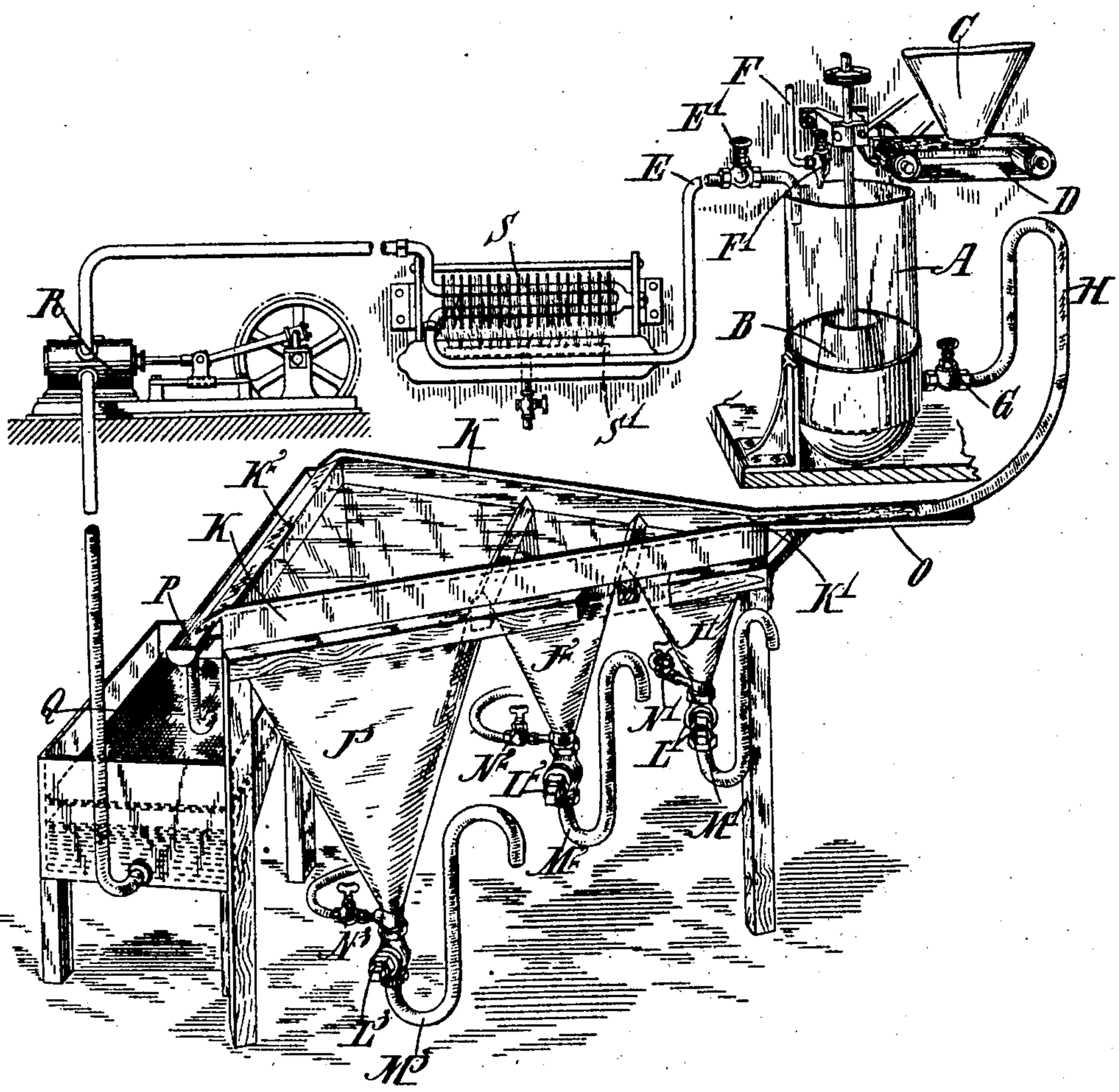
No. 835,143. PATENTED NOV. 6, 1906.

H. L. SULMAN.

ORE CONCENTRATION.

