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S. MALKE

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APPARATUS FOR ORE CONCENTRATION

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FIG. 1.

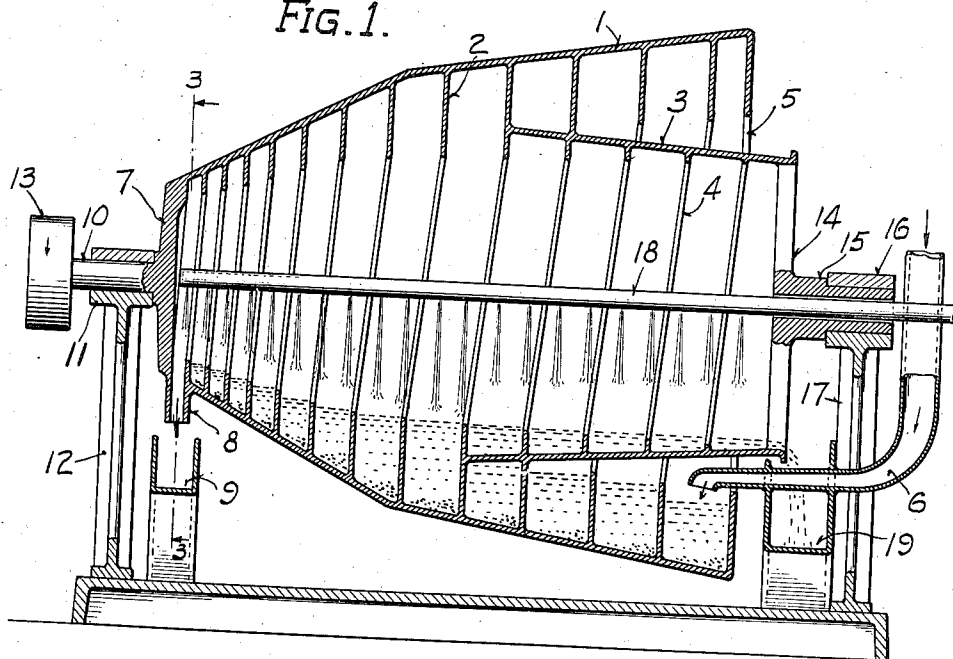


FIG. 2.

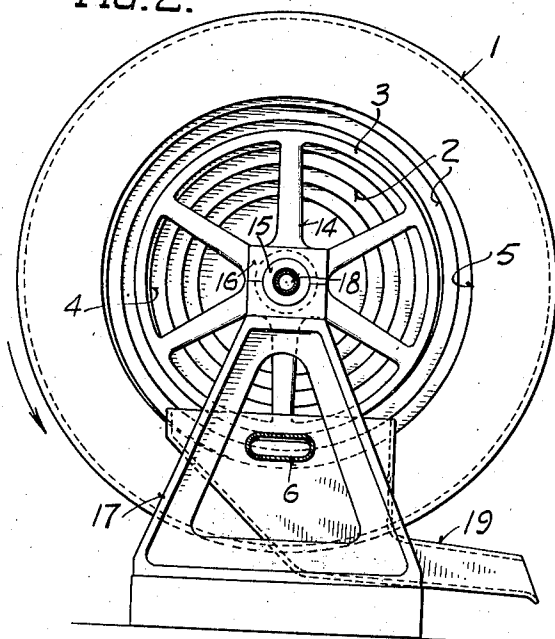
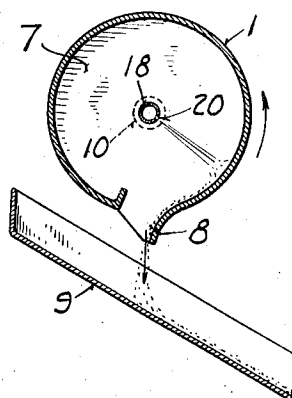


FIG. 3.



INVENTOR.
Sven Malke

BY *Erwin C. Anderson*
ATTORNEY.

UNITED STATES PATENT OFFICE

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APPARATUS FOR ORE CONCENTRATION

Sven Malke, Milwaukee, Wis., assignor to A. O. Smith Corporation, Milwaukee, Wis., a corporation of New York

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4 Claims. (Cl. 209—452)

This invention relates to apparatus for concentration of ores.

