

UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING AND SUBSEQUENTLY SEPARATING SULFID ORES, &c.

1,020,353.

Specification of Letters Patent.

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No Drawing.

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To all whom it may concern:

Be it known that I, EDWARD JAMES HORWOOD, mining engineer, a subject of the King of Great Britain, residing at Lane street, Broken Hill, in the State of New South Wales, in the Commonwealth of Australia, have invented a new and useful Process of Treating and Subsequently Separating Sulfid Ores, &c., of which the following is a specification.

This invention relates to an improvement upon or addition to the processes of treating crude ore or ore stuff or metalliferous material containing mixed metalliferous sulfids for the purpose of separating the zinc blende galena pyrites and other minerals or metalliferous material from one another or others in ore concentrates slimes or a mixed sulfid product resulting from or representing the result of flotation or granulation processes.

In flotation and granulation processes as at present employed the main object has been to effectively separate the metalliferous material from the gangue contained in an ore. The metalliferous material forming the final product of the separation or granulation resulting from the processes consists of mixed sulfids in varying proportions such as zinc blende with galena, pyrites or other metalliferous sulfids according to the character or values in the ore. The product has subsequently been classified by mechanical means such as vanning tables or concentrators. For example in flotation processes the mixed metalliferous sulfid particles have been indiscriminately floated practically free from gangue stuff by immersion of the ore in a hot acidulated bath, or after the ore has undergone a preliminary agitation with oil and acid, or by the application of a partial vacuum following digestion in acidulated solutions, or by other similar means or processes in which a mixed metalliferous sulfid product has been obtained by films or bubbles of air or gas. In the granulation processes the ore has been agitated with oil and or other substance for the purpose of coalescing the metalliferous constituents and the whole been subjected to a classification for the purpose of washing off the light earthy gangue stuff leaving mixed sulfid particles as a residue. The ore or material is generally prepared preparatory to its treatment by such flotation or granulation processes.

Many attempts have been made to still further increase the percentage of the product or of the separation of individual contents by such as destroying the oxidized films upon particular sulfids or increasing the buoyancy of the contents. In such preparatory treatment for an increased percentage of a particular mineral or separation (1) it has never been intended to alter or variously change the chemical character and chemical compound of one or more of the metalliferous constituents in the material so as to "deaden" the particles of any particular mineral in the metallic contents in relation to flotation or granulation, which would otherwise be floatable or separated, and (2) it has never been sought to provide or obtain a progressive separation of a particular class of the floatable mineral from the material but simply to increase the percentage of extraction or separation in the volume of metalliferous constituents.

The object of my invention is to provide a means whereby the zinc blende and other metalliferous constituents of ore concentrates or slimes containing mixed sulfids or a product of mixed sulfids resulting from or representing the product of flotation or granulation processes may be separated or classified the one from the other or others in the application of a flotation or granulation process.

I accomplish my object by subjecting the ore concentrates or slimes of mixed sulfids or the product of mixed sulfids to a preliminary "deaden" treatment whereby the character or composition of its contained minerals or metalliferous material is variously changed or independently altered in such manner that upon being subsequently subjected to a flotation or granulation process certain of the metalliferous constituents are so "deaden" or changed as not to float or granulate while the other or others are either unaffected or altered to a comparatively inappreciable degree or lost to a comparatively small percentage or extent.

For the purposes of my invention I subject the ore concentrates or slimes containing mixed metalliferous sulfids or product of mixed sulfids to a heating operation by itself either with or without a chemical reagent, or may digest the material in an aqueous solution of a chemical reagent with or without heat, as a preliminary treatment,

whereby certain of the metalliferous constituents become so "deadened" or changed that they will not float or granulate and readily obtain the desired separation of the metalliferous particles of such constituents by subsequently subjecting the treated material to a flotation or granulation process.

I have found that if the ore or metalliferous material in a sufficiently fine condition is gently heated with stirring for some time in a reverberatory or other suitable furnace until it attains a temperature of about four hundred to five hundred degrees centigrade or thereabout according to the character of the ore as determined by experiments, or if it is admixed and digested in an aqueous solution with a suitable reagent such as nitrated sulfuric acid with or without heat that some classes of the constituents are thereby sulfatized "deadened" or more or less variously influenced and changed as not to float or granulate when subsequently subjected to a flotation or granulation process. In particular I have found that the galena or sulfid of lead particles contained in the material become more or less altered and converted into sulfate of lead, and the pyrites or bisulfid of iron particles contained in the material become more or less converted into oxid of iron by my preliminary treatment and that they to such extent will not float or granulate when subsequently subjected to a flotation or granulation process, whereas the zinc blende particles contained in the material are practically unchanged during my preliminary treatment or in relation to their flotation when subsequently subjected to a flotation or granulation process. A separation of the zinc blende particles from the "deadened" or altered galena or pyrites particles is thereby readily obtainable by subjecting the material resulting from my preliminary treatment to a flotation or granulation process, and any loss of zinc from solubility in such separation is comparatively small and does not materially affect the desired result of separating the one sulfid from the other or others.