APPLICATION FILED OCT. 20, 1905.



Witnesses
H. A. Totten
F. H. Simmons

Inventor
Henry Livingstone Sulman
by Knight Bros
Attorneys

UNITED STATES PATENT OFFICE.

HENRY LIVINGSTONE SULMAN, OF LONDON, ENGLAND.

ORE CONCENTRATION.

No. 835,143. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed October 20, 1905. Serial No. 283,704.

To all whom it may concern:

Be it known that I, HENRY LIVINGSTONE SULMAN, a subject of the King of England, residing at London, England, have invented certain new and useful Improvements in Ore Concentration, of which the following is a specification.

This invention relates to improvements in the concentration of ores, the object being to separate metalliferous matter, graphite, and the like from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue.

In the process described in the specification of the previous patent application, Serial No. 262,889, filed May 29, 1905, a mineral pulp is agitated with a small proportion of an oily substance, such as oleic acid or petrol or other oil, amounting to a fraction of one per cent. on the ore until the oil-coated metalliferous matter forms into a froth which can be separated from the gangue by flotation, the pulp being acidified. It is also stated that the pulp may be warmed, say, to 30° to 40° centigrade to increase the tendency for the oily substance to disseminate through the pulp and the rapidity with which the metalliferous matter becomes coated.

It is now found that if the finely-powdered ore suspended in water is mixed with a small proportion of an oily substance—say five per cent. or less of the ore—agitated and heated to a high temperature—say, to boiling-point—that is to say, to a temperature at which bubbles of steam or vapor are generated in the pulp—the formation of a froth containing the oil-coated metalliferous matter is considerably promoted, and a very efficient separation of the metalliferous matter from the gangue may thus be obtained.

The water in which the oiling is effected may be slightly acidified by adding, say, a fraction of one per cent. of sulfuric acid or other mineral acid or acid salt, or the water may be neutral or alkaline. It is to be understood that the object of using acid in the pulp according to this invention is not to bring about the generation of gas for the purpose of flotation thereby, and the proportion of acid used is insufficient to cause chemical action on the metalliferous minerals present.

The quantity of oil employed is not sufficient to cause the flotation of the metalliferous matter by the buoyancy of the oil; but the quantity may be sufficient—say five per cent. or less on the quantity of ore—to coat the metalliferous particles with a thin film of oil.

The following is an example of the application of this invention to the concentration of ore: Broken Hill or certain copper ores are finely powdered and mixed with water, acidified or not. To this is added a proportion, as above described, of an oily substance, such as oleic acid, and the mixture is agitated in a cone mixer or the like in order to effect due oiling of the mineral particles. The pulp may now be removed from the agitation (oiling) vessel and subjected to heat in suitable apparatus. As the liquor becomes heated, and especially as the boiling-point of the liquor is approached, a froth or scum rises to the surface containing practically the whole of the metalliferous matter, while the gangue remains in the pulp. The froth may be removed from the liquid by skimming or in any usual way, or the frothy portion may be separated from the remainder of the pulp by causing this to flow through a spitzkasten or the like. The froth after separation and collection may be allowed to subside, and the oily substance may be removed from the metalliferous matter by treatment with an alkali or a solvent or otherwise.

The heating of the pulp may be effected by means of closed steam-coils, or of free steam-jets, or surrounding the agitating vessels with steam-jackets, or by any other suitable means, or the treatment of the pulp by heat may be made continuous by causing it to flow over heated surfaces in a continuous stream and collecting the suitably-heated product in an apparatus wherein the separation of the froth so produced from the mineral-depleted ore-pulp can be effected; or the contents of the agitation (oiling) vessel may be heated to the necessary extent, which approaches the boiling temperature, and on cessation of agitation the mineralized froth rises to the surface.

Should any coarser particles of oiled mineral (unremoved as "froth") remain in the coarse sands of the separated pulp, these particles may be recovered by passage over a concentration or aeration apparatus or the like.

It is to be understood that the details of the process may be varied without departing from this invention.

