

# UNITED STATES PATENT OFFICE.

ALEXANDER H. SIEGFRIED, OF SELIN'S GROVE, ASSIGNOR OF ONE-HALF  
TO TRUMAN H. PURDY, OF SUNBURY, PENNSYLVANIA.

## PROCESS OF TREATING IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 254,508, dated March 7, 1882.

Application filed February 1, 1881. (No specimens.)

*To all whom it may concern:*

Be it known that I, ALEXANDER H. SIEGFRIED, of Selin's Grove, in the county of Snyder and State of Pennsylvania, have invented  
5 certain Improvements in Processes of Treating Iron and Steel, of which the following is a specification.

The object of my invention is to improve the quality and increase the strength of cast-iron,  
10 wrought-iron, and steel by eliminating therefrom to a greater or less extent the phosphorus, sulphur, silicon, and other foreign matters contained therein; and to this end the invention consists essentially in combining with  
15 the metal while it is in a molten condition carbonate of soda and sulphate of copper in certain limited proportions—to wit, in an amount not exceeding fourteen ounces to each hundred pounds of the metal. In all cases the sulphate of  
20 copper and carbonate of soda are to be thoroughly incorporated with the molten metal. The manner of effecting the incorporation is immaterial, provided it secures a thorough and uniform distribution of the chemicals through  
25 the entire mass of metal. The chemicals may be introduced into the furnace and incorporated with the metal therein, or placed in a receiver of any suitable kind and the molten metal discharged therein; or they may be in-  
30 corporated with the molten metal after the latter has been drawn from the furnace into a ladle, shank, or other receiver.

In ordinary cases—that is to say, in cases in which the metal contains a usual or ordinary proportion of foreign matter—it is found sufficient  
35 to use from one to four ounces of the chemicals, the amount usually employed not exceeding one and a half ounce to each hundred pounds of metal. It is only in exceptional cases in  
40 which the metal contains a large proportion of sulphur and phosphorus that the proportion of chemicals used will exceed four ounces to the hundred pounds of metal.

I propose to make use of my method and com-  
45 pound for the purification and improvement of cast-iron, either before or at the time of using the same for foundry purposes; also, in connection with cast-iron in the puddling-furnace during the course of its transformation into  
50 wrought-iron; also, for the treatment of metal which is to be converted into steel by the Bes-

semer process; also, in the treatment of Bessemer metal for converting the same into wrought-iron; and, also, in the treatment of steel made  
by the Siemens or open-hearth process, or other- 55 wise.

When the metal to be purified and improved is cast-iron I incorporate the compound with the molten iron in the furnace or with the molten iron after it has been drawn from the fur- 60 nace into a ladle or other receiver, using ordinarily from one to four ounces of the compound for each hundred pounds of metal, and thoroughly incorporating it therein. It is found in practice that the effect of thus apply- 65 ing the chemicals is to eliminate or neutralize wholly or to a great extent the sulphur, phosphorus, silicon, and other foreign matters injurious to the metal, leaving the latter in a greatly-purified condition, in which it pos- 70 sesses far greater strength than before its treatment.

In connection with the Bessemer process for manufacturing steel I introduce the compound into the molten metal after the latter has been 75 decarbonized, either in the converter or in the shank, ladle, or other receiver into which the molten metal may be delivered from converter.

I also propose in the process of manufactur- 80 ing wrought-iron by means of the Bessemer apparatus to introduce metal into the Bessemer converter, and decarbonize it therein as usual, and then apply my compound to the molten metal either in the converter or in a ladle, shank, or other receiver into which the decarbonized 85 metal may be delivered from the converter. In this process the usual recarbonization of the metal followed in the Bessemer process is omitted.

I also propose to make use of my process in 90 connection with the Siemens or open-hearth process of making steel, introducing my compound in such case into the molten metal after the decarbonization has taken place, and also, if desired, after recarbonization. 95

In each and every instance in which my com- pound is used it is to be applied while the metal is in a molten condition. While a single treatment of the metal with the compound is highly beneficial, and is in many cases suffi- 100 cient for all purposes required, it is to be understood that the treatment may be repeated



any suitable number of times, either by simply remelting the metal for the purpose of applying my treatment, or by applying the treatment during the different steps or stages of converting the cast-iron into wrought-iron or steel. For example, the treatment may be applied to the cast-iron, again to the iron in the puddling-furnace, and again to the metal at one or more stages in the conversion of the wrought-iron into steel.

While great advantages are attained by the use of the sulphate of copper and carbonate of soda alone, it may be desirable in some cases to use other chemicals in connection therewith for peculiar and special purposes arising in individual cases from the character of the metal to be treated or the requirements of the metal to be produced. Certain of these compounds will be made the subject of a separate patent.

My present invention relates particularly to the removal of phosphorus and sulphur; and the invention consists in the application to molten metal containing said impurities, or either of them, of sulphate of copper and carbonate of soda, preferably within the limits hereinbefore named, either alone or as the basis of other compounds. In practice it is found that when sulphate of copper and carbonate of soda are used in proportions materially exceeding those herein named the results aimed at are not attained in a fully successful manner.

In a patent granted to me on the 24th day of September, 1872, No. 131,634, I described a compound for the preliminary treatment of wrought-iron in the course of converting the same into malleable iron, and in said compound I named, among other ingredients, sulphate of copper and carbonate of soda, specifying the use of the same in proportions exceeding those now named. The original patent does not describe and did not contemplate the removal of sulphur and phosphorus, or either of them; nor did it describe the application of carbonate of soda and sulphate of copper to molten metal containing sulphur or phosphorus. For the above reasons and the reason that said patent does not disclose the fact that sulphur and phosphorus can be eliminated or removed by the use of the carbonate of soda

and sulphate of copper the said patent in no manner affects my present invention.

The chemical effect or combination of the sulphate of copper and carbonate of soda I am unable at the present time to state with certainty, and for this reason I prefer not to set up herein any theory as to the mode of action of the ingredients named, deeming it sufficient to state that I have found by practical test that the carbonate of soda and sulphate of copper, when applied in the manner and in the proportions stated, will remove or eliminate to a very great extent the sulphur, phosphorus, and silicon which may be contained in the metal treated. I find that the sulphate of copper and the carbonate of soda will jointly secure the results named, but that neither one will alone secure the end sought.

Having thus described my invention, what I claim is—

1. The process of treating molten cast-iron or steel containing phosphorus or sulphur to remove said elements therefrom, the same consisting in incorporating with the molten metal a compound composed of sulphate of copper and carbonate of soda, in proportions substantially such as herein specified.

2. As an improvement in the art of eliminating phosphorus and sulphur from iron or steel, incorporating therewith while it is in a molten condition sulphate of copper and carbonate of soda in substantially the proportion of one and a half ounce to each hundred pounds of metal.

3. The herein-described method of treating iron and steel for the removal of sulphur, phosphorus, and silicon, consisting in incorporating therewith while it is in a molten condition carbonate of soda and sulphate of copper, substantially as described.

4. As an improvement in the art of treating iron and steel to purify and strengthen it, the process consisting in repeatedly melting the metal and incorporating therewith during each of its molten periods a compound consisting of sulphate of copper and carbonate of soda.

ALEXANDER H. SIEGFRIED.

Witnesses:

P. T. DODGE,  
GEO. F. GRAHAM.