An object of the invention is to provide improved apparatus of this kind suitable for use in the concentration of ores and the separation of the valuable constituents in ores from the other materials with which they may be mixed.

Other objects of the invention will be clear from the accompanying detailed description and the drawing in which:

Figure 1 is a longitudinal section through an embodiment of my invention;

Fig. 2 is an elevation of the right-hand end of the apparatus shown in Figure 1; and

Fig. 3 is a section through the concentrate discharge end taken on line 3—3 of Figure 1.

The ore concentrator of this invention comprises an outer drum 1 which may have the form of two frustums of cones joined together, as indicated in the drawing, or which may be of cylindrical, or other form, arranged to rotate about a horizontal axis or about an axis inclined to the horizontal. The inside surface of the outer drum is provided with a helix 2. The helix may be of uniform pitch, or of a variable pitch with the pitch decreasing toward the smaller end of the drum, as illustrated in the drawing. In some cases, the decreasing pitch toward the small end of the drum is of advantage; in others, a uniform pitch is more suitable. In any event, it is desirable that the rib which forms the helix should decrease in height as it approaches the small end of the drum.

An inner drum 3 is mounted rigidly within the outer drum and concentric with it. The inner drum has a helix 4 on its inner surface. Either one or both of the helixes may be formed from a single rib or from several ribs. In the embodiment of my invention shown in the drawing both helixes are formed from a single rib, and the helix on the inner drum is so arranged as to feed in the same direction as the helix on the inner surface of the outer drum. The rib which forms the helix 4 may desirably decrease in height as the outer end of the drum is approached. The rigid connection between the inner and outer drums is provided by the helix 2 of which a few turns are connected to the inner end of the drum 3.

At the right-hand end of the drum 1 an annular opening 5 is left between the drum 3 and the inside of the helix 2 to provide for the introduction of feed pipe 6.

Due to the seal which is provided by the turns of the helix which are secured to both the inner

and outer drums, all the material which is fed into the large end of the outer drum is forced into the middle section of this drum. From here it can be discharged only through the inner drum or through the small end of the outer drum. No water or other material can run back over the top of the rib in the outer drum and escape at the opening left for the entrance of the feed pipe. A water level, such as is indicated in Fig. 1, will be maintained, even though the drum is not in rotation, because of the inability of the water to pass from one convolution to the next one except by flowing over the top of the rib which separates them.

A cover 7 is securely fastened to the small, or left-hand, end of the drum 1. The cover 7 is provided with a spout 8, as indicated in Fig. 3 which is a section through the cover on line 3—3 of Fig. 1. As the drum rotates, the spout 8 discharges concentrates into the trough 9 which serves to convey them to any desired place for further treatment.

A shaft 10 is securely fastened to the cover 7 and rotates in bearing 11 carried by the support 12. A pulley 13 serves for driving the drum, but other means for rotating the drum may be used.

The other end of the drum may be supported by an open spider 14 which is rigidly secured to the inner drum 3 and the shaft 15. The shaft 15 rotates in a bearing 16 carried by a support 17. The shaft 15 is desirably made hollow so as to provide for the introduction of a spray pipe 18 for spraying water upon the material being treated. A trough 19 is provided for carrying away tailings discharged from the open end of the inner drum 3.

In the operation of this machine, the drums are set in rotation. The direction of rotation is such that the tendency of the helixes 2 and 4 is to drive any material which they contain from right to left, or from the large end of the outer drum to the small end. The drum may be rotated continuously in one direction, either at a constant or a varying speed, or it may be given an oscillatory rotation with a preponderance of movement in one direction. A pulp of ground ore and water is fed into the outer drum through the feed pipe 6.

Both the valuable constituent of the ore, such as gold, and the valueless sand, or other gangue with which it may be mixed, move initially in the same direction, that is, from the large end of the outer drum toward the small end, or from the feed end toward the concentrate discharge end. During this

initial motion, the heavy particles of gold, or other valuable material, sink through the pulp and tend to collect near the bottom. The pulp which is thus stratified then passes beyond the end of the inner drum 3 and is exposed to the action of jets of water issuing from holes 20 in the spray pipe 18. The jets are preferably so directed as to cause the water spray to impinge upon the inner wall of the drum at the place where the rising side of the rotating drum leaves the pulp. The jets of water wash off impurities from the heavy particles of gold, or other valuable mineral being separated. The tailings of the lighter and less valuable material are washed backward by the water and are ultimately discharged through the open end of the inner drum into a trough 19 which carries them away for disposal.

