Dec. 25, 1923. 1,478,703

S. H. DOLBEAR

APPARATUS FOR THE CONCENTRATION OF ORES

Filed Oct. 5, 1921 2 Sheets-Sheet 1

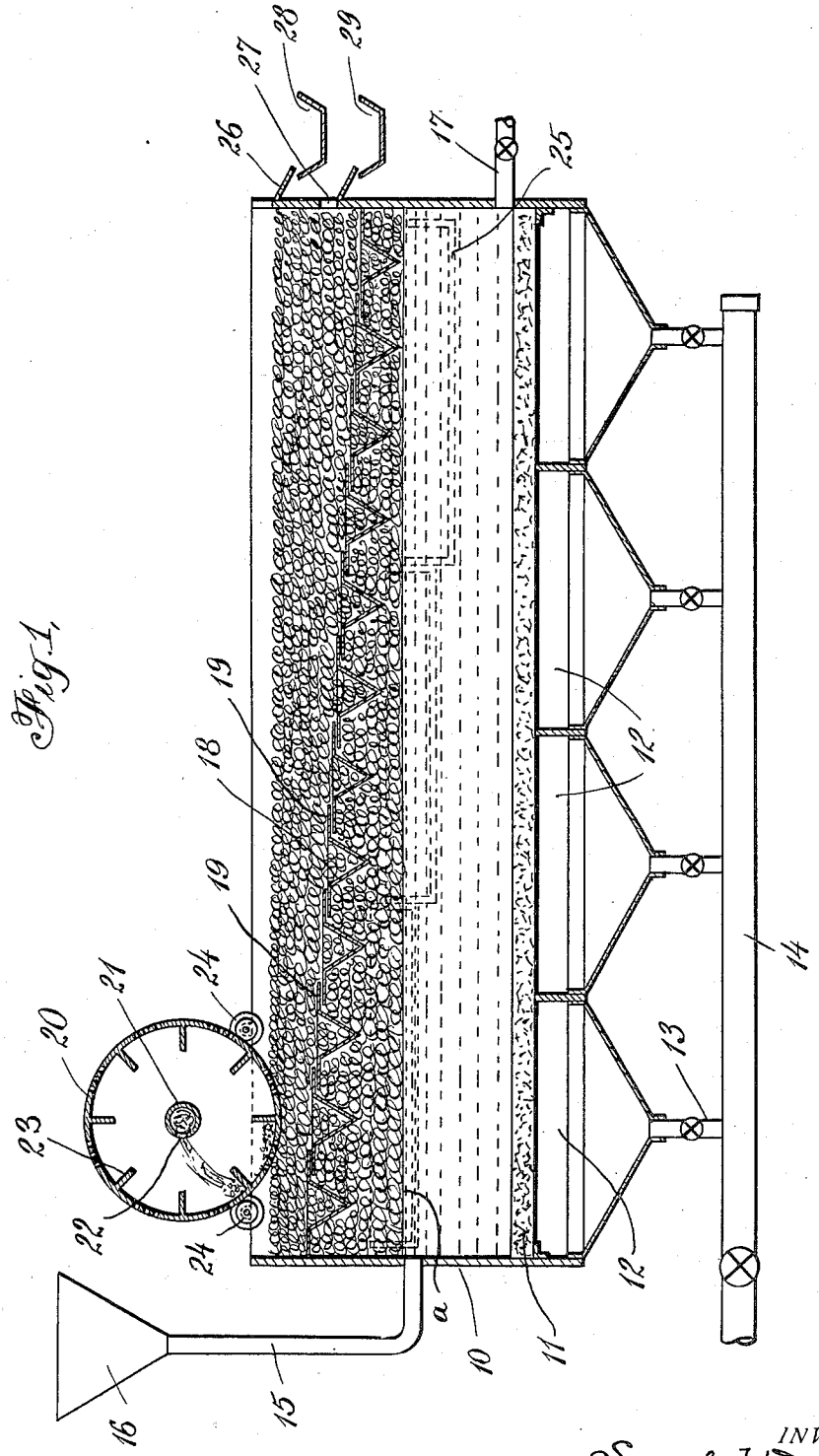


Fig. 1.

