

# UNITED STATES PATENT OFFICE.

FRANCIS G. BATES, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE BATES STEEL COMPANY, OF SAME PLACE.

## METHOD OF MANUFACTURING STEEL.

SPECIFICATION forming part of Letters Patent No. 428,446, dated May 20, 1890.

Application filed October 29, 1887. Renewed January 6, 1890. Serial No. 335,950. (No specimens.)

*To all whom it may concern:*

Be it known that I, FRANCIS G. BATES, a citizen of the United States, and a resident of Philadelphia, Pennsylvania, have invented 5 certain Improvements in the Manufacture of Steel, of which the following is a specification.

The object of my invention is to convert articles of cast, malleable, or wrought iron or Bessemer steel or steel castings into steel of 10 any degree of hardness and of such character that it is capable of being tempered and of receiving and retaining a sharp cutting-edge, so that it is available for the manufacture of tools of all kinds.

15 In carrying out my invention I subject any of the metals above alluded to to the action of heat when in contact with carbon, silica, and alumina.

In treating the articles which are to be converted into steel I pack them, with the compound of carbon, silica, and alumina, in a suitable flask, so that each article will be surrounded by said compound. The flask is then closed so as to be air-tight, and is then subjected to a gradually-increasing temperature 20 until it reaches a white heat, at which temperature it is maintained for a period which will vary depending upon the bulk of the articles being treated, articles of large bulk requiring treatment for a longer time than 25 smaller articles.

The proportions of the different ingredients in the compound used in carrying out my invention in this way may vary, the range being from five to thirty parts, by weight, of carbon, eighty to one hundred parts of silica, and ten to twenty parts of alumina, the variations in the amounts of carbon and silica being determined by the desired hardness of 35 the steel to be produced, while the variations

in the amount of alumina are governed by the desired malleability of the product. A large proportion of carbon may also be used when the articles which are being treated are of large bulk or where it is desired to shorten 45 the time of treatment.

When the articles are removed from the flask, they are by preference permitted to cool rapidly, so as to hasten the contraction.

I have found that castings of malleable iron, 50 steel castings, and articles of wrought-iron or Bessemer steel, when subjected to treatment in accordance with my invention, will change in character and acquire a fine grain and homogeneous structure, while at the same time 55 they are rendered so hard that they are available for use in the manufacture of all kinds of cutting-tools.

In carrying out my invention it is advisable to moisten the compound before applying 60 heat, in order that hydrogen gas may be generated during the treating operation, the process being thereby facilitated.

Having thus described my invention, I claim and desire to secure by Letters Patent— 65

The within-described mode of converting into steel of any desired degree of hardness or quality iron of any description or low steel, said mode consisting in packing the articles in a tight flask with carbon, silica, and alumina, in proportions substantially as specified, and then subjecting the closed flask and its contents to the action of heat, as set forth. 70

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses. 75

FRANCIS G. BATES.

Witnesses:

WILLIAM D. CONNER,  
HARRY SMITH.