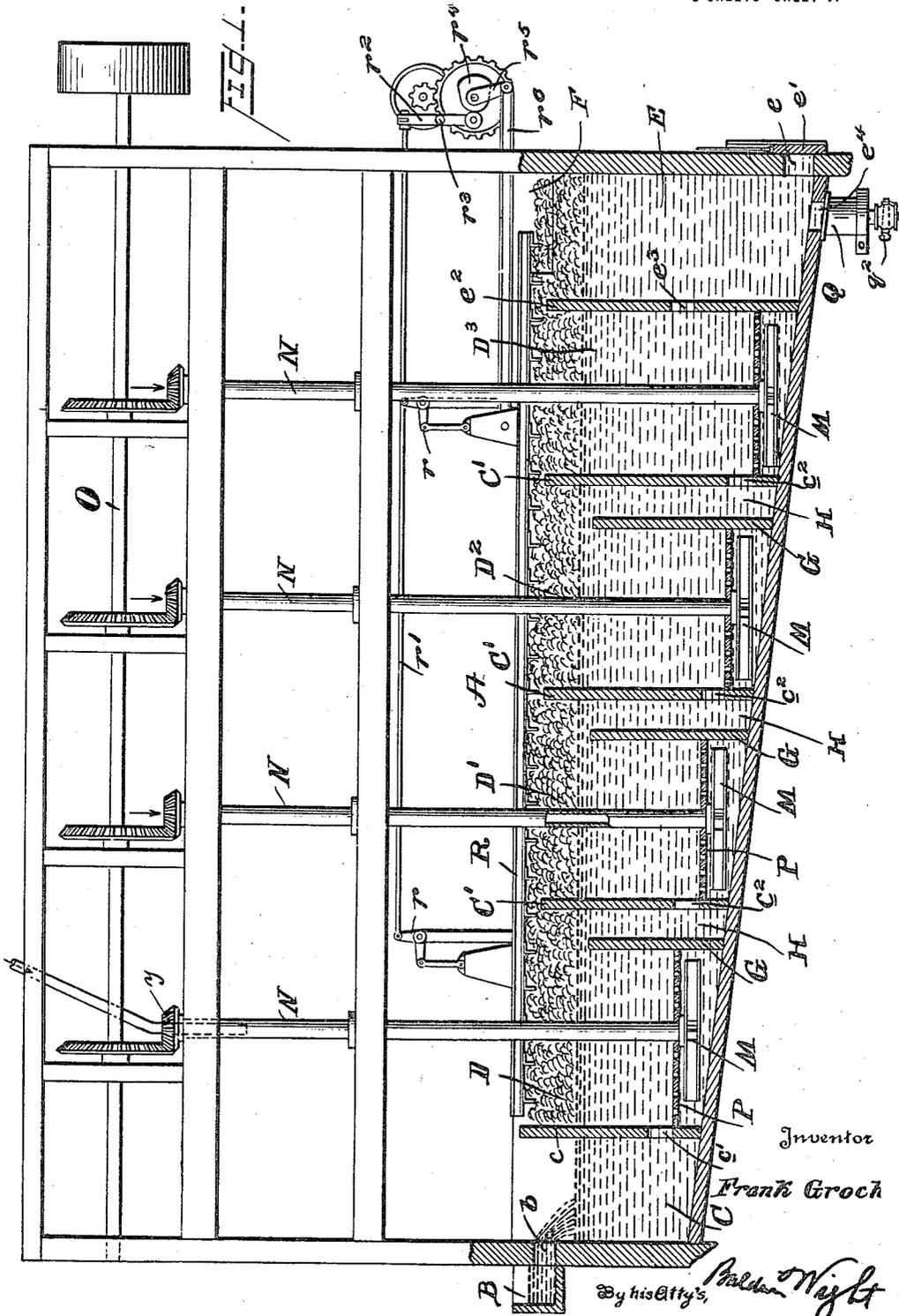


F. GROCH.  
 ORE CONCENTRATION.  
 APPLICATION FILED MAY 25, 1916.

1,276,753.