The accompanying drawing is a perpective view of one form of apparatus suitable for

carrying this invention into practice, the arrangement being such that the contents of the agitation vessel may be heated to the necessary extent.

A mixing vessel A (of which there may be any number in series) is provided with a rotatable stirrer B. Crushed ore is fed from a hopper C into the vessel by a band D. A pipe E, controlled by a tap E′, delivers circuit-water to the vessel, and oleic acid or other oil is introduced through the pipe F and tap F′. The outer cock G from the vessel A communicates, through a swan-neck pipe H, with the froth-separating apparatus.

In passing from the frothing apparatus A to the spitzkasten (say between O and K) the pulp may, if desired, be run in a thin layer over a smooth slightly-inclined plane.

The froth-separating apparatus comprises several (say three) pointed boxes J′ J² J³, which open at the top into a horizontal channel consisting of side walls K. The channel has a narrow inlet K′ and spreads out to a wide outlet K². The pointed boxes J′ J² J³ have full-way cocks L′ L² L³ at the bottom leading to swan-neck discharge-pipes M′ M² M³. An upcurrent of water may be led in at the bottom of each box through a tap N′ N² N³.

The boxes are all filled with circuit-water. The pulp from the vessel A is distributed horizontally from the flat trough O through the inlet K′. The heavy sands and coarser particles of mineral sink into the first box J′, from which they are led to a shaking-table, convex buddle, or the like, to be treated as above described. The middlings or medium sands fall into the box J², and if they contain any mineral may be removed for further treatment by agitation. The upcurrent of water from the taps N′ N² prevents the deposition of any slime in these boxes. The fine sands or gangue slimes settle in the last box J³, from which they are discharged to waste or further treatment.

The slime mineral in the form of froth or scum floats from the liquid and is carried by the stream over the outlet K² into a launder P and thence to a filter Q, where the metalliferous matter is removed from the circuit-water, which is returned to the vessel A by a pump R. The circuit-water may be brought to the proper temperature approximately to boiling-point by passing it through a heater S, having a burner S′, before admitting the water to the vessel A.

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

1. The herein-described process of concentrating ores which consists in mixing the powdered ore with water, adding a small proportion of an oily liquid having a preferential affinity for metalliferous matter, agitating the mixture, heating the mixture approximately to boiling-point until the oil-coated mineral matter forms into a froth and separating the froth from the remainder by flotation.

2. The herein-described process for concentrating ores which consists in mixing the powdered ore with water, adding a small proportion of oily liquid having a preferential affinity for metalliferous matter, agitating the mixture, heating the mixture until gaseous bubbles are generated therein so that the oil-coated mineral matter forms into a froth and separating the froth from the remainder by flotation.

3. The herein-described process of concentrating ores which consists in mixing the powdered ore with slightly-acidified water, adding a small proportion of oily matter having a preferential affinity for metalliferous matter, agitating the mixture, heating the mixture approximately to boiling-point until the oil-coated mineral matter forms into a froth and separating the froth from the remainder by flotation.

4. The herein-described process of concentrating ores which consists in finely powdering the ore, mixing it with slightly-acidified water, adding a small proportion of an oily substance having a preferential affinity for metalliferous matter in quantity insufficient to cause the flotation of the metalliferous matter by the buoyancy of the oil, agitating the mixture, heating the mixture to boiling-point until the oil-coated mineral matter forms into a froth, separating the froth from the remainder by flotation and removing the oil coating from the mineral by a solvent.

5. The herein-described process of concentrating ores which consists in finely powdering the ore, mixing it with water containing less than one per cent. of sulfuric acid, adding a proportion of less than ten per cent. of oleic acid, agitating the mixture until the oleic acid has come into sufficient contact with the mineral, heating the mixture up to boiling-point until the metalliferous matter has been raised in a froth to the surface, running the mixture over a current of water so that the froth is floated away by the current while the remaining mineral sinks, separating the froth and removing the oleic acid therefrom by a solvent.

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

HENRY LIVINGSTONE SULMAN.

Witnesses:
R. WILLIAMS,
T. B. BUSS.