UNITED STATES PATENT OFFICE.

JAMES J. McTIGHE, OF PITTSBURG, PENNSYLVANIA.

PROCESS OF MANUFACTURING STEEL.

SPECIFICATION forming part of Letters Patent No. 397,743, dated February 12, 1889.

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To all whom it may concern:

Be it known that I, JAMES J. McTIGHE, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in the Process of Manufacturing Steel; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improvement in the process of manufacturing steel, and is applicable to the production of the various grades thereof, from the soft kinds used for sheets and rails to that employed in the production of tools, needles, surgical instruments, &c.

It has commonly been held that the brittleness of iron or steely irons is due, according as the iron is hot or cold, to the presence of an excess of sulphur or phosphorus. Discarding this theory, and assuming that the "cold-shortness" or "red-shortness" of iron or steel is due principally to an admixture of oxide of iron, I have devised a new method or process of manufacturing carburized iron, according to which, even though both sulphur and phosphorus be in excess in the metal, it is exceedingly ductile when of the soft variety and having the qualities demanded in steel intended for widely different purposes.

Hitherto in the manufacture of ordinary steel of low grades—such, for instance, as is used for rails, boiler-plate, &c.—it has been customary to desiliconize and decarburize molten cast-iron by blowing air over or through it. It is an acknowledged fact that this air leaves an oxide of iron mixed with the mass.

My invention has for its object to rid the entire mass of iron of all this injurious oxide as well as to recarburize it to the required degree, as also to purify it by the extraction of phosphorus, sulphur, &c.; and to these ends my invention consists in the combination of two processes—the one being the treatment of any kind of molten ferric compound, usually called "cast-iron," by air or oxygen for the purpose of desiliconizing, decarburizing, and oxidizing; the other being the treatment of the same after the first step by commercial marsh-gas, commonly known as "natural gas."

The first process need not be described, as it is practiced now in a variety of ways and is well known to commerce as the "Bessemer" or "Siemens-Martin" method.

The second process consists in forcing natural gas through or over the bath of molten iron produced by the first process. The rationale of this second process is as follows: The gas disassociates the instant it comes in contact with the molten iron, as it always does in the presence of great heat, the carbon and hydrogen both assuming the nascent state. Carbon having in the presence of heat a great affinity for oxygen deoxidizes the oxide of iron existing in the mass, thus producing a certain quantity of heat calculated to keep the mass in a molten condition. Hydrogen, on account of a similar affinity, assists in this reaction and result, and the twofold product—carbonic oxide or acid and hydric oxide—passes off as waste, the developed heat effectually preventing the chilling of the mass in the converting-vessel. Simultaneously a further quantity of nascent hydrogen combines with portions of the sulphur and phosphorus, and forms, respectively, sulphureted and phosphoreted hydrogen, which pass off as vapors, thus further purifying the product. It is also probable that a portion of the nascent carbon will unite with some of the sulphur to form bisulphide of carbon—another vapor that is at once carried off. A certain quantity of the nascent carbon unites with the molten mass of iron to form steel, which will be of high or low grade according to the duration of the required described reaction.

The special features in the use of natural gas are—

First, its entire freedom from elements which might prove injurious to the steel, especially sulphur and phosphorus. This feature is not found in any gas made from any kind of coal.

Secondly, in the comparatively low amount of carbon it contains, it being almost entirely marsh-gas.

All other gases made from petroleums, oils, fat, &c., are very rich in carbon. When such carbons are brought into contact with molten iron, the amount of carbon disassociated by heat is so great as to chill the mass at once or leave flakes of uncombined carbon distributed

throughout the mass, which, when the iron is rolled into thin sheets, appear on the surface and effectually prevent its being properly galvanized or tinned. The percentage of nitrogen and free hydrogen shown by some analyses to be in natural gas obviously diminish the risk of producing such carbon flake.

By the use of natural gas a practical and cheap substitute is obtained in place of the expensive spiegel iron heretofore adopted, and a fine quality of excellent steel of any desired grade is obtained economically and commercially, the same furnace producing, as desired, rails or plate, or sheet or razor, or wire, or cast or malleable steel, a result heretofore never hoped for. These various grades of steel will follow the varying amounts of carbon allowed to combine with the molten iron, and they can be in practice regulated with the scientific precision of chemistry.

I claim—

1. The process of manufacturing steel, consisting in desiliconizing, decarburizing, and oxidizing molten iron by air or oxygen, then deoxidizing, desulphurizing, and dephosphorizing, by commercial marsh-gas, commonly known as "natural gas," and finally recarburizing to any degree desired by the disassociating carbon of the same marsh or natural gas.

2. The process of manufacturing steel, consisting in subjecting iron while in a molten state to the action of natural gas or methane, substantially as described.

3. The process of manufacturing steel by first melting cast-iron, then burning out its silicon and carbon with air, and finally, while still molten, recarburizing the iron by subjecting it to the action of natural gas or methane, substantially as described.

4. In the manufacture of steel, the process of recarburizing decarburized iron by forcing natural gas or methane through the iron while the latter is in its molten state, substantially as described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

JAMES J. McTIGHE.

Witnesses:

THOS. J. McTIGHE,

H. J. SCHNEIDER.