UNITED STATES PATENT OFFICE.

HENRI VICTOR CHAVOT AND ALBERT HOZANA, OF PARIS, FRANCE.

MANUFACTURE OF ALLOYS OF IRON OR STEEL.

SPECIFICATION forming part of Letters Patent No. 680,694, dated August 20, 1901.

Original application filed May 9, 1899, Serial No. 716,115. Divided and this application filed April 30, 1900. Serial No. 14,987. (No specimens.)

To all whom it may concern:

Be it known that we, HENRI VICTOR CHAVOT and ALBERT HOZANA, citizens of the Republic of France, residing at No. 32 Rue Caumartin, in the city of Paris, France, have invented certain new and useful Improvements in Methods of Manufacture of Alloys of Iron or Steel and for Testing the Same During the Process of Manufacture, this application being filed as a divisional application of our former application, Serial No. 716,115, filed May 9, 1899, of which the following is a specification, such as will enable others skilled in the art to which it appertains to perform the same.

This invention relates to the manufacture of steel, and in carrying our process into practice we prefer to employ a Martin-Siemens furnace to the exclusion of all others, the working being carried out at a very high temperature. The cast-iron and scrap-iron are selected so as to be as free as possible from sulfur and phosphorus, and the operation is conducted in the same manner as ordinary casting operations.

In the preparation of chromated steel in the Siemens-Martin furnace it is customary to add chromium in the form of large pieces to the bath, and aluminium is used for the disoxidation. In such process the chromium will only melt partially, so that after the casting part of the chromium will be found as chromium oxid on the bottom of the furnace. In order to obtain the complete fusion of the chromium, we have devised this process whereby the chromium is added in the form of finely-divided ferrochromium mixed with a certain quantity of finely-pulverized aluminium not in the bath but in the ingot-mold upon the bottom of the same. When the casting is effected, a stream of molten steel is poured into the ingot-mold upon the pulverized mixture of ferrochromium and sets the aluminium on fire. The necessary oxygen for this combustion is furnished by the air surrounding each particle of the finely-pulverized aluminium. The aluminium thus produces a reaction temperature of nearly 3,000°, and thus fuses the chrom-iron with which it is mixed (the chromium only requires a temperature of 2,000° for complete fusion) so rapidly and so completely that the chromium becomes at once thoroughly mixed with the stream of steel being poured into the ingot. We thus obtain a piece of steel of a perfectly homogeneous composition without blow-holes, the proportion of chromium in which can readily be predetermined. This steel is also very compact and without flaws, owing to the overheating produced by the combustion of the aluminium over the entire area of the ingot, and for this purpose in order to obtain a flawless piece of steel we also sometimes use pulverized aluminium without chromium.

The chemical reaction caused by the placing of pulverized aluminium in the ingot-mold is one of the main points of our invention. This reaction has not for its purpose to produce aluminium steel, for the reason that the aluminium disappears in the slag. The chemical result we claim is the use of a higher temperature than could otherwise be obtained throughout the ingot mass produced by the aluminium in the mold, the bubbling or boiling caused thereby, and the complete separation of all impurities in the slag, so that we obtain a very homogeneous steel free from flaws, blow-holes, and impurities.

For tool-steel we add the chromium or ferro chromium. The complete assimilation of this chromium is only obtained by the chemical reaction above set forth. In other processes the aluminium is added to the charge while it is cold and melted therewith or poured into the charge in a molten condition or added thereto from the top; but by these methods the reaction necessary for the thorough assimilation of chromium is not obtained and the slag is not thoroughly separated from the steel.

The amount of pulverized aluminium used is usually about two hundred and fifty (250) grams for each one thousand (1,000) kilograms of steel, and the amount of chromium or ferrochromium is from two hundred and fifty (250) to seven hundred and fifty (750) grams per each one thousand (1,000) kilograms of steel, according to the use for which the resultant steel is intended.

In order to determine exactly the moment when the metal has attained the necessary

condition for casting—that is, has been sufficiently decarbonized, while yet retaining the required quantity of carbon—we take a sample of about five hundred grams, which when hammered to form a plate of about six millimeters thickness should be capable of being bent, first, to an angle of sixty degrees without showing cracks or splits at the corner and after simply cooling in free air for extra hard steels be suitable for forming into heavy tools for lathes, planes, or the like; second, to an angle of forty-five degrees without cracks or splits and after hardening for medium-hard steel be suitable for tools for lathes of smaller section of thirty millimeters cutting edge for cold-chisels, drills, punches, and the like, and, third, to an angle of thirty degrees also without showing cracks or splits and after hardening for soft steels for casting. Any one of the above trials having been made and found satisfactory, we add to the charge about six per cent. (6%) of ferromanganese equal to sixty (60) kilograms and about three per cent. (3%) of ferrosilicon equal to thirty (30) kilograms for each one thousand (1,000) kilograms of the charge. We then place at the bottom of the mold to be used for receiving the molten metal the required quantity of aluminium, either in the form of powder or of small cubes, and when tool-steel is to be formed also the required quantity of pulverized ferrochromium, and then when the decarburation of the bath is judged to be sufficient for one of the three kinds of steel we desired to obtain we as rapidly as possible pour the molten metal into the mold so prepared to receive it. The aluminium then acts as a regulator in producing a deoxidation with a generation of heat inherent with any chemical reaction. It thus happens that the molten metal is not subjected to any partial cooling at the moment of casting, owing precisely to this generation of heat, and that consequently blow-holes are avoided and the casting is thus rendered homogenous. The steels or iron alloys thus produced have a power of resistance to rupture of from one hundred and seven to one hundred and fifty kilograms per square millimeter, while capable of expansion or elongation to the extent of from seven to ten per cent.; but the reaction, if any, occuring in the formation of these steels or alloy are, we believe, unknown, and in our opinion beyond the power of present chemical knowledge to absolutely determine, and we therefore do not consider it necessary to attempt to set them forth herein, except to say that we believe that the aluminium and ferrochromium mixture placed in the molds when the molten iron ferromanganese-silicon mixture with or without carbon falls upon it sets up a chemical reaction with a consequent generation of heat sufficient to prevent such sudden cooling as to cause the formation of blow-holes.

What we claim, and desire to secure by Letters Patent, is—

1. The hereinbefore-described method of forming alloys of iron or steel, which consists in decarburizing a charge of iron until a sample hammered into a thin plate and cooled will bend to a required angle without cracking at the bend, adding to the mass ferrosilicon and ferromanganese, depositing a quantity of ferrochromium and aluminium in small pieces in the ingot mold or molds, and pouring the charge into such mold or molds.

2. The hereinbefore-described method of forming alloys of iron or steel which consists in decarburizing a charge of iron until a sample hammered into a thin plate and cooled will bend to a required angle without cracking at the bend, placing a pulverulent mixture of aluminium and ferrochromium in the proportions of two hundred and fifty (250) grams of aluminium, and from two hundred and fifty (250) to seven hundred and fifty (750) grams of ferrochromium to each one thousand (1,000) kilograms of the charge in the bottom of the ingot mold or molds and pouring the charge into such mold or molds.

3. The hereinbefore-described method of forming alloys of iron or steel which consists in decarburizing a charge of iron, placing a pulverulent mixture of aluminium and ferrochromium in the bottom of the mold or molds, and pouring the charge into the mold or molds so prepared.

In testimony that we claim the foregoing we have hereunto set our hands this 10th day of April, 1900.

HENRI VICTOR CHAVOT.
ALBERT HOZANA.

Witnesses:
EMILE COUCHOUD,
EDWARD P. MACLEAN.