Patented Aug. 27, 1918.

3 SHEETS—SHEET 1.

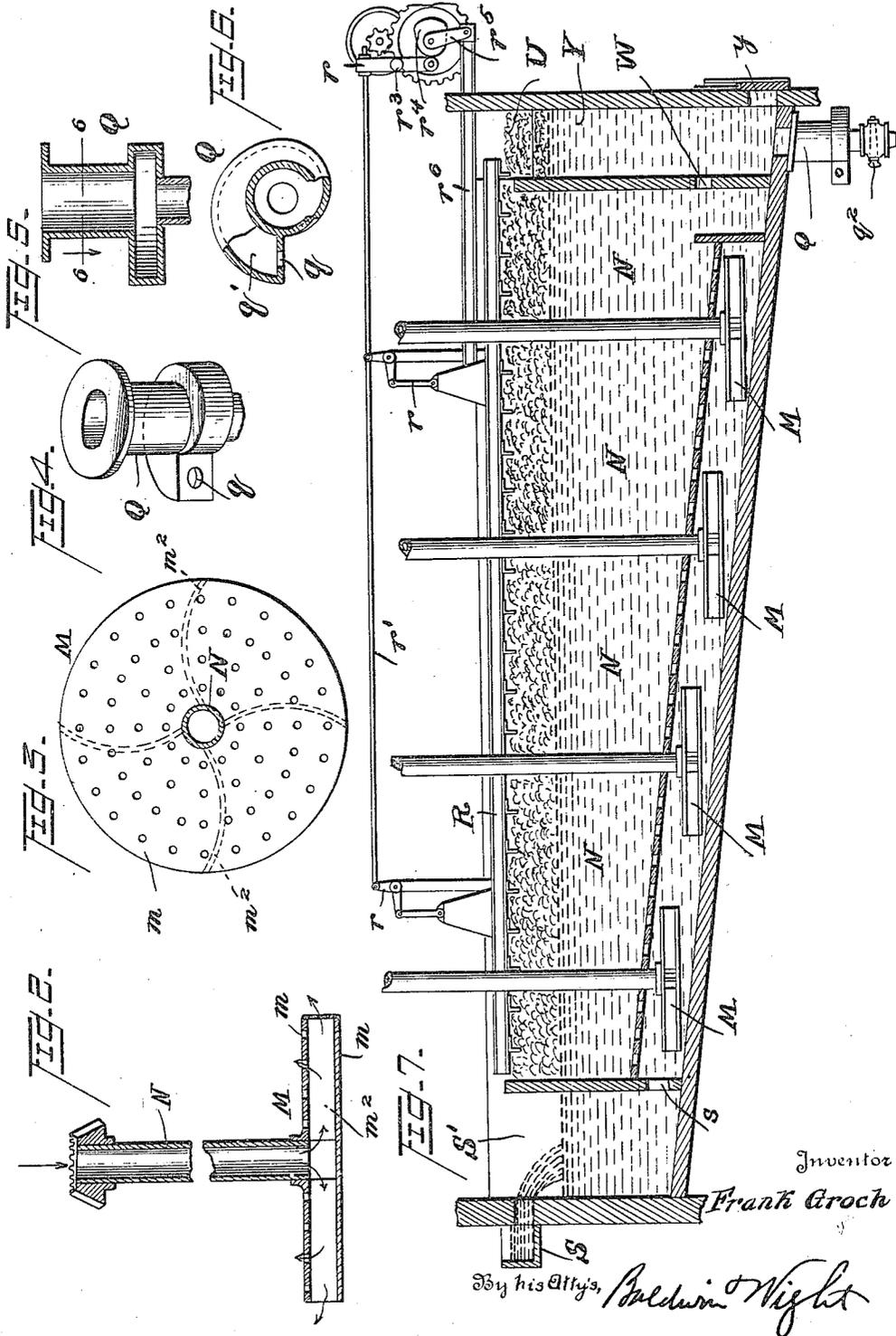


Inventor

Frank Groch

By his Atty's, Walden Wright

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3 SHEETS—SHEET 3.

