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CLASSIFIER

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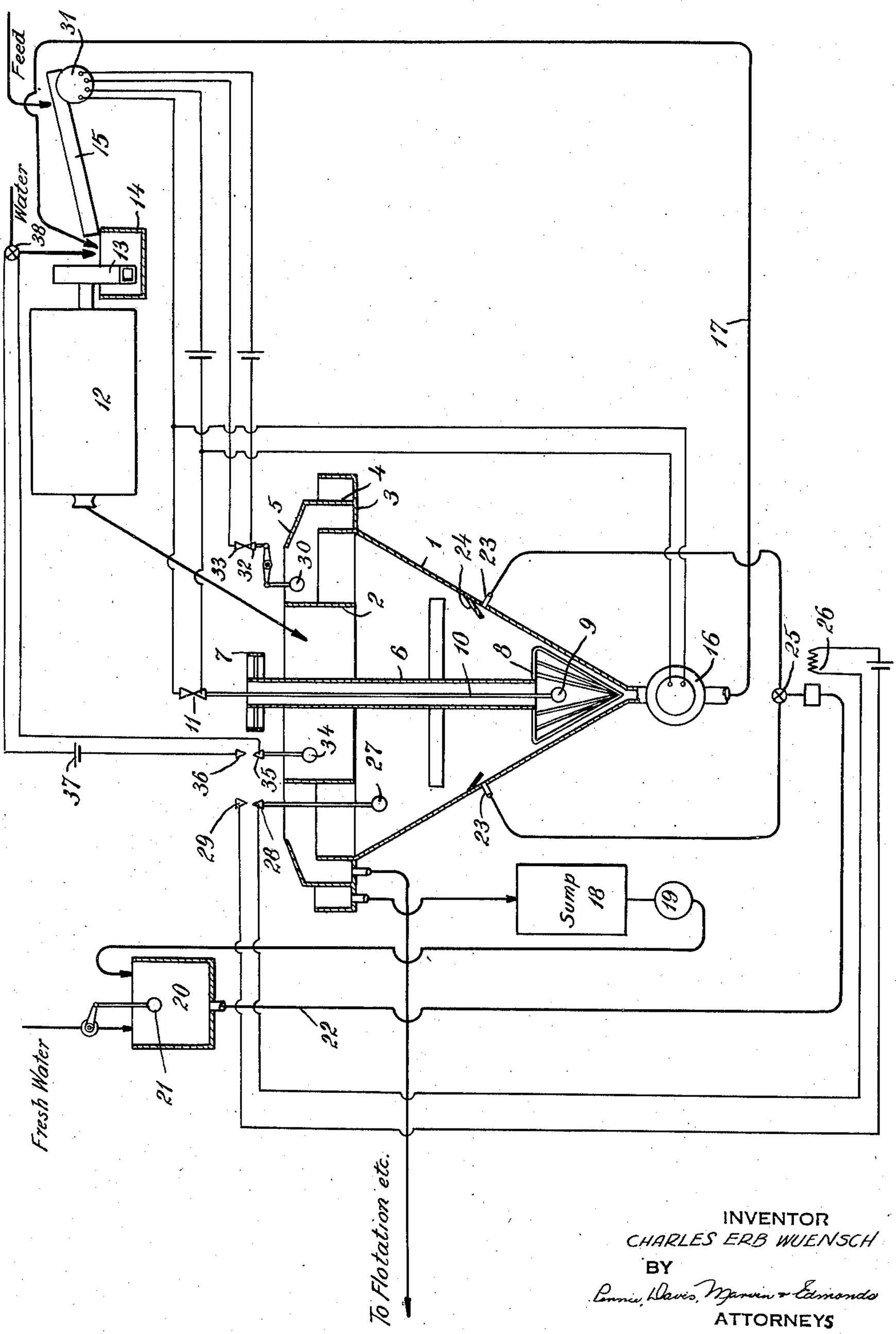

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This invention relates to the classification of minerals and the like, and contemplates improvements in apparatus for such classification. More particularly the invention is concerned with the classification of minerals in the presence of liquid such as water.

As a result of my investigations I have developed a system of classification whereby the density of a classified overflow, its volume, and the size of the particles in said overflow are controlled within very close limits.

Briefly my invention comprises a classifier of improved and novel design, as well as a novel grinding circuit in which this classifier may be incorporated. My invention also contemplates a novel system of control mechanism whereby the character, density, volume, etc., of the classifier feed or the classified product may be controlled within close limits.

The classifier of my invention comprises a tapered or conical chamber having its apex at the bottom, an agitating mechanism disposed centrally within the chamber, means for withdrawing material from the bottom of the chamber, a peripheral launder around the upper part of the chamber, and means for varying the rate of withdrawal of material from the bottom portion of the chamber in response to variations in the density of the material in this portion.

