

UNITED STATES PATENT OFFICE.

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METALLURGICAL TREATMENT OF SULFUROUS ORES BY THE PRECIPITATION PROCESS.

No. 875,579.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ANTOINE HENRI IMBERT, engineer, residing at 75 Avenue de la République, Grand-Montrouge, Department of the Seine, France, a citizen of the French Republic, have invented a new and useful Improvement in the Metallurgical Treatment of Sulfurous Ores by the Precipitation Process, of which the following is a specification.

As is known, the metallurgical treatment of sulfid ores (such as blende, galena, complex lead and zinc ores, sulfid of antimony, etc.), by the precipitation process, consists in driving off the metal from its sulfid by means of another metal having more affinity for sulfur than the metal to be separated, notably by means of iron. This reaction, so simple theoretically, has for long failed in practice, principally because it requires too high a temperature and takes place very incompletely. To avoid these difficulties, it has been variously proposed to "dissolve" or liquefy the sulfid ores in a "dissolving" bath whereby to render the action of the re-acting metal rapid, uniform, regular and about complete, while, at the same time, the temperature required was brought down within industrial limits.

As a dissolvent of the sulfids to be treated (more especially for blende), it has heretofore been proposed to employ, as a dissolving bath, on the one hand, a melted mixture of metallic oxids and, on the other, a metallic sulfid, especially sulfid of iron. But the single employment either of metallic oxids or of a sulfid offers, in practice, so many serious inconveniences that the results sought for were but partially obtained. Thus, the results obtained by these processes were especially unsatisfactory when it was a question of treating blende; for, in the case of zinc, where the operation requires treatment in a closed vessel on account of the necessity of condensing the zinc vapors produced without contact with air, the difficulties increase. This is due to the fact that it is important not only to dissolve the blende, to render the action of the re-acting metal complete, rapid, and capable of realization at a relatively low temperature, but also because it is indispensable in practice (the work being done in a closed vessel) that a fluid residue shall be obtained in order to be able to run it off from the retort. I have discovered

that the latter result, that is a fluid residue, can be obtained by employing, as a dissolvent of blende, or of any other analogous sulfid, a mixture of metallic oxids and metallic sulfids, the sulfid especially suitable being sulfid of iron.

The employment as a dissolvent, of a suitable mixture of metallic sulfids and oxids constitutes therefore the present invention. As an example, a very good "dissolvent" can be formed by mixing sulfid of iron with peroxid of iron. In practice about three parts of sulfid are mixed with about one part of peroxid. This mixture forms a very fluid bath at a temperature in the neighborhood of 1000° C.—1100° C., and can "dissolve" six parts of blende such as is ordinarily used in industry, containing about 45% Zn. By adding the necessary iron, preferably cast iron, for the displacement of the zinc, a rapid disengagement of zinc is obtained after which the residual material, in a very fluid condition, can be run off from the retort. This material classifies itself spontaneously into two distinctly separated parts, the one formed of slag containing the gangues and the other of a ferrous matte which latter, by roasting a part of the mass, gives sulfur while also regenerating the oxid of iron necessary for the formation of the "dissolvent" for the subsequent charges. If deemed advisable, a portion of the oxid of iron obtained can in its turn be treated for regenerating the metallic iron required as a re-agent. The other part of the matte is used over and over again, indefinitely, in the operation of the process as sulfid of iron.

In the mixture of sulfids and oxids, which constitute the "dissolvent", the oxid of iron may, in certain cases, be replaced by oxid of manganese, lime, magnesia, etc. In special circumstances, where manganese is employed as a re-agent, the "dissolvent" can be formed of sulfids and oxids of manganese. If ferro-manganese, more or less rich, is used the bath can be composed of equivalent proportions of sulfids and oxids of manganese and of iron, according to or determined by the proportion of manganese contained in the ferro.

The particular category of "dissolvents" formed by the sulfids and oxids of the re-acting metal, that is to say, precisely the sulfid and the oxid of the same metal as that destined to take the place of the metal which

is sought to be extracted from the sulfid treated, is characterized by the employment over and over again of a portion of the residual sulfid, such as it is, and also of another portion of the residual sulfid, to produce, by roasting for instance, the oxid necessary to the bath. Furthermore, a portion of the produced oxid can be treated so as to regenerate the reacting metal itself; consequently, the cycle of operations yields important technical and economical advantages.

Having thus described my invention, but without limiting myself to the precise operations and details specified, what I claim is:

1. The process of reducing metallic sulfids which consists in heating the sulfid in the presence of an oxid and a sulfid of such a character that they will form a dissolvent for the said metallic sulfids with a metal having a greater affinity for sulfur than the metal of the sulfid being reduced.