FIG. 3.

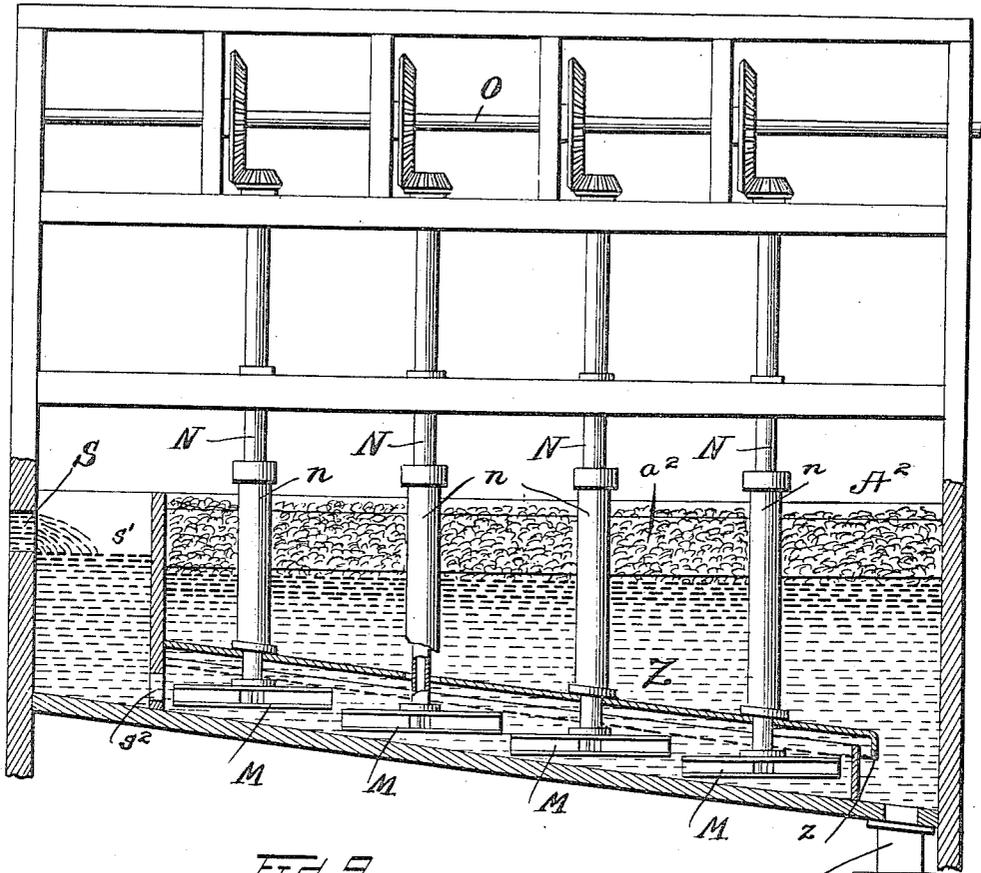
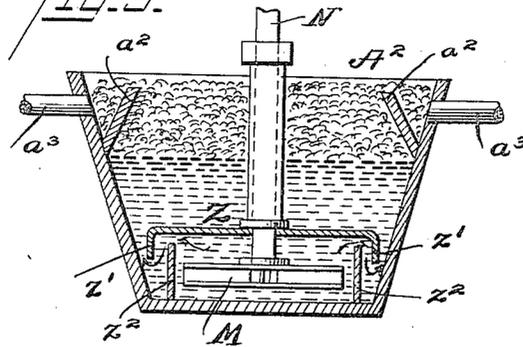


FIG. 4.



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# UNITED STATES PATENT OFFICE.

FRANK GROCH, OF COBALT, ONTARIO, CANADA.

## ORE CONCENTRATION.

1,276,753.

Specification of Letters Patent. Patented Aug. 27, 1918.

Application filed May 25, 1916. Serial No. 99,846.

*To all whom it may concern:*

Be it known that I, FRANK GROCH, a citizen of the United States, residing in Cobalt, in the Province of Ontario and Dominion of Canada, have invented certain new and useful Improvements in Ore Concentration, of which the following is a specification.

