, or ferro-manganese, spiegeleisen, or like highly manganized iron, whereby metal containing a high percentage of silicon or sulphur may be employed; the bad effects of "hot heats" are entirely avoided, and a saving in fuel, metal, time, and labor is effected, while the capacity of the works is increased; a smaller percentage of recarburizing agent is required, and homogeneous steel of the highest grades is readily produced.

The usual manner of conducting the Bessemer process is to charge the converter with molten metal from a cupola, air, or blast furnace, in which a proper mixture of pig-irons or ores has been previously melted, and then to turn the air-blast onto the metal in the converter, and continue the blowing until the flame indicates that conversion is complete, after which the converter is turned down, the blast shut off, and the proper amount of spiegeleisen or ferro-manganese, in either a melted or solid condition, is added.

To make the proper admixture for the blast-furnace or cupola, the manufacturer has to keep on hand a large stock of various brands of pig-iron and ore, so that he may vary the proportion of each according to their several qualities in preparing the charge, and thus obtain molten metal for the converter process that shall not contain above a certain percentage of silicon, and shall be comparatively free from sulphur and phosphorus. If the melted iron from the cupola or other furnace contains too high a percentage of silicon it will "blow" or work too hot, and cause, if not always the production of bad steel, at least the rapid destruction of the ingot-molds and other appliances with which it comes in contact. In addition to the above difficulties,

the manufacturer has to contend with and make provision for the sulphur imparted to the metal by the fuel used in the cupola or other furnace employed to melt the charge.

We will now proceed to describe our invention, so that others skilled in the art to which it appertains may apply the same.

We first proceed to obtain a charge of melted metal for the converter in the usual manner, with this exception, that the cupola, blast, or other furnace may be charged with such brand or brands of pig-iron or qualities of ores as may be at hand, without regard to the relative proportions of each, care only being taken to ascertain the percentage of silicon, carbon, &c., which will be present in the resulting molten metal, as, to a certain extent, the amount of unmelted pig-iron or spiegeleisen thereafter to be added in the converter will depend thereon.

Knowing the percentage of silicon, &c., present in the charge, the temperature of the charge, and the pressure and amount of blast to be blown, all of which are readily ascertained, the operator can readily determine to what extent the charge will work or blow too "hot," and what amount of solid or unmelted pig-iron cold, or at any given temperature, must be added to absorb the heat and reduce the temperature to the desired point. As the proportionate amount of unmelted metal to be used in the converter depends on the conditions of the charge, as above stated, and also on the percentage of silicon, manganese, and carbon contained in, and the temperature of, the unmelted metal, we cannot be more specific, but may here state that we have added as high as twenty-five (25%) per cent. of unmelted metal with a good result. We use the solid metal either cold or heated, the temperature of the solid metal being governed by the amount to be introduced and the temperature of the melted metal in the converter.

Bearing in mind that it will require a larger quantity of solid metal, when heated above the common temperature, to reduce the heat in the converter to the desired degree, and also the converse, that if it is desirable to use as much solid metal as possible in the converter, the pieces should be heated to as high a temperature as possible, short of fusion, and

having determined the quantity, quality, and temperature of the solid metal to be used in the process, we next proceed to introduce it into the converter before conversion of the charge in the converter is effected.

We find it most convenient, and therefore prefer, to introduce the solid metal before the molten metal from the cupola, blast, or other furnace is run into the converter; but if the quantity of solid metal used is very large, part of it may be thrown in after the conversion has commenced and the converter is turned up. We consider that the best results are attained by introducing the solid metal during the first part of the conversion or "blow," though it may be added at any time before conversion is complete. From this point on, the usual Bessemer process may be followed, excepting that it will be found that a smaller quantity of the recarburizing agents will be required.

The advantages of our improved process are, 1st, that irons containing extremely high percentages of silicon can be used, for the reason that the solid metal, even though of the same chemical nature as the melted metal, being added in a cold or unmelted state to the charge in the converter, absorbs in melting such an amount of heat as to keep down the ultimate heat of the charge, and thus prevent its blowing too hot, and this without the use of scrap steel or other converted metal; and 2d, the use of unmelted pig-iron enables the operator to produce better steel, or steel of the highest grades and more homogeneous, than by the usual process, for the reason that in all stages of the conversion, even to the finishing of the blow, the gradual melting of the added metal will supply silicon and carbon to the charge, and thus prevent the blast from oxidizing the metal already almost entirely free from carbon and silicon.

By substituting spiegeleisen for a portion or the whole of the solid pig-iron, steel of low grades and fine quality, and steel of high grade equal to the best cast steel can be produced; an additional and powerful agent, manganese, which prevents oxidation of the metal, is also obtained, and the resulting steel

will be more free from blow-holes than the product of the common process; 3d, there is a saving of fuel to the extent of what would be required to melt that portion of the metal which is added to the charge in a solid condition, and as the solid metal has no chance to absorb sulphur, as would be the case if it were melted before introducing it into the converter, a metal containing a higher percentage of sulphur can be readily used, thus reducing the necessity for employing high-priced charcoal iron and expensive steel scrap, valuable for other steel processes.

In the manufacture of tool-steel, it will be found advantageous to blow rather short, which can be easily done, as the "change" takes place rather slowly, permitting the blast to be cut off with safety at the desired point. To make soft steel, the charge should be blown for the full time.

So far as this process is concerned, what we mean herein by pig-metal is not only the ordinary products commonly so called, but also those highly manganiferous pigs known as spiegeleisen or ferro-manganese.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The process of manufacturing Bessemer steel from high silicon pig, as herein described, which consists in adding unmelted pig metal to the melted charge in the converter, previous to the conversion of the charge, substantially as and for the purpose specified.

2. The process of manufacturing Bessemer steel, herein described, which consists in adding portions of pig-iron and spiegeleisen, or ferro-manganese, in a solid or unmelted condition to the charge in the converter previous to the conversion of the charge, substantially as and for the purpose specified.

In testimony whereof we, the said ROBERT W. HUNT and AUGUST WENDEL, have hereunto set our hands.

ROBERT W. HUNT.
AUGUST WENDEL.

Witnesses:

P. HARRY MITCHELL,
LEMUEL HURLBUT.