UNITED STATES PATENT OFFICE.

JOSEPH BEDFORD, OF SHEFFIELD, ENGLAND.

MANUFACTURING STEEL.

SPECIFICATION forming part of Letters Patent No. 535,659, dated March 12, 1895.

Application filed March 13, 1894. Serial No. 503,470. (No specimens.)

To all whom it may concern:

Be it known that I, JOSEPH BEDFORD, a subject of the Queen of Great Britain and Ireland, residing at Sheffield, in the county of York, England, have invented certain new and useful Improvements in the Manufacture of Steel; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in the manufacture of steel, and is designed to produce a steel of great hardness having also toughness and self-hardening properties.

For this purpose, I combine with the steel, which may, like ordinary steel contain carbon, silicon, and manganese, the following composition: sulphur, phosphorus, tungsten, chromium, and iron, so that the finished steel may contain, say from three to 3.50 per cent. each of tungsten and chromium.

The composition may be added to the steel, while the latter is in a fluid condition, or it may be added to a charge of steel scrap, converted bar, or bar iron, or other of the well known materials used in the manufacture of steel, while the said steel, steel scrap, or the like, is in the crucible, melting pot, or otherwise.

I prefer to add the charge to the steel, or steel scrap, converted bar, bar iron, or the like, in a proportion depending on the known composition of the charge.

The following gives the composition of a good self-hardening tool steel manufactured according to my invention: tungsten, three to 3.50 per cent.; chromium, three to 3.50 per cent.; carbon, 1.50 to 1.90 per cent.; manganese, 0.50 to 1.50 per cent.; silicon, 0.10 to 0.20 per cent.; sulphur, 0.02 to 0.04 per cent.; phosphorus, 0.03 to 0.04 per cent.; iron, (difference,) 91.85 to 89.32 per cent.

The manganese and the carbon and metalloids, viz: silicon, sulphur, and phosphorus, in the above list are, or may be, such as are added to, or acquired by, the steel in the ordinary manufacturing processes to which it is subjected prior to the addition of the alloy. I can, however, if desired, add the carbon and manganese during the melting operations in making the iron, tungsten and chromium alloy, or they may be added to the steel making charge at the time of melting.

The charge of tungsten, chromium and iron used in manufacturing steel according to my invention, may be formed in any suitable way. For instance, I may form it by melting together tungsten ore and ferro-chromium with the required addition of iron and carbonaceous material; or I may first mix an ore of tungsten, such as wolfram or scheelite with a reducing agent, such as carbon (for instance powdered coke or charcoal) and with iron, and melt the whole in a furnace to form an alloy which is cast into molds, and afterward combined with ferro-chromium by melting it therewith, and casting it into molds. The resulting alloy forms the tungsten, chromium, and iron alloy which is added to the steel, steel-scrap or the like as aforesaid.

The ferro-chromium above referred to may be the ordinary ferro-chromium of commerce, or I may use that which has been treated or purified in the manner described in the specification of my United States Patent No. 477,490, granted the 21st day of June, 1892.

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

Steel containing the following composition, tungsten, chromium, carbon, manganese, silicon, sulphur, phosphorus and iron, in substantially the following proportions, tungsten three per cent., chromium three per cent., carbon 1.50 per cent., manganese 0.50 per cent., silicon 0.10 per cent., sulphur 0.02 per cent., phosphorus 0.03 per cent., and iron 91.85 per cent., as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOSEPH BEDFORD.

Witnesses:

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