# UNITED STATES PATENT OFFICE.

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## STEEL MANUFACTURE.

967,335. Specification of Letters Patent. Patented Aug. 16, 1910.

No Drawing. Original application filed April 27, 1907, Serial No. 370,575. Divided and this application filed March 30, 1908. Serial No. 424,054.

*To all whom it may concern:*

Be it known that I, JESSE M. DARKE, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Steel Manufacture, of which the following is a specification.

My present application is directed to a novel process of compounding alloys, and is a division of my application Serial No. 370,575, filed by me April 27, 1907, and describing a steel characterized in its chemical composition by the presence of tungsten in the percentage now found in the so-called "high speed steels", by the presence of manganese in relatively high percentage, by the low carbon content, and by the relatively low chromium content, also, in certain cases, by the presence of vanadium in small percentage.

As a basis for the steel, I prefer to use Swedish muck-bar, ferro-tungsten and ferro-chromium. The ferro-tungsten may be of the variety now being produced by the electric furnace process and may contain about 67% tungsten and little or no carbon. The ferro-chromium may also be of the electric furnace variety, low in carbon and containing say 68% chromium. I prefer to use sufficient ferro-tungsten to give the finished steel about 13.5 per cent. tungsten, though the percentage of tungsten may be varied somewhat above or below this value as in the chrome-tungsten steels now commonly designated as "high-speed" steels. The ferro-chromium is used in relatively small quantity, and the percentage of chromium in the steel is kept lower than one-half of one per cent. As previously stated, the carbon content is low, preferably less than one-half of one per cent. in the finished steel.

The components above mentioned may be melted in a crucible in the usual way. Ordinarily these materials, during fusion, yield a slag which floats on the top and protects the steel. If for any reason the components are too "dry" to produce slag, I add a certain amount of slag to the crucible according to common practice. When the steel is nearly ready for pouring, I introduce sufficient manganese to yield a finished steel having approximately 3% manganese. Some variation in the manganese content is permissible, but the quantity should not be greater than 3.25% nor less than 2%. I prefer to introduce this manganese as pure metal, or at least in a form substantially or entirely free from carbon. The manganese now commercially produced by the Goldschmidt thermit process is substantially free from carbon and is quite suitable for use according to my invention.

As the protective layer of slag in the crucible has a great chemical affinity for manganese, special means must be resorted to for introducing the manganese into the steel. I find that this step can be successfully effected by introducing a tube of iron, steel or other suitable material through the top of the furnace and into the crucible until the end of the tube is well below the layer of slag, and then introducing the manganese through the tube. The manganese may be in lumps the size of a walnut and will pass through the tube into the steel with very little loss by slagging. After the manganese is introduced, the crucible may remain in the fire for about five minutes and may then be poured in the usual way.

The steel resulting from the above described process may be hardened like other air hardening steels and is suitable for cutting tools. Like the alloy steels relatively high in chromium, it may be used for heavy cuts at high speed. The tools retain their cutting edge at high temperatures much better than carbon steels, and are in other ways well suited for heavy duty.

For certain purposes I may introduce a certain quantity of vanadium into the steel, say in the proportion of about one-fourth of one per cent. This vanadium increases the "red hardness" and enables the tool to stand up better when taking a heavy cut or chip; what is more important, it prevents the chip from sticking to the point of the tool. The vanadium may be introduced in any suitable form, as by including ferro-vanadium with the Swedish muck-bar and other components of the original charge.

It will be understood that the process herein described and claimed is applicable to alloys of many different kinds and is not limited to the specific alloy referred to herein as admitting of an advantageous use of the method claimed.

What I claim as new and desire to secure by Letters Patent of the United States, is—

1. The process of compounding a steel, which consists in melting some of the components under protection of slag, and then adding through a tube projecting below said slag a metal having high chemical affinity for the slag.

2. The method of compounding an alloy, which consists in melting some of the components under protection of slag, and then introducing through a tube connecting with the mixture below the surface thereof, a component having high chemical affinity for said slag.

3. The method of compounding an alloy steel, which consists in melting some of the components, adding material to form a protective layer of slag, and subsequently introducing through a tube projecting below the layer of slag a metal having high chemical affinity for the slag.

In witness whereof, I have hereunto set my hand this twenty-fifth day of March, 1908.

JESSE M. DARKE.

Witnesses:
ALEX. F. MACDONALD,
JOHN A. MCMANUS, JR.