

# UNITED STATES PATENT OFFICE.

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## ORE CONCENTRATION.

1,170,637.

Specification of Letters Patent.

Patented Feb. 8, 1916.

No Drawing.

Application filed August 31, 1915. Serial No. 48,177.

*To all whom it may concern:*

Be it known that I, ARTHUR HOWARD HIGGINS, a subject of the King of England, residing at 62 London Wall, London, England, have invented certain new and useful Improvements in Ore Concentration, of which the following is a specification.

This invention relates to ore concentration and more particularly to processes of the type generally known as froth flotation processes.

The invention is in some respects, a development from that covered in the United States Patent No. 962,678.

It has been found that for the purpose of the froth flotation process a class of compounds hitherto never used for such purpose is very efficient and produces excellent separation of the minerals from the gangue. These compounds are the sulfuric acid derivatives of certain organic bodies such as fats, oils, alcohols, phenols and their homologues.

This invention therefore lies in the employment as frothing agents of the products obtained by treating organic bodies, such as fats, oils, alcohols, phenols, or their homologues with sulfuric acid.

The sulfuric acid derivatives of a large number of fats, oils and similar organic bodies have already been used in the dyeing and other industries under the general name of "soluble oils" and a feature of this invention therefore consists in the employment of such "soluble oils" as frothing agents in the concentration of ores.

Hitherto it has been common practice to employ oils and also other insoluble or soluble mineral-frothing agents in an aqueous pulp which also contains sulfuric acid but under these conditions the formation of these sulfuric acid derivatives does not take place. Some organic bodies used by themselves are superior to their sulfuric acid combinations. Preliminary tests will show whether it is advantageous to treat any suitable organic compound with sulfuric acid to produce an agent for use in the froth flotation process.

The following are examples of applications of this invention:

Example I: In an apparatus similar to that described in United States Patent No. 835,120, that is in a cone mixer, there was agitated for one minute a charge of finely

powdered zinc ore (Broken Hill tailings) containing 18.2% of zinc and 5.5% of lead, hot water acidulated with 30 pounds per ton of sulfuric acid with respect to the ore, and 2 pounds per ton of the sulfuric acid compound castor oil also with respect to the ore. On stopping the agitator the froth which rose to the surface was removed, and was found to assay 40.5% of zinc and 9.5% of lead giving a recovery of 86.6% of zinc and 65.1% of lead. The sunken material contained 5.3% zinc and 3.0% of lead.

Example II: In the same apparatus the same ore yielded in the same manner on treatment with 2 pounds per ton of B naphthol after conversion to the sulfuric acid ester a froth assaying 42.7% of zinc and 8.9% of lead giving a recovery of 64.7% of the zinc and 57% of the lead.

Example III: In the same apparatus a zinc ore (Black Rock, Butte, Montana,) carrying 21.5% of zinc yielded in the same manner on treatment with 2 pounds per ton of the sulfuric acid compound of olive oil a froth assaying 44.7% of zinc giving a recovery of 73% of the zinc.

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

1. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of a sulfuric acid derivative of an organic body, agitating and aerating the mixture to form a froth, and separating the froth.

2. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of a sulfuric acid derivative of an organic body and a small quantity of acid, agitating and aerating the mixture to form a froth, and separating the froth.

3. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of a sulfuric acid derivative of a non-mineral oil, agitating and aerating the mixture to form a froth, and separating the froth.

4. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of a sulfuric acid derivative of a non-mineral oil and a small quantity of acid, agitating and aerating the mixture to form a froth, and separating the froth.

5. A process of concentrating ores which

consists in mixing the finely crushed ore with water, adding a minute quantity of "soluble oil", agitating and aerating the mixture to form a froth, and separating the

5 froth.

6. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of "soluble oil" and a small quantity of acid, agitating and aerating the mixture to form

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a froth, and separating the froth.  
7. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of a

sulfuric acid derivative of castor oil, agi- 15  
tating and aerating the mixture to form a froth, and separating the froth.

8. A process of concentrating ores which consists in mixing the finely crushed ore with water, adding a minute quantity of a 20  
sulfuric acid derivative of castor oil and a small quantity of sulfuric acid, agitating and aerating the mixture to form a froth, and separating the froth.

In testimony whereof I have affixed my 25  
signature.

ARTHUR HOWARD HIGGINS.