UNITED STATES PATENT OFFICE.

WILLIS EUGENE EVERETTE, OF TACOMA, WASHINGTON.

METALLURGICAL PROCESS.

No. 804,936. Specification of Letters Patent. Patented Nov. 21, 1905.

Application filed February 25, 1905. Serial No 247,279.

To all whom it may concern:

Be it known that I, WILLIS EUGENE EVERETTE, a citizen of the United States, and a resident of Tacoma, in the county of Pierce and State of Washington, have invented certain new and useful Improvements in Metallurgical Processes, of which the following is a specification.

The object of my invention is to improve the manufacture of pig-iron, the smelting of ores, and the refining of metals generally.

Pig-iron as ordinarily obtained from blast-furnaces contains sulfur, phosphorus, silicon, titanium, and graphitic carbon in such quantities that as pig metal it can only be used for ballast and cannot be successfully forged. Such pig-iron is commonly known as "cold-short" and "hot-short" or "red-short," meaning that the iron is brittle at low temperatures and at red heat, due to the presence of the sulfur and phosphorus. The subsequent treatment of such pig-iron by way of puddling or to manufacture steel is expensive and slow.

As applied to blast-furnaces, therefore, the object of my invention is to make a purer and better form of pig-iron by expelling a greater proportion of sulfur and phosphorus while still in the furnace and to make the process of converting the iron ore into pig-iron quicker and cheaper than present methods.

Ores as ordinarily smelted are placed in a furnace and reduced to a metallic state by a flux with proper fuel and a blast of atmospheric air. Many such ores, such as sulfids and arsenids, require preliminary treatment before smelting in this manner.

As applied to the smelting of ores, therefore, the object of my invention is to do away with the preliminary treatment and also to make the smelting itself cheaper and quicker and resulting in a purer metal.

My invention is also applicable to the refining of metals, which it accomplishes with unusual quickness and economy. By subjecting pig-iron to repetitions of this improved process it can be converted into steel, thus dispensing with the Bessemer and other usual processes.

In the following description I shall use the word "melt" to include "slag-melt," as those terms are akin in that one is a melt of metal and the other of metal and dross or other impurities, and I shall use the term "liquid oxygen" as including liquid air, as it is the oxygen content which is needed to effect combustion rather than the nitrogen content. In this way I shall be able to avoid confusing alternatives.

In order to carry out my improved process, the materials to be treated, whether iron oxid or other metalliferous ores or pig-iron or other metals, are previously to be crushed or ground to a reasonable fineness, my process starting with pulverized materials without regard to how the pulverized condition has been brought about; but as it is difficult to crush or grind metals at their normal temperature I have discovered a method of crushing such metals by the application of liquid air, which forms the subject-matter of another application for patent and which, therefore, I will only refer to here by stating that I have found that when metal is reduced to an extremely-frigid condition—say 280° below zero Fahrenheit—it becomes readily crushable, losing its tensile strength and coherence.

The first step of my improved process consists in preparing a preliminary quantity of a suitable melt and keeping it at white heat or incandescence. When a true melt, it is composed of the metal which is to be refined; but when a slag-melt, it contains or is akin to the metals or metal which I desire to extract from the ore to be treated. I then prepare any desired quantity of pulverized material for feeding it to the melt. This is done by subjecting it to the action of liquid oxygen, by which it is reduced to an extremely frigid condition in the neighborhood of 280° below zero Fahrenheit. In this intensely-cold condition the pulverized matter seems to absorb a portion of the oxygen under well-known laws somewhat as a sponge absorbs water, the rest of the oxygen remaining for a time unabsorbed and afterward passing off by evaporation. Of course it will all evaporate eventually; but the pulverized material is to be used while still containing such oxygen as it has absorbed. The presence of this oxygen in what may be called the "minute" pores of the pulverized material causes the mixture to be highly inflammable and to the extent of its content of free oxygen increases the heat evolved in the next step of the process under the well-known law that combustion is fiercer in proportion to the excess of oxygen present as compared with ordinary air. This very cold mixture of pulverized materials and liquid oxygen is then to be forced into and through the melt, which, as before stated, is incandescent, by means of compressed air, so that in its passage upward the sulfur and phosphorus are largely driven

off or consumed by the great heat generated by the combination of carbon and oxygen, which latter, as will readily be understood, is present in quantities largely in excess of that present in the usual smelting or refining processes. By reason of the enormous heat evolved in this step I am able to diminish to about one-third the carbon usually required for smelting or refining ores and metals. The consequent nearly-complete expulsion of sulfur and phosphorus make the molten metal much more nearly pure than is usually the case.

When this improved process is to be applied to an ore, the pulverized material is composed of the ore, the normal quantity of flux, and about one-third of the normal amount of carbon used in smelting. When it is to be applied to a metal instead of an ore, the flux is of course omitted.

The surface of the melt will gradually rise as the pulverized material which melts in its passage reaches the top and spreads over the surface. This continues until all the pulverized material has been treated and used, after which the nearly pure metal separates from the slag by gravity, and the metal and slag are to be drawn off at different levels in any convenient way.

When this process is to be applied to the conversion of pig-iron into steel, the process is to be repeated, simply changing the character of pulverized material, as follows: When first applied, the pulverized materials are pig-iron and carbon, and the result of the process is to refine the iron. When the iron has thus been refined, it is again reduced to a pulverized state and mixed with such pulverized ingredients as may be demanded by the special kind of steel desired and put through the process a second time, with the result that the desired kind of steel is formed.

Metallurgists will readily understand that by reason of the finely-divided state of the ore or metal, the flux, and the carbon fuel fusion takes place much more readily and quickly than under usual conditions, that in feeding the pulverized materials up through the melt there is no danger of blowing them out of the furnace, as would be apt to happen if fed from above, and also that by reason of the large quantity of oxygen supplied by the liquid oxygen or liquid air an unusual heat is generated, thereby quickening the process.

I claim—

A metallurgical process which consists first, in preparing a suitable preliminary melt and heating it to incandescence; second, in subjecting the previously-pulverized materials, which are to be treated, to the action of liquid oxygen, whereby they are reduced to an extremely-frigid condition and are caused to occlude a portion of said oxygen; third, forcing this frigid mixture into and through the incandescent melt whereby the metals in said mixture are largely freed from sulfur and phosphorus and are rapidly fused; and finally separately drawing off the metal and slag at different levels.

WILLIS EUGENE EVERETTE.

Witnesses:

W. P. PREBLE, Jr.,

ANNA H. VAN HOVENBERG.