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Fig. 2

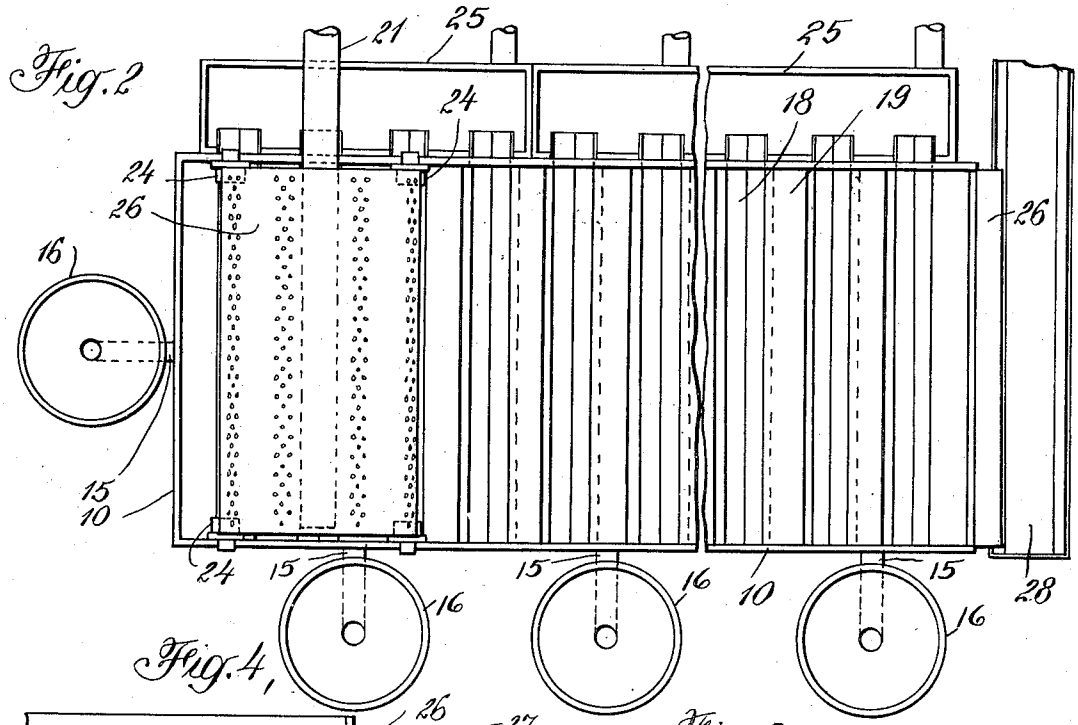


Fig. 4,

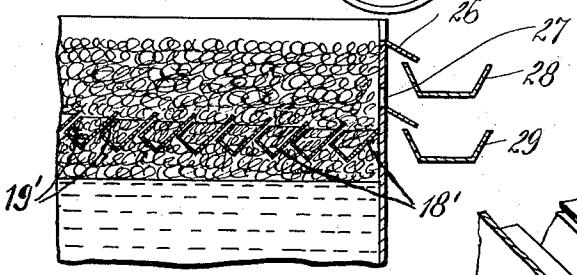


Fig. 3,

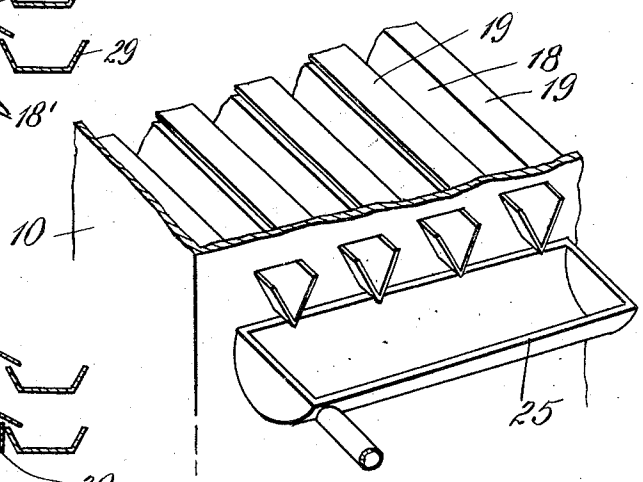
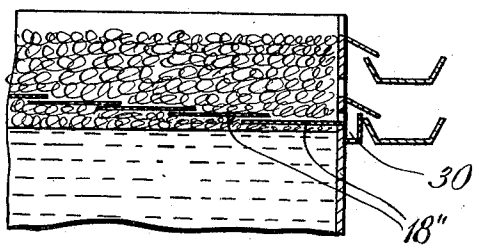


Fig. 5,



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Patented Dec. 25, 1923. 1,478,703

UNITED STATES PATENT OFFICE.

SAMUEL H. DOLBEAR, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO PNEUMATIC PROCESS FLOTATION COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

APPARATUS FOR THE CONCENTRATION OF ORES.

