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APPARATUS FOR CONCENTRATING ORES.

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1,187,772.

Patented June 20, 1916.

Fig. 1.

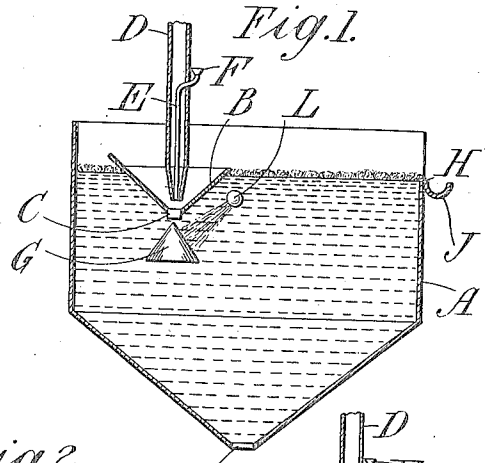


Fig. 2.

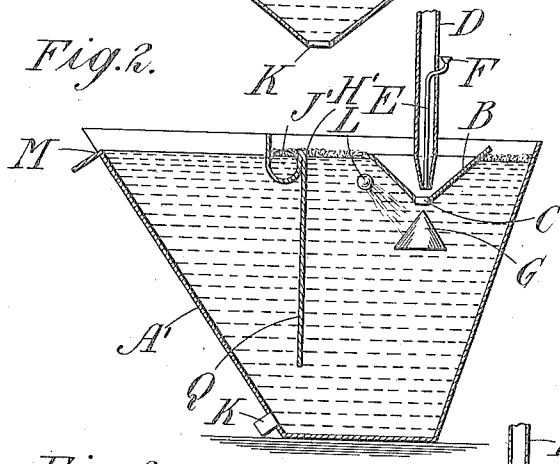
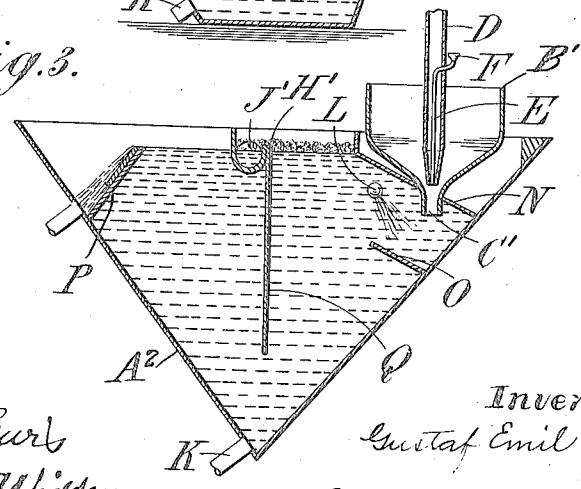


Fig. 3.



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UNITED STATES PATENT OFFICE.

GUSTAF EMIL ÖHRN, OF LIDINGÖ, STOCKHOLM, SWEDEN, ASSIGNOR TO MINERALS SEPARATION LIMITED, OF LONDON, ENGLAND.

APPARATUS FOR CONCENTRATING ORES.

1,187,772. Specification of Letters Patent. Patented June 20, 1916.

Application filed October 4, 1913. Serial No. 793,270.

To all whom it may concern:

Be it known that I, GUSTAF EMIL OHRN, subject of the King of Sweden, and residing at Lidingö, Stockholm, Sweden, have invented certain new and useful Improvements in Apparatus for Concentrating Ores, of which the following is a specification.

This invention is for improvements in or relating to apparatus for concentrating ores and it refers more particularly to apparatus for carrying into effect the agitation froth process of ore concentration.

In the United States Patents Nos. 835120, granted November 6th, 1906, 962678 granted June 28th, 1910, and 1064723 granted June 17th, 1913, processes have been described which consist in agitating the ore mixed with water with a minute proportion of a mineral frothing agent in such a manner as to beat in air; in certain cases acid may be added to the mixture of ore, water and frothing agent. In the prior Patents Nos. 979857 and 1064209 apparatuses have been described for carrying such processes into effect and the agitation has been produced by mechanical agitators.

It is the object of this invention to provide an apparatus in which mechanical agitators are dispensed with.

According to this invention apparatus for concentrating ores comprises in combination a pulp vessel, a hopper for the crushed ore whose outlet is below the surface of the water in the pulp vessel, a steam pipe in the hopper forming with it an injector and a launder for removing the froth as it overflows from the pulp vessel.