This invention relates to ore concentration in which the metals and metalloids in an ore pulp containing them are separated from the gangue by the selective action of a froth or foam producing agent, such as oil, which carries the metallic particles to the surface of a bath while the particles of gangue are allowed to settle. By thus separating the values from the gangue the two products may be separately removed and further treated.

The object of my invention is to provide improved apparatus for practising a method of concentration of the kind referred to.

In such processes it is important that the metalliferous particles should be detached or separated from the particles of gangue as thoroughly as possible in order that the buoyant oil and the upward currents of air may cause them to rise while the gangue is settling, and it is also important that where possible the process of separation should be continuous in a single apparatus and should reduce to a minimum the metallic content of the tailings.

According to my invention I provide an apparatus wherein a pulp containing the material to be separated is thoroughly aerated in a novel way as hereinafter claimed and wherein the bath is so agitated that substantially all of the metallic particles are caused to rise to the surface of the bath, while the particles of gangue are allowed to settle. The apparatus is so constructed that the foam or froth containing the values is continuously removed from the vat while the settled gangue is also continuously removed and contains a minimum quantity of values.

In one form of the apparatus the settling vessel, which has an inclined bottom, is divided by vertical partitions into compartments each of which is equipped with a rotary agitator which thoroughly distributes air in the lower portion of the compartment and some of the compartments are each provided with a vertical weir extending upwardly from the bottom of the compartment to a plane somewhat below the top thereof over which the froth and pulp pass, while

the froth which passes over the weirs and over said chambers flows to the concentration discharge opening at the delivery end of the apparatus. There is a chamber between each weir and an adjacent partition and openings are formed in the lower portions of the partitions whereby the liquid below the froth may pass over the weirs and through said chamber and openings from one compartment to the other.

At the feed end of the apparatus a compartment is provided to which the pulp is delivered and from the lower portion of which it passes to the first agitation compartment and at the delivery end of the apparatus there is a compartment beneath the froth-discharge opening where quiet settling takes place of particles of gangue which may be carried with the froth, and this last mentioned compartment is provided with means for discharging the settled material.

In order to promote the flow of the froth toward the froth-discharge opening I provide devices preferably in the form of rakes which act upon the surface of the froth in such manner as to move it gently over the bath.

In another form of the apparatus the compartments referred to are dispensed with and I provide a series of rotary agitators from which air is distributed below a perforated plate which further serves to distribute air in the lower portion of the settling vessel. In this form of the apparatus the material to be treated is fed in the form of a pulp to a compartment which delivers to a settling vessel either above or below the perforated plate, and at the discharge end of the apparatus there is a compartment for quiet settling to receive the gangue still adhering to the froth and which reaches the delivery end of the apparatus therewith.

In another form of the invention a series of rotary agitators is arranged above the inclined bottom of a settling vessel below a flanged plate. The pulp is fed to the vessel below said plate and is thoroughly agitated and aerated and is delivered over weirs and below said flanges to the body of the settling vessel where separation takes place. The froth containing metallic values overflows into launders from which it is discharged while the settled gangue is withdrawn through suitable discharging devices.

In the accompanying drawings,

Figure 1 is a view partly in side elevation and partly in vertical section showing one

form or apparatus constructed in accordance with my invention.

Fig. 2 is a detail view in vertical section of one of the air distributors employed.

5 Fig. 3 is a plan view thereof with the shaft in section.

Fig. 4 is a perspective view of a device employed at the delivery end of the apparatus through which the settled material is discharged.

10 Fig. 5 shows a vertical section thereof.

Fig. 6 shows a horizontal section on the line 6—6 of Fig. 5 with some parts broken away.

15 Fig. 7 is a view partly in elevation and partly in vertical section of a modified form of apparatus.

Fig. 8 is a similar view of still another modification.

20 Fig. 9 shows a transverse section thereof.

The drawings show the apparatus mainly in outline, the details of construction not being important so far as my invention is concerned.