The novel classifier circuit into which my improved classifier may be incorporated comprises a wet grinding means, means for feeding coarse material to the grinding means, a classifier, a conduit whereby material withdrawn from the bottom portion of the classifier may be returned to the grinding means, a conduit whereby material discharged from the grinding means may be introduced into the classifier, and means whereby the amount of coarse material fed to the classifier is varied in response to variations in the density of the material in the bottom portion of the classifier.

My invention will be more completely understood if reference is had to the accompanying drawing, in which

The figure represents a preferred apparatus of my invention.

Referring now to the figure, it will be seen that my apparatus comprises a separating chamber 1, the bottom of which is conical in form with the apex of the cone pointed downward. Within the separating chamber and near the upper end thereof is a concentrically disposed splash ring 2 to prevent the disturbance of the outer surface of liquid in the chamber. Around the upper periphery of the separating chamber is a launder 3, provided with an annular partition 4. At the top of the annular partition is a vertically adjustable weir or overflow lip 5, which should be fastened to the top of the launder in such manner that its top may be raised or lowered. Thus the lip may overlap the partition and be supported at its inner portion by three or more vertically adjustable bolts 40 which rest in brackets 41 on the innermost wall of the launder and are threaded through the lip. By turning the bolts the lip is raised or lowered.

Centrally disposed in the chamber is a vertical hollow shaft 6 provided with means 7 for revolving it, such as a gear, at its upper end. At the lower end of the hollow shaft is a skeleton conically-shaped agitator structure 8, of cage-like construction. Within the cage is a float 9 fastened to the end of a rod 10 which extends upwardly through the hollow shaft and is provided with an insulated contact 11 at its upper end.

A ball mill 12 or other wet grinding device provided with a scoop 13 or other convenient means for introducing feed into the mill is operatively associated with the classifier. The feed for the mill passes into a feed box 14 from a feeder chute 15 which is ordinarily in operation except when interrupted as will hereinafter be described. Water is also supplied to the feed box and the mixture of water and ore is scooped up and introduced into the feed end of the mill. The discharge from the mill is sent into the central zone of the classifier within the splash ring.

A pump 16 is fastened to the bottom of the classifier cone and is connected by suitable pipe line 17 to the feed box for the ball mill.

The outer portion of the peripheral launder on the classifier is provided with a drain to a sump 18. Another pump 19 is so disposed as to pump material from this sump up into a surge tank 20 into which water may also be introduced through a float operated valve 21. By means of a gravity flow through a pipe line 22, water, together with solid material from the surge tank, may be introduced into the classifier cone through a series of annularly disposed pipes 23 which are protected at their discharge ends by means of guards 24.

In the aforementioned pipe line there is a solenoid operated valve 25 which is actuated by a power source 26 and opened when a hydrometer 27 placed in the upper portion of the classifier rises so as to close a pair of contacts 28, 29.

Also disposed in the upper portion of the classifier is a float 30 which, when it rises, will open

a pair of contacts 32, 33 and interrupt a supply of power to a motor (not shown) which drives a shaker mechanism 31 for the feeder and thus interrupts the supply of feed to the ball mill.

Also disposed within the upper portion of the classifier is a second hydrometer 34 which, when it rises, will close a pair of contacts 35, 36 and supply power from a source 37 to open a solenoid operated valve 38 on the water supply to the mill.

The pair of contacts 11 on the top of the rod extending up through the hollow shaft of the classifier open when the float at the lower end of the rod is raised and thus interrupt the supply of power to the shaker mechanism and speed up the pump discharging the sandy accumulations to the feed sump of the ball mill.

The operation of my apparatus may be described as follows:

Comminuted feed of the proper density for grinding, (say 80% solids), is delivered from the discharge of the mill to the center of the classifier. Within the classifier segregation takes place and due to interrupted settling a certain amount of material overflows from the classifier through the inner launder and may be sent to flotation. Coarser material which will not overflow settles into the bottom of the cone and is there withdrawn by the pump and returned to the feeder. The cage-like structure in the bottom of the cone is continuously revolved and prevents clogging. At the same time, should the density of the material in the bottom of the cone become too great, thus indicating that the grinding operation is not producing a sufficiently fine product, the float will rise and the feed will be momentarily cut off of the ball mill, until such time as the float again sinks. The same accumulation in the bottom of the cone will be removed and returned to the ball mill feed box.

The density of the material overflowing from the classifier is controlled by means of the hydrometer 27 which, rising, closes the contacts 28, 29 and thus permits water to be introduced through the jets 23 around the periphery of the cone. This water is also accompanied by such solids as overflow over the adjustable weir 5 and are passed through the sump 18 and the pump 19 into the surge tank 20.