The mineral frothing agent is preferably supplied to the ore by a steam injector and in the preferred form of apparatus it is supplied through a pipe arranged in the steam pipe and having a funnel shaped extension outside the steam pipe, the frothing agent passing into the funnel shaped extension from a reservoir. The steam pipe acts with the pipe supplying the agent as an injector for delivering the agent to the ore and at the same time it acts as an air injector, the air being drawn in with the frothing agent through the funnel shaped extension of the supply pipe. A cone of wood, metal or other material may be arranged in the pulp vessel below the outlet from the hopper to distribute the ore pulp as it issues therefrom. It is found convenient to arrange below the surface of the liquid in the pulp vessel a water spray in such position that streams of water issue from it and meet the rising mineral froth.

The hopper may be arranged with a portion of its periphery on a level with the overflow lip from the pulp vessel so that a part of the froth overflows into the hopper and is submitted to a retreatment; also the pulp vessel may be divided by a partition extending nearly to the bottom, the hopper and overflow lip for the concentrates being arranged on one side of the partition and an outflow for the water carrying the gangue slimes on the other side of the partition. In this latter case the outflow for the gangue slimes is arranged at a level just below the level of the overflow lip for the concentrates.

Forms of apparatus according to this invention will now be described with reference to the accompanying drawings in which—

Figure 1 shows an apparatus in which the hopper is arranged with a portion of its periphery on a level with the overflow lip for the concentrates. Fig. 2 shows a modification in which the pulp vessel is divided by a partition and Fig. 3 shows a further modification in which a guide plate is arranged under the outlet of the hopper.

Like letters refer to like parts throughout the drawings.

Referring to Fig. 1 a pulp vessel A is provided with a hopper B whose outlet C is below the level of the water therein. In the hopper B is arranged a steam pipe D which with the hopper constitutes an injector. Within the steam pipe D and passing through it is arranged a small pipe E

having a funnel shaped extension F outside the steam pipe. A cone G of wood, metal or other material is arranged with its apex under the outlet C from the hopper. The pulp vessel is provided with an overflow lip H, a launder J, and an outlet K at the bottom for the tailings. A water spray L is arranged under the surface of the water in the pulp vessel to direct streams of water on the froth as it rises to the surface.

In the apparatus shown in Fig. 2 the pulp vessel A′ is divided by a partition Q which extends nearly to the bottom, the hopper B being arranged on one side of it and the concentrates launder J′ into which the froth flows over overflow lips H′ extending across the middle of the box. On the other side of the partition an outlet M is provided for the water carrying the gangue slimes.

Referring now to Fig. 3, the hopper B′ is supported on a shelf N and under the outlet C′ is arranged a baffle O to direct the ore mixture toward the surface of the liquid in the pulp vessel. A partition P is also provided extending upward from the wall of the pulp vessel to a point just below that of the overflow lip H′ for the concentrates.

The operation of the apparatus is as follows. The crushed ore is fed into the hopper B, either dry or preferably mixed with water in the form of pulp. Steam under pressure is supplied to the steam pipe D and a frothing agent, such for example as oleic acid, is allowed to drip from a reservoir into the funnel shaped opening F of the pipe E. The steam passing through the pipe D acts with the frothing agent supply pipe E as an injector and sucks in frothing agent and air, and it also acts with the hopper B as an injector forcing the ore pulp together with the frothing agent through the outlet C into the pulp vessel. The steam jet causes a thorough agitation of the mixture which is forced under the surface of the water in the pulp vessel. The metalliferous particles become attached to the bubbles of air mixed into the ore pulp by the action of the steam jet and are carried by them to the surface. The guide plate O shown in Fig. 3 guides the agitated mixture toward the surface. As the mineral coated bubbles rise they meet jets of water issuing from the spray L which help to remove any particles of gangue which may have become attached to the air bubbles. The gangue sinks to the bottom of the pulp vessel and is removed through the outlet K and the metalliferous particles in the form of a copious froth overflow over the lip H into the launder J from which they are removed. The water containing gangue slimes flows under the dividing partition Q over the lip of the short partition P and away through the outlet M. When necessary acid such as sulfuric acid may be added to the ore and in this case it is found convenient to allow the acid to mix with the ore in the hopper B.

