# UNITED STATES PATENT OFFICE.

HENRY D. BOOTH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE MIDVALE STEEL COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

## STEEL.

No. 914,633. Specification of Letters Patent. Patented March 9, 1909.

Application filed June 20, 1908. Serial No. 439,477.

*To all whom it may concern:*

Be it known that I, HENRY D. BOOTH, a citizen of the United States, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in Steel, of which the following is a full, clear, and exact description.

Heretofore it has been attempted to use copper in a steel mixture, for the purpose of increasing the physical properties of the steel. However, the use of copper has been accompanied with considerable troubles and defects, such, for instance, as the tendency, if sufficient copper be added to produce a notable result, to have so large an amount of copper as to produce red-shortness and also to have some of the copper not properly alloyed and remaining in the mixture in its original condition. I have discovered that if to a steel mixture containing copper in quantity safely insufficient to produce red-shortness and to avoid its appreciable separation in the ultimate steel, say from 1/2 to 1 1/2 per cent., I add a very small quantity of vanadium, say from 1/10 to 6/10 per cent. I can produce an efficient result without any of the deleterious effects which would arise if I attempted to produce such result without the addition of vanadium. As an example of the steel which I have made, the following is given:

| | | |
|---|---|---|
| Carbon | .433 | per centum |
| Phosphorus | .057 | " " |
| Manganese | 1.22 | " " |
| Silicon | .259 | " " |
| Sulfur | .038 | " " |
| Copper | .72 | " " |
| Vanadium | .30 | " " |

Having now fully described my invention, what I claim and desire to protect by Letters Patent is—

1. The method of improving steel, which consists in adding thereto a small amount of copper and vanadium.

2. A steel containing a small amount of copper and vanadium.

3. The method of improving steel, which consists in adding thereto from 1/2 to 1 1/2 per cent. of copper and from 1/10 to 6/10 per cent. of vanadium.

4. A steel containing from 1/2 to 1 1/2 per cent. of copper and from 1/10 to 6/10 per cent. of vanadium.

In testimony of which invention, I have hereunto set my hand, at Philadelphia, on this 17th day of June, 1908.

HENRY D. BOOTH.

Witnesses:

JOHN BROWN MCKEE,

HENRY D. BOOTH, Jr.