Application filed October 5, 1921. Serial No. 505,465.

To all whom it may concern:

Be it known that I, SAMUEL H. DOLBEAR, a citizen of the United States, residing at San Francisco, in the county of San Francisco, State of California, have invented certain new and useful Improvements in Apparatus for the Concentration of Ores; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the concentration of ores, and has for its object the provision of an improved apparatus for ore concentration. More particularly the invention aims to provide an improved apparatus especially adapted for carrying out the method of ore concentration described in my co-pending application Serial No. 431,024, filed December 15, 1920.

The method of ore concentration described in my aforementioned application takes advantage of the fact that metallic, metalliferous, and some other substances, exhibit a preferential affinity for oils and other substances commonly known as flotation reagents. The method of my co-pending application is not, however, a flotation method in the commonly accepted definition of that term, inasmuch as there is present in my improved method of ore concentration no agitation or aeration of an ore pulp. Thus, in accordance with the method of my co-pending application, the ore is fed into or upon a froth of selective character, continually rising and replacing broken down froth, and the operation is so conducted that the gangue matter present in the ore sinks either out of the froth or into the lower part of the froth, while the metalliferous or similar particles present in the ore are retained in the froth or in the upper portion thereof. The gangue matter and any metalliferous matter escaping the froth is prevented from settling into the froth-making chamber, which latter contains only a suitable liquid, such as water, and an appropriate frothing and/or selective reagent or reagents.

In the improved apparatus of the present invention appropriate means are provided for bringing finely divided ore, either in a dry state or in the form of an ore pulp, into contact with a body of active froth above the lower boundary, or lower level, of the froth body. By active froth I mean an unstable froth which is continuously breaking down and continuously being replaced by fresh froth. The apparatus of the invention includes appropriate means for forming a body of froth and for maintaining such body of froth separate from the liquid from which the froth is formed. Another feature of the present invention consists in the provision of appropriate means for bringing the ore into contact with the body of froth, while the froth is kept in motion, and at the same time preventing any particles of the ore from passing into the froth-making chamber. The apparatus of the invention is also preferably arranged so as to give the froth a more or less lateral path of travel towards the discharge end of the apparatus. Preferably, provision is also made for dividing the froth in the discharge end of the apparatus, by providing froth discharge passages at various levels of the froth bed. These and other novel features of construction of the improved apparatus of the invention will be better understood from the following description taken in conjunction with the accompanying drawings, in which;

Figure 1 is a sectional elevation of an apparatus embodying the invention;

Fig. 2 is a top plan view of the apparatus;

Fig. 3 is a perspective view of a portion of the apparatus; and

Figs. 4 and 5 illustrate certain modifications of the invention.

The improved apparatus of the invention comprises a tank 10 having a transverse porous medium 11 arranged near the bottom thereof. The porous medium may be of any appropriate character, such as canvas, porous tile, or the like, which is adapted to support a suitable body of liquid and at the same time permit the passage upwardly therethrough of an appropriate quantity of a suitable gas, such, for instance, as air. A plurality of gas compartments 12 are provided beneath the porous bottom 11, and an appropriate gas, such as air, under suitable pressure, is admitted to the compartments 12 by means of valved pipes 13 communicating with a gas supply main 14.

The liquid level in the tank 10, under normal operating conditions, is not higher than the dotted line *a*. Liquid, such as

water, and appropriate frothing and/or selective agent or agents are introduced into the tank 10 through a plurality of pipes 15 provided at their upper end with funnels 16. The tank 10 is also provided with a liquid discharge pipe 17, the valve of which, under normal operating conditions, is maintained closed.

A plurality of V-shaped deflectors or troughs 18 are mounted in the upper portion of the tank 10 above the normal liquid level of the tank under operating conditions. The deflectors are arranged transversely in the tank and are parallel to one another. Each deflector is provided with substantially horizontal flanges 19 and the deflectors are arranged so that the flanges 19 of adjacent deflectors overlap, as clearly illustrated in Fig. 1 of the drawings. The overlapping flanges 19 are appropriately spaced so as to permit the passage therebetween of froth formed above the liquid level *a*.

A perforated hollow drum 20 is provided for feeding ore pulp into or upon the body of froth formed above the baffles 18. The drum is mounted for rotation upon rollers 24. The perforations of the drum are preferably staggered in order to uniformly distribute the ore pulp and to avoid channeling and breaking down of the froth. A stationary feed pipe 21 having a discharge opening or openings 22 is arranged centrally within the drum 20. The drum is interiorly provided with a plurality of spaced baffles 23.