25 Referring first to Fig. 1. At one end of the apparatus there is a feed launder B which delivers through an opening *b* to a compartment C, the inner wall *e* of which is provided near its lower end with an opening *e'* which delivers to the first agitation compartment D. I may, however, introduce the pulp into the first compartment D through the first hollow shaft N at *y*. At the delivery end of the apparatus there is 35 a compartment E having a discharge or outlet opening *e* the size of which may be regulated by a gate or valve *e'*. The inner wall *e''* of this compartment is provided with an opening *e'''* which establishes communication between the last agitation compartment 40 in the series and the settling compartment E. F indicates an outlet for the froth from the surface of the bath. As a substitute for, or in addition to the outlet *e*, I may employ a discharge device Q for the compartment 45 E. This device is shown in detail in Figs. 4, 5, and 6. It communicates with an outlet opening *e''* and the material may pass through it and through a suitably regulated valve or gate *q''*. Air or water, or both, may 50 be admitted at *q* to a curved chamber *q'* surrounding the central discharge opening. In this way air or water or both may be introduced into the settling compartment E 55 to agitate or wash the settling material and without interfering with the discharge thereof.

I have shown in the drawings four agitation compartments D, D', D<sup>2</sup>, D<sup>3</sup>. The compartment D is bounded on one side by the partition *c* and on the other side by a partition C' having in its lower portion an opening *c''*. The other compartments D', D<sup>2</sup>, D<sup>3</sup> are similarly equipped. A weir G is arranged in each of the compartments D, D',

D<sup>2</sup> and has no openings through it, but it is shorter than the partitions *c*, C'. It is so arranged that the liquid containing the gangue may pass over its top and into a compartment or chamber H between the weir and the partition while the froth which also passes over the weir is allowed to pass over the top of the partition. The course taken by the gangue and that taken by the froth is clearly indicated in the drawings. 75 The compartment D<sup>3</sup> is separated from the compartment E by the partition *e''* and the settled material passes from the compartment D<sup>3</sup> to the compartment E through the opening *e''*. 80

In each of the compartments D', D<sup>2</sup>, D<sup>3</sup> I provide a rotary agitator M, each consisting, as shown in Figs. 2 and 3, of plates *m* and *m''* separated by blades *m'* providing spaces between them which communicate 85 with a hollow shaft N extending through suitable bearings upwardly and geared in the manner shown to a driving shaft O. The hollow shafts are open at the top and air enters in the manner indicated by the 90 arrows, passes down through the hollow shafts into the agitators and is discharged thereby. Preferably the upper plates *m* are perforated as indicated and the construction is such that as the agitators rotate air will 95 be drawn downwardly through the tubular shafts and forced outwardly through the agitators and also through the perforations in the upper plates thereof. In this way air is thoroughly distributed in the bath and 100 is made to act upon all particles of crushed ore therein in such manner as to thoroughly detach or separate the metal-bearing portions of the ore from the gangue and to mingle the buoyant liquid, such as oil, with 105 the metalliferous particles.

No special apparatus for supplying air or gas under pressure is required as the agitators, which serve mechanically to agitate the pulp, serve also to supply air thereto. 110 In this way considerable power and the use of extra apparatus is avoided.

The agitator in each compartment may be located below a perforated plate or screen P which assists in distributing air below the 115 pulp.

The pulp treated in the first compartment produces some froth on the surface of the bath in said compartment. This froth is retained on the surface of the bath by the 120 partitions and is not allowed to mingle with that portion of the bath containing the gangue. Such last mentioned portion of the liquid passes from the compartment D over the weir G and then downwardly through 125 the chamber H and through the openings *c''* to the agitation compartment D' where a foam or froth is again produced which joins the froth produced in the first agitation compartment. In a similar way the gangue 130

bearing metalliferous particles is passed from one agitation compartment to the other. Finally the froth bearing the buoyant agent and the metallic values passes out at the discharge end while the gangue passes out through the opening  $e$ , the size of which may be regulated by the gate  $e'$  or the device  $Q$ . As before stated, air or water, or both, may be introduced through the discharge device  $Q$  for the purposes before mentioned.

