

# UNITED STATES PATENT OFFICE.

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## PROCESS OF CONCENTRATING ORES.

No. 807,501.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, ALFRED SCHWARZ, a subject of the Emperor of Germany, and a resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Processes of Concentrating Ores, of which the following is a specification.

In the concentration of ores by the employment of hydrocarbons as adhesive agents it has been observed that sulfids yield better results than oxids, carbonates, and chlorids. In fact, so far as known to me, a practical application of such process before my inventions relating to this art has been largely, if not wholly, confined to sulfid ores.

The object of the present invention is to extend the application of hydrocarbon concentrating processes to ores heretofore considered unworkable by first converting such ores into sulfids, preferably by a wet method, to thereby preserve the mass of ore in its crushed condition and suitable for treatments according to known methods.

In carrying out the present invention I proceed by preparing a soluble sulfid in any well-known manner—for example, by dissolving sulfur in an aqueous solution of potassium or sodium hydrate, the sulfur being added in sufficient quantity to give the desired reaction. The pulverized ore containing the mineral in the form of oxid, carbonate, or chlorid is then mixed in a suitable vessel with the sulfid solution, the mass being either cold or heated by suitable means and the vessel provided with an agitator to effect a thorough and intimate mixture. During this operation the oxid, carbonate, or chlorid is converted into a sulfid by the action of the potassium or sodium sulfid, a form which is capable of subsequent practical treatment with hydrocarbons for the separation of the values from the earthy or rocky constituents of the ore. As the action of the hydrocarbon on the metallic constituents of the ore is a surface action, it is unnecessary to proceed so far as to convert the entire mass of the particles of oxid, carbonate, or chlorid into a sulfid, it being sufficient if the surface of the particles is so converted, as thereby there is presented all that is necessary for the desired action of the hydrocarbon.

After the initial conversion, as above described, the ore may be concentrated by any suitable treatment with a hydrocarbon, and for such purpose I may use a hydrocarbon which is normally liquid or one which is solid at normal temperatures, or the latter in admixture with the former, as described in my applications Serial Nos. 210,137, 210,138, 225,370, and 231,395, and United States Patent No. 771,277. Of hydrocarbons which are solid at normal temperatures and required to be melted there may be used paraffin or ozocerite, or a resinous hydrocarbon, such as resin, pitch, or asphaltum. Of normally liquid hydrocarbons there may be used any suitable vegetable, animal, or mineral oil. These hydrocarbons may be used singly or in combination of two or more, it being understood that the constitution of the adhesive agent will depend upon the character of the ore to be treated, varying as the ore varies.

Ore either in a dry or wet condition is mixed in any suitable vessel having an agitator with the hydrocarbon, sufficient quantity being added to effect the desired separation. If the hydrocarbon is one which is solid at normal temperatures, it is first melted and then stirred in with the ore, the mixture being effected by any suitable mechanical means and, if desired, air, steam, or gas may be injected into the mass either alone or to assist the mechanical agitation. The injection of such gaseous agent results in the hydrocarbon taking up an appreciable quantity of air or gas, giving a certain sponginess which increases its floating power.

As a specific example of my invention I have used as an adhesive agent a mixture of paraffin and resin, heat being employed if necessary to maintain this compound in a melted condition after it has been mixed with the ore.

After an intimate mixture with all parts of the ore has been effected the mass is subjected to the action of water heated to any desired temperature, even as high as the boiling-point, whereby the earthy or rocky constituents are liberated and washed out and settle in the bottom of the vessel. The metallic constituents of the ore having united with the adhesive agent may be skimmed or



screened off and run to a centrifugal drier for the separation or recovery of the concentrates from the adhesive agent.

Instead of subjecting the mass to the action of heated or boiling water cold water, preferably under pressure, may be injected into the mass, the effect of which is to solidify or granulate the adhesive agent, which with the entrapped metallic constituents may be floated or screened off, while the tailings being saturated with water will be precipitated more or less completely to the bottom of the vessel. By subjecting the mass to heat in a suitable vessel the adhesive agent is melted and the concentrates may be separated and recovered therefrom by a centrifugal drier, filter-press, or other means. The mass of ore and adhesive agent may first be treated with heated or boiling water and subsequently treated with cold water. Also during the treatment with water, which may be made acid or alkaline, if desired, the mass may be agitated mechanically or by the injection of air, steam, or gas.

The concentrates, if necessary, may be washed with a solution of potassium or sodium hydrate to remove any remaining portions of the adhesive agent.

While I have described in giving a specific method of procedure the use of a mixture of paraffin and resin, I may use either one of these singly, the successive steps of the operation being the same, or I may use singly a normally liquid hydrocarbon, following the same method of operation except in such case there will of course be no solidification or granulation of the hydrocarbon. When using a normally liquid hydrocarbon, the mass may be treated either with cold or heated water to effect the separation of the adhesive agent with the metallic constituents of the ore from the tailings.

The essential feature of the present invention is the conversion of an ore of the character above specified into a sulfid to adapt it for treatment by a hydrocarbon, the particular method of concentrating by the employment of a hydrocarbon being varied according to known methods as may be desired or suitable to the particular ore, and while I have given specific examples I do not wish to be wholly restricted thereto.

In carrying out the conversion above described I use an excess of sulfur above the theoretical quantity necessary to effect the change of oxid, carbonate, or chlorid to sulfid.

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

1. The method of treating ores which consists in subjecting a non-sulfid ore to the action of a soluble sulfid to convert the mineral into a sulfid, then treating the mass with a hydrocarbon and finally separating the hydrocarbon with the entrapped metallic constituents of the ore from the tailings.

2. The method of treating an ore containing non-sulfid mineral by subjecting the same to the action of an alkaline sulfid to convert the mineral into a sulfid, then treating the mass with a hydrocarbon and finally separating the hydrocarbon with the entrapped metallic constituents of the ore from the tailings.

3. The method of treating an ore containing non-sulfid mineral by subjecting the same to the action of an aqueous solution of potassium or sodium sulfid to convert the mineral into a sulfid, then treating the mass with a hydrocarbon and finally separating said hydrocarbon with the entrapped metallic constituents of the ore from the tailings.

4. The method of treating an ore containing non-sulfid mineral by subjecting the same to the action of a soluble sulfid, then treating the resulting metallic sulfid with a melted hydrocarbon which is solid at normal temperatures and finally separating said hydrocarbon with the entrapped metallic constituents from the tailings.

5. The method of treating an ore containing non-sulfid mineral by subjecting the same to the action of a soluble sulfid, then treating the resulting metallic sulfid with a compound of melted paraffin and resin, then separating said compound with the entrapped metallic constituents from the tailings.

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

ALFRED SCHWARZ.

Witnesses:

E. F. PORTER,  
ALEXANDER RODMAN.