The troughs 18 project through one side wall of the tank 10, and are arranged to discharge into launders 25 mounted on the side of the tank. One or more launders may be provided for collecting the discharge from troughs 18, and in the apparatus illustrated in Figs. 1 and 2 of the drawings three such launders are provided.

The operation of the apparatus illustrated in the accompanying drawings is substantially as follows: Air, or other suitable gas, is forced through the porous medium 11 into the liquid in the tank 10 and forms within this liquid a continuously rising stream of air bubbles. The liquid level is maintained approximately constant by adding additional liquid, such as water, to the tank through the supply pipes 15. An appropriate flotation and/or selective agent or agents are supplied to the tank preferably through a plurality of pipes 15, thereby securing the uniform distribution of such agent or agents throughout the whole body of the froth-making liquid. In some instances it is advisable to emulsify the flotation and/or selective agent with water before introducing it into the tank, since the free agent might tend to kill the froth. Froth-making gas bubbles rise to the surface of the liquid and there is formed above such surface a body of froth which gradually rises and coming into contact with the deflectors 18 is forced through the apertures between the overlapping flanges 19. In this manner a mass of froth is built up reaching in depth or thickness from the top of the liquid level (*a*) to the level of the upper froth discharge 26.

When a suitable depth of froth has been formed, ore pulp is conducted into the drum 20 through the feed pipe 21 and discharged into the drum through the apertures 22. The lower portion of the drum preferably comes in contact with the froth since it is desirable to prevent the ore pulp from falling upon the froth, thereby causing the froth to be broken down. Ore pulp, upon discharging from the apertures 22, strikes the baffles 23, the weight of the falling ore pulp being sufficient to revolve the drum 20, the drum being supported by the rollers 24 upon which it revolves. The speed of rotation of the drum may be appropriately varied by adjusting the spouting velocity of the ore pulp discharged from the feed tube 21. The ore pulp passes through the perforations of the drum into the body of froth in the tank 10. The froth rising through the apertures between the overlapping flanges 19, immediately below the drum, receives a charge of ore pulp. Gangue matter, having no affinity for the selective reagent in the froth, sinks out of or into the lower portion of the froth, and is caught in the V-shaped troughs or deflectors 18, and is discharged through the wall of the tank into the launders 25. From the launders 25 such gangue matter may be conducted to any suitable place for disposal or retreatment.

Mineral particles exhibit a tendency to remain in the froth while gangue particles exhibit a tendency to fall through the froth, and for these reasons the froth, and more particularly the top portion thereof, becomes enriched in metalliferous particles. The entire body of froth is given a longitudinal movement, that is, a movement from the feed end of the apparatus towards the discharge end. In other words, as viewed in Fig. 1 of the drawings, the body of froth moves from left to right, and is discharged into launders 28 and 29 through discharge openings 26 and 27, respectively. This movement is due to the fact that the froth is ejected through the spaces or apertures between the flanges 19 with a lateral movement, and such lateral movement is imparted to the overlying froth. If desired, the discharge opening 27 may be closed. When open, this discharge opening enables the froth to be removed at two different levels, thereby obtaining concentrates of different grades.

If desired, the apparatus may be operated so as to permit certain of the mineral particles to sink out of the body of froth altogether, and to pass into the V-shaped troughs 18, and be there collected as concentrates. The gangue will, of course, be first deposited in the troughs 18 nearest the feed end of the apparatus, and would, in such cases, be disposed of by the first launder 25 separately from the product or products deposited nearer the discharge end of the apparatus. Several different products may, if desired, be collected in this way. Thus, in the apparatus illustrated in Fig. 1 of the drawings three different products can be collected from the launders 25 and two additionally different products can be collected in the launders 28 and 29. In this manner it is practicable to carry out with ease various procedures of differential separation or concentration of ores.

In Fig. 4 of the drawings a modified arrangement of the V-shaped troughs or deflectors is illustrated. In this modification the troughs or deflectors 18′ need have no horizontal flanges but are arranged to overlap one another. Preferably, the overlapping troughs 18′ are provided with flanges 19′, and the troughs are so arranged that an appropriate space is provided between the flanges 19′ and the adjacent troughs for producing a lateral movement of the body of froth.

A further modification of the collecting troughs is illustrated in Fig. 5 of the accompanying drawings. In this modification the deflectors take the form of overlapping horizontal plates 18″. With this arrangement the gangue is worked over the overlapping plates 18″ and is discharged into a launder 30. It will be understood that the plates 18″ may be slightly inclined instead of being approximately horizontal, and that the overlapping portions of the plates are appropriately spaced to permit the passage therethrough of a suitable amount of froth to properly maintain the desired depth of froth in the apparatus.

