

UNITED STATES PATENT OFFICE.

JOSEPH BEDFORD, OF SHEFFIELD, ENGLAND.

METHOD OF PURIFYING ALLOYS OF IRON AND CHROMIUM.

SPECIFICATION forming part of Letters Patent No. 477,490, dated June 21, 1892.

Application filed November 25, 1891. Serial No. 413,092. (No specimens.) Patented in England December 13, 1887, No. 17,156.

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 a certain new and Improved Method of Purifying Alloys of Iron and Chromium, (for which I have received Letters Patent in Great Britain, No. 17,156, dated December 13, 1887;) 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 especially to the treatment and purification of alloys of iron and chromium, containing also carbon, silicon, sulphur, phosphorus, and manganese, and which alloys are ordinarily known in commerce as "chrome pig-iron," "chromeisen," or "ferro-chromium."

I am aware that prior to my invention certain processes existed for the purification of pig-iron and mixtures of pig-iron with scrap-iron or scrap-steel—as, for instance, those of Bessemer, Siemens, Thomas, and Gilchrist, and others; but it is not with such material that I propose to deal nor to which my invention has reference.

My object is to purify the crude alloys of chromium and iron from silicon, sulphur, phosphorus, and manganese as completely as possible and to eliminate the whole or any portion of the carbon, so as to render them suitable, say, for producing a steel superior to that made by the use of the crude alloys of chromium and iron now met with in commerce. I can effect this purification either in a separate operation or in an operation preliminary to or constituting part of the process of manufacturing chrome steel with such purified alloy, or in an operation in which such purified alloy is produced in a separate or subsidiary furnace, from which it may be poured in a molten state at the commencement of or at any subsequent stage of the steel-manufacturing process; or I may add the solid purified alloy at any stage of the steel-manufacturing process, in the manner hereinafter described. I can, also, by the ad-

dition to such purified alloy (in the manner hereinafter specified) of tungsten, copper, nickel, aluminium, manganese, silicon, or phosphorus, or any combinations of them, render these purified alloys suitable for use in the manufacture of steel or for the manufacture of brass, gun-metal, bronze, anti-friction metal, or similar alloys of iron or metals other than iron, as largely used in the arts.

In carrying out my invention I proceed in the following manner: On the hearth or bed of an open hearth, or other suitable furnace, (preferably lined with basic material, as now well known in steel-manufacturing processes, or lined with chrome ore or ganister or other suitable material,) I place a charge of hematite-iron ore, manganese ore, or manganiferous-iron ore, and chrome ore, whether containing iron or not; or I introduce quicklime or magnesian lime, or other suitable alkaline, alkaline-earthly, or earthy substance. In using the word "ore" above my intention is to cover the use of any minerals, whether oxides, sulphides, carbonates, chlorides, or other compounds. Upon such bed of ores I charge a properly-proportioned weight of the crude alloy hereinbefore stated, together with either or any of the materials charged at the outset, as just mentioned. The whole is then melted, with or without stirring, and when sufficiently melted or prepared a further charge of extra material can, if desired, be added. The resulting product of this operation is the purified alloy, free, or nearly so, from silicon, sulphur, phosphorus, and manganese and with a reduced percentage of carbon. This purified product may be either run out into suitable molds for future use or be added in a molten state to a charge of steel in another furnace, or may be used to form the preliminary melting or basis in the same or another furnace for a charge of pig-iron, steel, or iron scrap or other materials commonly used in the manufacture of steel. The process of steel manufacture is conducted in the ordinary manner, the purified alloy being added at the outset or at any subsequent stage and in either the molten or the solid state. At the later stages or at the end the usual additions of ferro-

manganese or spiegeleisen may be made; or aluminium may be used instead for the decomposition and elimination of the contained gases.

- 5 When it is required to incorporate or combine with such purified chrome alloy tungsten, copper, nickel, aluminium, silicon, or phosphorus, or any one or any combination of these for the purpose of producing a compound alloy, I add to the alloy, at any stage or at the
10 end of the purifying process and in any desired proportion, any one or more of the following substances: For producing a compound alloy containing tungsten I add metallic
15 lic tungsten or any alloy thereof. For producing a compound alloy containing copper I add metallic copper or any alloy thereof. For producing a compound alloy containing nickel I add metallic nickel or any alloy thereof.
20 For producing a compound alloy containing aluminium I add metallic aluminium or any alloy thereof. For producing a compound alloy containing manganese I add metallic manganese or any alloy thereof, as ferro-manganese,
25 spiegeleisen, iron-nickel-manganese alloy, or alloy of manganese with any other metal. For producing a compound alloy containing silicon I add ferro-silicon, silicious pig-iron, or silico-spiegel, or silicide of iron and manganese.
30 For producing a compound alloy containing phosphorus I add phosphorus or any phosphide, either a phosphide of a metal or of a non-metal.

The alloys so made, containing one or more
35 of the ingredients above specified in combination with iron and chromium, possess many valuable properties and combine great strength with toughness, which render them suitable for the manufacture of iron, steel,
40 brass, bronze, gun-metal, anti-friction metal, and for many other well-known purposes.

I do not confine myself to any exact percentages of chromium or carbon which my purified alloy is to contain, as these may be
45 varied to suit circumstances; but I give, as an example: chromium, twelve per cent.; carbon, 0.25 per cent.; manganese, 0.2 per cent.; silicon, 0.01 per cent.; phosphorus, 0.02 per cent., and sulphur 0.02 per cent.; but I may
50 make this alloy to contain from one to fifty per cent. or upward of chromium, from none to two per cent. or more carbon, keeping the other ingredients as low as possible, and add-

ing, if I wish, any desired proportion of any other element, as tungsten, copper, nickel, 55 aluminium, manganese, silicon, or phosphorus.

Steel alloyed with chromium according to this invention is much tougher and more ductile than that made by the processes now in use, and is very much better suited for 60 materials requiring high tensile strain, such as wire or steel for railway purposes, or for materials required to resist impact, such as projectiles or armor-plates, or for materials required to resist compression, such as for 65 ordnance purposes, for ship-plates, and for engineers' purposes, such as dies and stamps, and in all structural work, as for girders and bridges.

Having fully described my invention, what 70 I claim, and desire to secure by Letters Patent, is—

1. The herein-described method of purifying alloys of iron and chromium containing carbon and other metalloids and manganese, 75 which consists in melting such alloys with ore in a suitably-lined furnace, so as to dissociate the carbon and other metalloids and manganese contained in the alloys, thereby producing a pure alloy of iron and chromium. 80

2. The herein-described method of purifying alloys of iron and chromium containing carbon and other metalloids and manganese, which consists in melting such alloys with ore in a furnace lined with basic material, so 85 as to dissociate the carbon and other metalloids and manganese contained in the alloys, thereby producing a pure alloy of iron and chromium.

3. The herein-described method of purifying 90 alloys of iron and chromium containing carbon and other metalloids and manganese, which consists in melting such alloys with ores of iron in a furnace lined with basic material, so as to dissociate the carbon and other 95 metalloids and manganese contained in the alloys, thereby producing a pure alloy of iron and chromium.

In witness whereof I have hereunto signed my name in the presence of two subscribing 100 witnesses.

JOSEPH BEDFORD.

Witnesses:

CHARLES B. LAISTOE,
FRANK M. CLARK.