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

1. Apparatus for concentrating ores comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, and means for removing the froth from the pulp vessel.

2. Apparatus for concentrating ores comprising in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore so arranged that the steam pipe forms therewith an injector for the frothing agent and air, and means for removing the froth from the pulp vessel.

3. Apparatus for concentrating ores comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore arranged inside the steam pipe and having a funnel-shaped extension outside the steam pipe so that the steam pipe forms with the said pipe an injector for the frothing agent and air, and means for removing the froth from the pulp vessel.

4. Apparatus for concentrating ore comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore arranged inside the steam pipe and having a funnel-shaped extension outside the steam pipe so that the steam pipe forms with the said pipe an injector for the frothing agent and air, a cone-shaped device arranged under the outlet from the hopper to distribute the ore mixture, and means for removing the froth from the pulp vessel.

5. Apparatus for concentrating ore comprising, in combination, a pulp vessel, a hopper for the crushed ore having an out-

let in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a water spray in the pulp vessel below the surface of the liquid and in proximity to the outlet from the hopper arranged to spray the froth as it forms and rises to the surface, and means for removing the froth as it overflows from the pulp vessel.

6. Apparatus for concentrating ores comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore so arranged that the steam pipe forms therewith an injector for the frothing agent and air, a water spray in the pulp vessel below the surface of the liquid and in proximity to the outlet from the hopper arranged to spray the froth as it forms and rises to the surface, and means for removing the froth from the pulp vessel.

7. Apparatus for concentrating ores comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore arranged inside the steam pipe and having a funnel-shaped extension outside the steam pipe so that the steam pipe forms with the said pipe an injector for the frothing agent and air, a water spray in the pulp vessel below the surface of the liquid and in proximity to the outlet from the hopper arranged to spray the froth as it forms and rises to the surface, and means for removing the froth from the pulp vessel.

8. Apparatus for concentrating ore comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore arranged inside the steam pipe and having a funnel-shaped extension outside the steam pipe so that the steam pipe forms with the said pipe an injector for the frothing agent and air, a cone-shaped device arranged under the outlet from the hopper to distribute the ore mixture, a water spray in the pulp vessel below the surface of the liquid and in proximity to the outlet from the hopper arranged to spray the froth as it forms and arises to the surface, and means for removing the froth from the pulp vessel.

9. Apparatus for concentrating ores comprising in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein arranged with a portion of its periphery on a level with a discharge lip of the pulp vessel, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore arranged inside the steam pipe having a funnel-shaped extension outside the steam pipe so that the steam pipe forms with the said pipe an injector for the frothing agent and air, and means for removing the froth from the pulp vessel.

10. Apparatus for concentrating ores comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein arranged with a portion of its periphery on a level with the discharge lip of the pulp vessel, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a water spray in the pulp vessel, below the surface of the liquid and in proximity to the outlet from the hopper arranged to spray the froth as it forms and rises to the surface, and means for removing the froth as it overflows from the pulp vessel.

11. Apparatus for concentrating ore comprising, in combination, a pulp vessel, a hopper for the crushed ore having an outlet in the pulp vessel below the liquid level therein arranged with a portion of its periphery on a level with the discharge lip of the pulp vessel, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with the outlet an injector for feeding the ore into the pulp vessel, a cone-shaped device arranged under the outlet from the hopper to distribute the ore mixture, a water spray in the pulp vessel below the surface of the liquid and in proximity to the outlet from the hopper arranged to spray the froth as it forms and arises to the surface, and means for removing the froth as it overflows from the pulp vessel.

12. Apparatus for concentrating ores comprising, in combination, a pulp vessel divided by a partition extending nearly to the bottom, a hopper for the crushed ore

having an outlet in the pulp vessel below the liquid level therein, a steam pipe having an injector nozzle in the hopper in proximity to the outlet thereof so as to form with such outlet an injector for feeding the ore into the pulp vessel, a pipe for supplying a frothing agent and air to the crushed ore arranged inside the steam pipe and having a funnel-shaped extension outside the steam pipe so that the steam pipe forms with the said pipe an injector for the frothing agent and air, and means for removing the froth as it overflows from the pulp vessel.

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

GUSTAF EMIL ÖHRN.

Witnesses:

JOHANNES FREDRIK ARONSON,
GUSTAF FREDK. BESKOW.