As an example of my invention, if the material to be submitted to a flotation or granulation process be metalliferous sulfids or an ore such as the well known Broken Hill sulfids in a sufficiently fine state of division containing zinc blende and galena in about equal proportions with or without pyrites and varying quantities of gangue in which by the well known flotation or granulation processes lead sulfid iron bisulfid and zinc sulfid are separated as a mixed product from the gangue, my preliminary treatment of the material by gently heating and stirring at a temperature approximately 400° or 500° centigrade or thereabout for a suitable length of time in any suitable furnace will more or less sulfatize the sulfid of

lead and oxidize any bisulfid of iron in which form the lead and iron particles will not float whereas the zinc sulfid is practically unaltered. By subjecting the treated material to a flotation or granulation process, the blende will therefore readily be separated from the other constituents of the ore or metalliferous material whether lead or iron or other sulfid either alone or together, and such other constituents be therefore also a separated product.

It will of course be clearly understood that my invention can be varied within comparatively wide limits without affecting the desired result of separating the one sulfid from another or others; that if the process follows an oil process it is not necessary to de-oil the concentrate produced from the original process prior to its sulfatization or "deadening" by my preliminary treatment before the final separation; that for different ores or products the most efficient limits of time and temperature at which the same is to be sulfatized or "deadened" can be readily determined by preliminary tests in each particular case and that my process or preliminary treatment before final separation is applicable to any process of separation or granulation of ore or ore stuff or metalliferous material or product containing mixed sulfids of zinc with lead or iron either alone or with other sulfids or minerals.

What I claim as my invention and desire to secure by Letters Patent is:—

1. The process of separating zinc sulfid from other sulfids associated therewith which consists in superficially changing sulfids other than zinc sulfids by subjecting the mass to heat, and thereafter separating by flotation, the heat-affected particles from those unaffected.

2. The process of separating zinc sulfid from other sulfid material such as that comprising pyrites and lead sulfid, which consists in subjecting the mixture to a roasting to an intensity sufficient to at least superficially oxidize the sulfids other than zinc sulfid, while insufficient materially to affect the zinc sulfid, and thereafter separating the zinc sulfid from the other ingredients by flotation.

3. The process of separating zinc sulfid from other sulfid material such as that comprising pyrites and lead sulfid, which consists in subjecting the mixture to a roasting to an intensity sufficient to at least superficially oxidize the sulfids other than zinc sulfid, while insufficient materially to affect the zinc sulfid, and thereafter separating the zinc sulfid from the other ingredients by a liquid separation process dependent upon the superficial differentiation caused by said roasting.

4. The process of separating zinc sulfids from other sulfids associated therewith,

which consists in superficially chemically changing sulfids other than zinc sulfids by subjecting the mass to heat and thereafter separating the heat treated mass by a liquid separation process dependent upon the superficial differentiation caused by said heat treatment.

5. The process of separating mixed metalliferous sulfids which consists in diversely superficially chemically changing some of the sulfids and thereafter separating by flotation the treated sulfid material.

6. The process of separating mixed metalliferous sulfids which consists in diversely superficially oxidizing part of such metalliferous sulfids and thereafter separating the treated metalliferous sulfids by a liquid separation process dependent upon the superficial differentiation caused by said oxidizing treatment.

7. The process of separating mixed metalliferous sulfid material which consists in superficially chemically changing part of such sulfid material and thereafter separating the treated material by a liquid separation process dependent upon the superficial differentiation caused by said chemical treatment.

8. The process of separating mixed metalliferous sulfid slimes which consists in roasting the mixture to at least about 400° C. to at least superficially oxidize part of the mixture and thereafter separating the mixture by a liquid separation process dependent upon the superficial differentiation caused by said roasting.

9. The process of separating mixed metalliferous sulfid slimes which consists in roasting the mixture to at least about 400° C. to at least superficially oxidize part of the mixture and thereafter separating the mixture by flotation.

10. The ore separating process for separating the sulfid material recoverable from ore slimes which consists in subjecting the ore to a preliminary flotation process to remove the gangue from the sulfid material, in

diversely superficially oxidizing part of said sulfid material and in thereafter separating the treated sulfid material by flotation.

11. The ore separating process for separating the sulfid material recoverable from ore slimes which consists in largely removing the gangue from the sulfid material, in diversely superficially oxidizing part of the sulfid material and in thereafter separating the treated sulfid material by a liquid separation process dependent upon the superficial differentiation caused by said oxidizing treatment.

12. The ore separating process which consists in subjecting a mass of mixed material comprising sulfid material to treatment superficially chemically changing part at least of said sulfid material and thereafter separating the treated mixed material by a flotation process dependent upon the superficial differentiation caused by said treatment.

13. The ore separating process for separating zinc sulfid from other material comprising other sulfid material which consists in diversely superficially chemically changing some of the sulfid material and thereafter separating the treated mass by flotation.

14. The ore separating process for separating zinc sulfid from other material comprising other sulfid material which consists in diversely superficially chemically changing some of the sulfid material and thereafter separating the treated mass by a liquid separation process dependent upon the superficial differentiation caused by said chemical change.

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

EDWARD JAMES HORWOOD.

Witnesses:

JOHN BERSFERNE,
ARTHUR JAMES LEYSON.