As a control of the volume of the material overflowing from the classifier into the inner launder, the float 30 is provided. If the volume at this point is too great, the shaker mechanism 31 will be stopped until such time as the amount and character of the ball mill discharge are proper.

Lastly, the hydrometer placed within the splash ring in the classifier serves to automatically change the amount of water introduced into the mill and thus assures a proper amount of water in the ball mill overflow.

My apparatus is particularly desirable in that the classifier, even without the automatic controls, permits an amazingly uniform classifier product to be obtained.

When the automatic controls are also utilized, the character of the product becomes still further improved.

I claim:

1. In a classifier which comprises a downwardly tapering chamber, means for withdrawing material respectively from lower and upper portions of the chamber, and an agitator disposed in the lower portion of the chamber, the combination which comprises a cage-like agitator in the lower portion of the chamber driven from the top by an upright hollow shaft, a float disposed within the agitator and attached to a rod extending upwardly through the hollow shaft, means for increasing the speed of withdrawal of material from the lower portion of the chamber when said float is buoyed up and means operatively connecting the float and said means for increasing the speed of withdrawal.

2. In a classifier circuit comprising a settling chamber, a wet grinding means, means for discharging wet ground material from the grinding means into an upper central portion of the settling chamber, means for withdrawing settled material from a lower portion of the settling chamber and returning it to the grinding means, and means for withdrawing unsettled material from an outer upper portion of the settling chamber, the combination which comprises a hydrometer disposed in the upper central portion of the chamber, means for supplying liquid to the wet grinding means, means operatively connected to the hydrometer and to the means for supplying liquid to the wet grinding means for increasing the amount of liquid to the wet grinding means when said hydrometer rises, a second hydrometer disposed in the outer upper portion of the chamber adjacent the withdrawal means for unsettled material, a plurality of conduits communicating with the settling chamber at points intermediate the top and bottom thereof, means for introducing water into the settling chamber through said conduits when said second hydrometer rises, means operatively connecting said second hydrometer and the means for introducing water into the settling chamber.

3. In a classifier circuit comprising a settling chamber, a wet grinding means, means for discharging wet ground material from the grinding means into an upper central portion of the settling chamber, means for withdrawing settled material from a lower portion of the chamber and returning it to the wet grinding means, and means for withdrawing unsettled material from an upper outer portion of the settling chamber, the combination which comprises a hydrometer disposed in the upper central portion of the chamber, means for increasing the amount of water introduced into the grinding means when the hydrometer rises, means operatively connecting the hydrometer and the means for increasing the amount of water introduced into the grinding means, a second hydrometer disposed in the upper outer portion of the chamber, means for admitting water into the chamber at a plurality of points intermediate the top and bottom thereof, means for increasing the amount of water admitted at said points when the second hydrometer rises, a float disposed in a lower portion of the chamber, means for reducing in response to a rise of said float the amount of fresh solid feed to the grinding means and increasing the amount of settled material withdrawn from the chamber and returned to the grinding means and means operatively connecting said float to said means for reducing the amount of fresh solid feed and increasing the amount of settled material withdrawn.

4. In a classifier which comprises a chamber, means for introducing material to be classified into the chamber and means for withdrawing classified material respectively from lower and upper portions of the chamber, the improvement which comprises an overflow for liquid disposed above the means for withdrawing classified material from the upper portion of the chamber, a tank positioned above the classifier, means for

introducing the liquid overflow into said tank, a conduit for conducting the liquid from the tank to an inlet positioned in the classifier between the upper and lower withdrawal means, a hydrometer disposed in the chamber adjacent the overflow, closure means disposed in the conduit and means operatively connected with the hydrometer and the closure means for opening the closure means when the hydrometer rises.

5. Apparatus according to claim 4 provided with a conduit for introducing additional liquid into said tank, a closure means disposed in said conduit, a float disposed in said tank and means operatively connected with the float and the closure means for closing the closure means when the float rises.

6. In a classifier which comprises a chamber for retaining solids and liquids, means for introducing solids to be classified into the chamber and means for withdrawing classified solids respectively from lower and upper portions of the chamber, the improvement which comprises an overflow for liquid disposed above the means for withdrawing classified solids from the upper portion of the chamber, storage means for said liquid overflow, a conduit for conducting the overflow into said storage means, an inlet positioned in the classifier between the upper and lower means for withdrawing classified solids, a conduit for conducting the overflow liquid from the storage means to the inlet, a hydrometer disposed in the chamber adjacent the overflow, closure means disposed in the conduit leading from the storage means to the inlet and means operatively connected with the hydrometer and with the closure means for opening the closure means when the hydrometer rises.

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