

UNITED STATES PATENT OFFICE.

ROBERT ABBOTT HADFIELD, OF SHEFFIELD, ENGLAND.

PROCESS OF IMPROVING THE MAGNETIC QUALITIES OF IRON-SILICON-MANGANESE ALLOYS.

No. 837,682.

Specification of Letters Patent.

Patented Dec. 4, 1906.

Application filed August 21, 1906. Serial No. 331,423.

To all whom it may concern:

Be it known that I, ROBERT ABBOTT HADFIELD, a subject of the King of Great Britain, and a resident of Sheffield, England, have invented a certain new and useful Improvement in Processes of Improving the Magnetic Qualities of Iron-Silicon-Manganese Alloys, of which the following is a specification.

In another application for Letters Patent, Serial No. 324,892, filed July 5, 1906, I have described and claimed an alloy of iron with silicon in such proportion as to increase the magnetic permeability and electric resistance and to decrease the hysteresis action, and thus to reduce the total magnetic and electric losses in the mixture, (when such alloy is used for ballast-coils, transformer-plates, or like electric apparatus,) to which alloy manganese is added in order to improve the physical properties of said alloy in point of capacity for being worked, rolled, or forged. In order to effect the best reduction of the said magnetic and electric losses, a heat treatment of said alloy is necessary.

My present invention is a process of heat treatment applied to the aforesaid iron-silicon-manganese alloy for the purpose stated.

In carrying my invention into effect I first prepare an alloy of iron and silicon in molten state and add manganese thereto in proportion not exceeding one-half of one per cent. of the total mass. Such a proportion of manganese is not sufficient to impair the magnetic qualities of the alloy, while it is sufficient materially to improve its working or rolling qualities. I then cast the ingots in the usual way and convert the ingots into desired shapes and thicknesses and heat the alloy to a temperature above a critical point (hereinafter defined) and then cool the same slowly. When said alloy is subjected to progressive temperature variations (below fusion) from 600° centigrade upward, it undergoes at a certain temperature-point an apparent molecular change, and on further alteration of temperature another point ensues at which another molecular change occurs. The term "critical point" herein used

means the point of higher temperature of the two above noted and approximates to the 900°-centigrade point in the case of pure iron, which is the lower limit of its so-called "gamma" state. This gamma state is definitely shown, for example, in ordinary carbon steels when heated. A diagram accurately illustrating this point is given by Messrs. Arnold and McWilliam in their paper on the thermal transformations of carbon steels published in the *Journal of the Iron and Steel Institute*, 1905, Vol. 2. Diagram 2 in this paper shows the critical point for a certain carbon steel at about 870° centigrade. The alloy should be low in carbon and contain, say, under twelve one-hundredths of one per cent.

For certain purposes, if desired, the material as cast may be used, being suitably treated in the same manner as the forged or rolled material.

I claim—

1. The process of increasing the magnetic permeability and electric resistance and reducing the hysteresis action of an iron-silicon-manganese alloy low in carbon, which consists in heating said alloy to a temperature above its critical point, and then cooling.

2. The process of increasing the magnetic permeability and electric resistance and reducing the hysteresis action and also of improving the working and rolling qualities of an iron-silicon alloy, low in carbon, which consists in melting together iron and silicon, adding manganese in proportion not sufficient to impair said magnetic qualities casting into ingot form converting said ingots into desired shapes and thicknesses by appropriate means, heating said alloy to a temperature above the critical point of said alloy, and finally cooling.

In testimony whereof I have signed my name hereto in the presence of two witnesses.

ROBERT ABBOTT HADFIELD.

Witnesses:

WILLIAM CROSS,
WILLIAM CRAWLEY.