Flotation agents of a selective and/or frothing character adapted to create froths are well known in the art, and it is only necessary to make a preliminary test to determine the particular agent or agents best suited to the particular ore under treatment.

In the accompanying drawings, I have illustrated what I now consider the best embodiment of the invention, but it will be understood by those skilled in the art that various modifications may be made in the particular form of apparatus illustrated without departing from the spirit of the invention.

The introduction of the ore or ore pulp to be treated upon or into the froth tends to a certain extent to break down the froth, and for this reason it is frequently desirable to produce a more voluminous froth at the place or places where such introduction of ore or ore pulp takes place. In the apparatus illustrated in the accompanying drawings, this result can be effected by relatively increasing the gas pressure, or the volume of gas passing through, the gas compartment or compartments beneath the ore or ore-pulp feeding device.

From the foregoing description it will be seen that the present invention provides an apparatus for effectively concentrating ores in which a concentrate of very high grade can be obtained together with other products of various grades. The various inferior grades so obtained may be given any appropriate retreatment peculiarly adapted to each product, thereby affording means for recovering the metalliferous matter from ores with the smallest possible cost of treatment. The power consumption in concentrating ores by the use of the apparatus of the invention is considerably less than is consumed in the concentration of ores by the heretofore customary methods of concentration. This saving in power consumption results from the fact that in producing the froth no agitation of the ore pulp with the attendant elevating and moving of a large weight of ore is necessary as in the present common methods of ore concentration by flotation.

I claim:

1. An apparatus for the concentration of ores comprising a froth producing chamber, means for causing the froth to flow in a lateral direction, means for distributing ore in a discontinuous body uniformly in the froth, whereby certain particles of the ore are retained in the froth while other particles settle from the froth, means for collecting the froth, means for substantially preventing the settled particles from entering the froth producing chamber, and means for collecting and discharging such settled particles from the apparatus.

2. An apparatus for the concentration of ores, comprising a froth producing chamber, means for distributing ore in a discontinuous body uniformly in the froth, whereby certain particles of the ore are retained in the froth while other particles settle from the froth, means above the froth producing chamber so positioned and spaced as to collect and discharge the settled particles and to deflect the rising column of bubbles in a lateral direction, and means for collecting the froth.

3. In an apparatus for the concentration of ores, a froth producing chamber, means for distributing ore in a discontinuous body uniformly in the froth whereby some particles of the ore are retained by the froth

while others settle through the froth, means for substantially preventing the ore from settling into the froth producing chamber, and means for discharging settled particles from the apparatus.

4. In an apparatus for the concentration of ores, means for producing a froth having a greater tenacity for metalliferous particles than for gangue particles, means for distributing the ore in a discontinuous body uniformly in said froth whereby metalliferous particles in the ore are retained in the froth for a longer time than gangue particles, and means for separately removing gangue and metalliferous particles from the froth without permitting either metalliferous or gangue particles in any substantial amount to penetrate into the froth producing means.

5. In an apparatus for the concentration of ores, froth producing means a perforated hollow drum capable of being revolved and adapted to deposit an ore pulp in the body of froth formed in the apparatus, an ore pulp feed means located within said drum, and means associated with said drum and arranged so that ore pulp discharged from said feed means cooperates therewith to produce rotation of the drum.

6. In an apparatus for the concentration of ores, froth producing means a perforated hollow drum capable of being revolved and adapted to deposit an ore pulp in the body of froth formed in the apparatus, an ore pulp feed means located within said drum, baffles extending from the inner surface of said drum and so arranged that ore pulp discharged from said feed means comes in contact with the baffles and causes rotation of the drum.

7. In an apparatus for the concentration of ores, froth producing means a perforated hollow drum mounted for rotation and arranged to deposit ore pulp in the body of froth formed in the apparatus, an ore pulp feed pipe centrally located within the drum, baffles extending from the inner surface of the drum and so arranged that ore pulp discharged from said feed pipe comes in contact with the baffles and causes rotation of the drum.

8. In an apparatus for the concentration of ores, froth-producing means, a series of V-shaped troughs above the normal operating liquid level operatively associated with said means, each of said troughs being provided with flanges so arranged that the adjacent flanges of adjacent troughs overlap thereby forming laterally directed spaces for deflecting a layer of froth uniformly and continuously in a lateral direction, and means for depositing ore in the body of froth above said troughs.

In testimony whereof I affix my signature.

SAMUEL H. DOLBEAR.