In order to promote the flow of froth to the discharge opening  $F$ , I may employ a rake  $R$ . This may be hung from bell-crank levers  $r$  connected by a rod  $r'$  which is also connected to a lever  $r^2$  pivotally mounted at  $r^3$  and operated by a cam  $r^4$ . The shaft of the cam carries a crank arm  $r^5$  connected by a pitman rod  $r^6$  to the rake, the organization being such that at the commencement of a stroke toward the froth-discharge opening the rake is lowered and engages the froth, as shown in Fig. 1, and moves it toward the opening  $F$ . Near the end of such feed stroke the rake is raised and on the back stroke it is in a plane above the level of the froth. Rakes of this general kind are well known in the art where employed for a different purpose.

In Fig. 7 I have shown a modified form of apparatus. The agitators illustrated are of the same construction as those before described and are rotated in a similar way. In this case the settling vessel is not divided into compartments but the pulp to be treated is admitted at  $S$  to a compartment  $S'$  and flows through an opening  $s$  to the settling vessel either above or below an inclined perforated partition or screen  $T$  below which the agitators  $M$  are located. Said perforated plate serves in connection with the rotary agitators to thoroughly distribute the air in the bath. The froth on the surface of the bath is discharged at  $U$  while the settled material passes through an opening  $W$  to a compartment  $Y$  in which metallic values settle from the froth while it is being discharged. The gangue passes from the compartment  $Y$  through a valved opening  $y$ , or it may be withdrawn through a discharge device  $Q$  similar to that shown in Figs. 4, 5, and 6. A rake  $R$  similar in all respects to that shown in Fig. 1 and operated in the same way may be employed for the same purpose. Or the froth may overflow the sides into suitable launder for taking it away.

Some parts of my improvements may be applied to apparatus of the kind illustrated

in Figs. 8 and 9. In this case the agitators  $M$ , constructed and operated as before described, are located above the inclined bottom of the settling vessel  $A^2$  and below a plate  $Z$  having down-turned side flanges  $z'$  overlapping weirs  $z^2$  rising from the bottom of the settling vessel. A down-turned flange  $z$  is also formed at the lower outer end of the plate  $Z$ , as indicated in Fig. 8. The hollow shafts  $N$  of the agitators pass upwardly through sleeves  $n$  which extend from the upper plates of the agitators to a level above that of the froth. The shafts  $N$  are driven by suitable mechanism  $O$  of the kind before referred to. The liquid pulp is fed at  $S$  to a compartment  $s'$  and passes through an opening  $s^2$  to the agitators below the plate  $Z$ . The pulp is thoroughly agitated and aerated in the chamber below said plate, passes over the weirs  $z^2$  and under the flanges  $z, z'$  and then enters the body of the settling vessel, the froth being formed on the surface of the bath and overflowing into the troughs  $a^2$  from which it is discharged at  $a^3$ . The settled material may be delivered in the manner before described and a discharge device  $Q$ , similar to that before mentioned and provided with means for introducing air or water or both, may be used for the delivery of the tailings.

I claim as my invention:

1. An apparatus for concentrating ores, comprising an agitation and froth decanting chamber, a centrifugal agitator and distributor in the lower portion of said chamber, and a vertically arranged, hollow shaft extending outside of said chamber and receiving feed of air and pulp from the exterior thereof, to which the agitator is secured and through which air and pulp are delivered to the central portion of said agitator.

2. An apparatus for concentrating ores, comprising an agitation and froth decanting chamber, a centrifugal agitator and distributor in the lower portion of said chamber, comprising radial impeller blades and upper and lower plates incasing them, and a vertically arranged hollow shaft extending outside the agitation chamber and receiving feed of air and pulp from the exterior thereof, to which the agitator is secured and through which air and pulp are delivered to the central portion of said agitator.

In testimony whereof, I have hereunto subscribed my name.

FRANK GROCH.

Witnesses:

(Mrs.) A. C. ROSCOE,  
L. BARKELL.