2. The process of reducing sulfid ores which consists in heating the ore in the presence of an oxid and a sulfid of such a character that they will form a dissolvent for the said metallic sulfids with a metal having a greater affinity for sulfur than the metal of the ore.

3. The process of reducing sulfids which consists in heating the sulfid with a mixture of peroxid of iron, sulfid of iron, and a metal having a greater affinity for sulfur than the metal of the sulfid being reduced.

4. The process of reducing sulfid ores in which the metal has less affinity for sulfur than has iron which consists in heating the ore with a mixture of peroxid of iron, sulfid of iron and metallic iron.

5. The process of reducing sulfid ores which consists in heating the ore in the presence of a metal having a greater affinity for sulfur than the metal of the ore being reduced, and an oxid and a sulfid of said metal, and re-employing a portion of the residual sulfid for the reduction of further ore.

6. The process of reducing sulfid ores which consists in heating the ore in the presence of a metal having a greater affinity for sulfur than the metal of the sulfid being reduced, and an oxid and a sulfid of said metal, reemploying a portion of the residual sulfid for the reduction of further ore, and reemploying another portion of the residual sulfid for regenerating the oxid required for reducing further ore.

7. The process of reducing sulfid ores which consists in heating the ore in the presence of a metal having a greater affinity for sulfur than the metal of the sulfid being reduced, and an oxid and a sulfid of said metal, reemploying a portion of the residual sulfid for the reduction of further ore, reemploying another portion of the residual sulfid for regenerating the oxid required for reducing

further ore, and for regenerating the metallic oxid required for regenerating the reacting metal for the treatment of further ore.

8. The process of reducing sulfid ores in which the metal has less affinity for sulfur than has iron which consists in heating the ore in the presence of metallic iron and of peroxid and sulfid of iron, and reemploying a portion of the residual sulfid of iron for the reduction of further ore.

9. The process of reducing sulfid ore in which the metal has less affinity for sulfur than has iron which consists in heating the ore in the presence of metallic iron and of peroxid and sulfid of iron, reemploying a portion of the residual sulfid of iron for the reduction of further ore, and reemploying another portion of the residual sulfid of iron for regenerating the peroxid of iron required for reducing further ore.

10. The process of reducing sulfid ore in which the metal had less affinity for sulfur than has iron which consists in heating the ore in the presence of metallic iron and of peroxid and sulfid of iron, reemploying a portion of the residual sulfid of iron for the reduction of further ore, and reemploying another portion of the residual sulfid of iron for regenerating the peroxid of iron required for reducing further ore, and for regenerating the peroxid of iron necessary to regenerate the metallic iron for the treatment of further ore.

11. The process of reducing successive charges of sulfid ores which consists in heating each charge of ore in the presence of a metal having a greater affinity for sulfur than the metal of the ore being reduced, and an oxid and a portion of the sulfid of said metal derived from the reduction of the preceding charge.

12. The process which consists in heating sulfid ore in the presence of a metal having a greater affinity for sulfur than the metal of the ore being reduced; and of a dissolvent containing an oxid and a sulfid of said metal, drawing off the residual material, roasting a portion of said material to regenerate the metallic oxid, and mixing said oxid with a metal and a sulfid of said metal to form a new charge of the dissolvent.

13. The process which consists in heating sulfid ore in the presence of a metal having a greater affinity for sulfur than the metal of the ore being reduced; and of a dissolvent containing an oxid and a sulfid of said metal, drawing off the residual material, roasting a portion of said material to regenerate the metallic oxid, regenerating a portion of said oxid to produce the metal, and mixing the said metal with the remaining portion of said oxid and with a sulfid of said metal to form a new charge of the dissolvent.

14. The process which consists in heating sulfid ore in the presence of a metal having

a greater affinity for sulfur than the metal of the ore being reduced; and of a dissolvent containing an oxid and a sulfid of said metal, drawing off the residual material, roasting a
5 portion of said material to regenerate the metallic oxid, regenerating a portion of said oxid to produce the metal, and mixing the said metal with the remaining portion of said oxid and with the remaining portion of said
10 residual material to form a new charge of the dissolvent.

15. The process which consists in heating sulfid ore in the presence of a metal having a greater affinity for sulfur than the metal of

the ore being reduced; and of a dissolvent 15 containing an oxid and a sulfid of said metal, drawing off the residual material, and mixing a portion of said material with an oxid and a metal to form a new charge of the dissolvent for the sulfid ore. 20

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

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Witnesses:

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