The heavy constituents seek the lowest level in the apparatus. They lodge at the bottom of the helix and are thus kept from being swept away with the tailings. The continued rotation of the drum drives the valuable constituents forward until they are ultimately discharged through the nozzle 8 into a trough 9 provided for their reception. As the ribs of the helix 2 are made to decrease in height as the concentrate discharge end is approached, more and more of the lighter valueless material is forced above the convolutions of the helix and is swept away to the tailings discharge. Consequently, a cleaner or higher grade concentrate is produced than if the helix were maintained of uniform height throughout its entire course.

While the jets of water from the spray pipe are of considerable assistance to the production of an effective separation, they are not indispensable to the successful operation of the machine since, even in their absence, the continued rotation of the drum will result in forcing concentrates out of one end, and tailings out of the other.

Before the tailings are discharged from the machine they must pass through the inner drum 3, which is provided with the helix 4 having a pitch in the same direction as the pitch of helix 2. This helix therefore propels heavy materials which lodge in it in a forward direction. Any gold particles which may have been carried with the tailings into the inner drum are caught in this drum and returned to the outer drum to be discharged at the concentrate end. The inner drum thus makes for tailings which contain little or no values, that is, for a high degree of recovery of the valuable material in the ore being treated. The inner drum may have the shape of a frustum of a cone, as shown in the drawing, and may be provided with a helix which decreases in height toward the tailings discharge end; but these features, while desirable, are not essential for the performance of the important function of the inner drum of thoroughly cleaning the tailings and guarding against the loss of values.

It is to be noticed that with this apparatus for concentrating ores, the valuable material and the gangue are initially moved in the same direction to produce an initial stratification of the pulp, and that the pulp is then subjected to the action of forces which produce a separation of the valuable and valueless materials by moving one material

in one direction, and the other in substantially the opposite direction.

While the description above has been given in terms of an apparatus for the treatment of ores, it is to be understood that the apparatus can be modified without departing from the spirit of invention and is suitable for the separation of many other mixtures of particles differing in density. It is also to be understood that the apparatus is likewise suitable for the separation of a valueless heavy material from a valuable lighter material. In this case, the heavy material constituting the tailings will be discharged at what has been termed the concentrate discharge end of the machine, while the concentrate of the lighter material will come out of the open end of the inner drum.

I claim:

1. An ore concentrator which comprises a drum of circular cross section having the form of two frustums of cones joined together at their meeting line, the two frustums being from cones of different apex angles and so arranged that in both the apex falls to the same side of the frustum; a helix coiled on the inner surface of the drum with convolutions decreasing in depth as the helix approaches the smaller end of the drum; a second drum mounted rigidly within and concentric with the outer drum, said inner drum extending longitudinally beyond the larger end of the outer drum and longitudinally within the outer drum for only a portion of the distance from its larger to its smaller end; a helix arranged on the inner surface of the inner drum with a pitch in the same sense as the pitch of the helix on the outer drum; means for rotating said drums about their common axis; and means for feeding ore to the large end of the outer drum.

2. In an ore concentrator, the combination of a rotatable drum; a second drum mounted within the first drum; a helix on the inner surface of the outer drum; and a helix on the inner surface of the inner drum, the pitch of both helixes having the same sense, and not less than about one complete convolution of the rib which forms the helix on the inner surface of the outer drum being sealed to both the inner surface of the outer drum and the outer surface of the inner drum.

3. In an ore concentrator the combination of a rotatable drum, a helix on the inner surface of the drum, and a second drum arranged within said helix, not less than about one complete convolution of the helix being sealed to both the inner surface of the outer drum and the outer surface of the inner drum.

4. In an ore separator, the combination which comprises a rotatable drum provided with a helix on its inner surface, means for feeding a pulp of ore and water to one end of said drum, means for discharging concentrate from the opposite end of said drum, and a second drum for discharging tailings, said second drum being mounted interiorly of the first drum and extending from beyond the feed end of the first drum to a position intermediate its ends, and being sealed intermediate the ends of the first drum to not less than about one complete convolution of the helix on the inner surface of the first drum.

SVEN MALKE.