UNITED STATES PATENT OFFICE.

ROBERT W. HUNT AND AUGUST WENDEL, OF TROY, NEW YORK.

IMPROVEMENT IN RECARBURIZERS FOR USE IN THE PNEUMATIC PROCESS.

Specification forming part of Letters Patent No. **200,724**, dated February 26, 1878; application filed November 28, 1877.

To all whom it may concern:

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

The object of our invention is the production of a highly-carburized steel, having a low percentage of manganese and silicon, and has special reference to the manufacture of such steel by the pneumatic process commonly known as "Bessemer steel," but is also adapted to use in the open-hearth or Siemens-Martin process and the crucible process of steel-manufacture.

In the ordinary method of the manufacture of Bessemer steel the melted pig metal is first decarburized in a converter by the agency of a blast of air, and when the required point of decarburization has been reached the metal is recarburized by the addition of ferro-manganese or spiegeleisen.

If, however, it is desired to produce by that process a steel containing a high percentage (say, for example, 0.8 per cent.) of carbon, it involves the necessity of adding so much spiegeleisen as to give the resulting metal an undue amount of manganese, causing the steel so produced to possess a very different character from steel having a like percentage of carbon, but manufactured by other processes, which is found to be objectionable.

It might be possible, perhaps, to obtain the required grade of steel by the Bessemer process by using for the purpose of recarburization a certain proportion of spiegeleisen together with a certain proportion of pig-iron containing little or no manganese and a minimum of silicon and phosphorus; but it would be difficult to procure exactly the grade of pig-iron required, and the result would be empirical.

In order to overcome these difficulties and enable the manufacturer to produce a high-carbon Bessemer steel having a low percentage of manganese and silicon, we prepare, in the manner hereinafter described, a suitable recarburizer, to be used instead of spiegeleisen (or, if preferred, together with a portion of spiegeleisen) in the recarburization of metal after decarburization by the pneumatic process.

Our improved recarburizer is produced in the following manner: Melted spiegeleisen and melted pig metal, in suitable proportions, are run into a Bessemer converter or other pneumatic vessel or furnace, where they are subjected to the air-blast until the manganese and silicon have become oxidized and united to form a slag, and then, while as yet the decarburization of the pig metal is only just commencing, the air-blast is shut off, so as to decarburize the metal as little as possible. The resulting metal constitutes our improved recarburizer.

The following modifications may be adopted, if preferred, in the production of our improved recarburizer: The manganiferous iron may be melted separately from the pig metal in a cupola, reverberatory, or other furnace, and mingled with the pig metal in the pneumatic vessel or converter; or it may be charged unmelted, with the pig metal, into a cupola, and both be melted together, which, perhaps, will be found the most economical and convenient method, and has the additional advantage of preventing the access of sulphur to the iron, which might otherwise be absorbed from the coal employed in melting it; or part of either or both of the spiegeleisen and pig metal may be charged cold into the converter.

The blowing of air into the melted spiegeleisen and pig metal should, as we have stated, be arrested as soon as the manganese has become oxydized, it being desirable to oxidize the metal no more than is necessary for the union of the silicon therewith. The presence of the manganese is important chiefly because, being more susceptible to the action of the oxygen than is the carbon of the pig metal, it is first attacked thereby, and unites with the silicon, which is oxidized simultaneously with it, before the pig metal is materially decarburized, forming a slag, and thereby purifying the iron, and at the same time protecting the pig metal from decarburization. By this means the resulting product (our recarburizer) is not only sufficiently rich in carbon, but is comparatively free from silicon, manganese, and sulphur, and is thereby peculiarly adapted for use in lieu of

the ordinary recarburizing agents for the manufacture of a high-carbon Bessemer steel exceptionally free from manganese and silicon.

The proper time for arresting the blast of air in the process before described of making our improved recarburizer may be determined with great accuracy by the use of the spectroscope, the appearance of carbon lines in the spectrum being the signal for so doing; or it may be ascertained by those skilled in the art by the appearance of the flame, or less conveniently by taking samples of the metal from time to time.

The peculiar physical characteristics of our improved recarburizer, besides those already specified, are a white crystalline structure, great hardness, strength, and density, with the minimum of manganese, silicum, and sulphur.

The metal thus produced is designed to be used for recarburizing the decarburized metal in the usual and well-known Bessemer process of making cast-steel, in such proportions as may be needed to produce the desired grade of steel, and in like manner as ferro-manganese or spiegeleisen has heretofore been employed.

Our improved recarburizer may be also used in the manufacture of steel by the well-known Siemens-Martin process, in which the pig metal is melted in the open hearth of a reverberatory furnace or Siemens furnace, so as to form a bath, which is decarburized by the introduction of wrought-iron scrap. In this process our recarburizer may be used to form the entire bath; or a suitable proportion of our recarburizer may be melted with the pig metal, so as to form a part of the bath; or it may be used for recarburization. Our recarburizer may also be used to advantage in the manufacture of steel by the crucible process, as the amount of carbon which it shall contain may be regulated in its production with great precision. This metal, here designated "recarburizer," may also be used to advantage for castings where great hardness and homogeneity is required.

The processes of making steel to which we have referred, known as the "Bessemer process," the "Siemens-Martin or open-hearth process," and the "crucible process," are so well known that the application to them of our improved recarburizer will be well understood without further explanation.

The suitable proportions of spiegeleisen and pig metal to be used in making our recarburizer will depend on the percentage of manganese contained in the former and of silicon in the latter. As these percentages vary, we cannot give any precise quantities; but we may state that, with pig metal containing four per cent. of silicon and no manganese, we prefer to use about sixty per cent. of pig-iron and forty per cent. of spiegeleisen containing ten per cent. of manganese. If the pig metal should contain manganese, the proportion of spiegeleisen should be proportionally reduced.

With these suggestions, the skillful operator will be at no loss to proportion his ingredients, having in view the object to be attained.

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

1. The method herein described for producing a recarburizing agent for use in the manufacture of steel, which consists in subjecting a melted or partially melted mixture of pig-iron and spiegeleisen or ferro-manganese to the action of an air-blast sufficiently long to substantially oxidize the silicon and manganese without materially decarburizing the metal.

2. As a new article of manufacture, the improved recarburizing metal hereinbefore described, having as characteristics a white crystalline structure, great hardness, strength, and density, with the minimum or but a trace of manganese, silicon, and sulphur, substantially as hereinbefore set forth.

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

ROBERT W. HUNT.
AUGUST WENDEL.

Witnesses:
E. W. GREENMAN,
A. B. SLOCUM.