Jan. 8, 1929. 1,697,867

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METHOD OF AND APPARATUS FOR INDICATING THE SIZE OF THE PARTICLES IN ORE PULP FLOWING IN CONDUITS

Filed Sept. 12, 1922

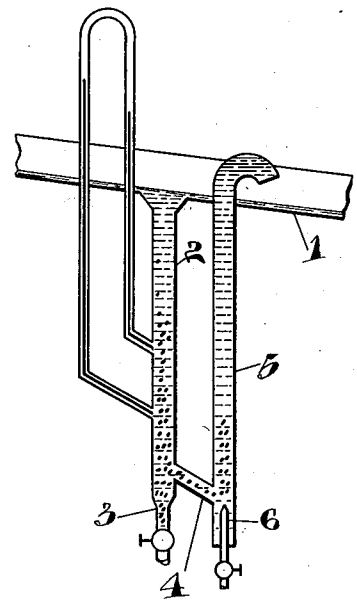


FIG. 1.

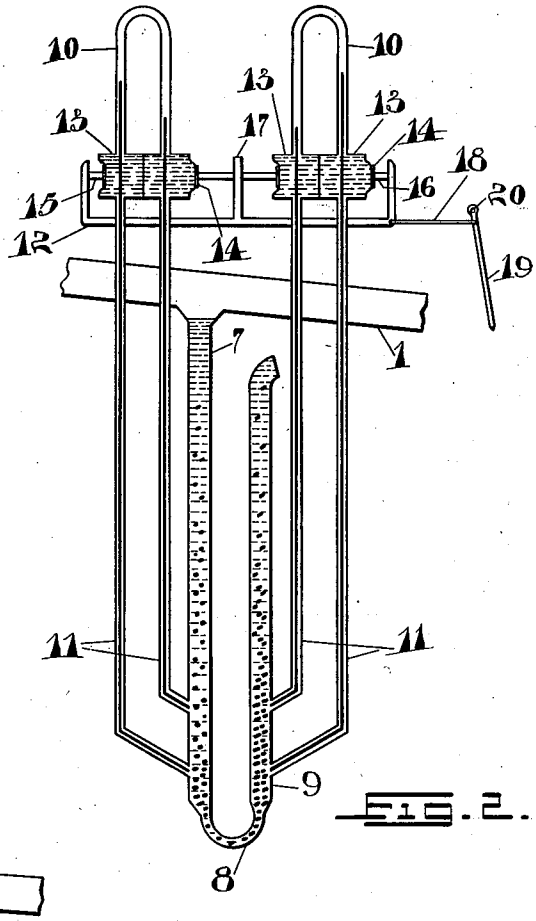


FIG. 2.

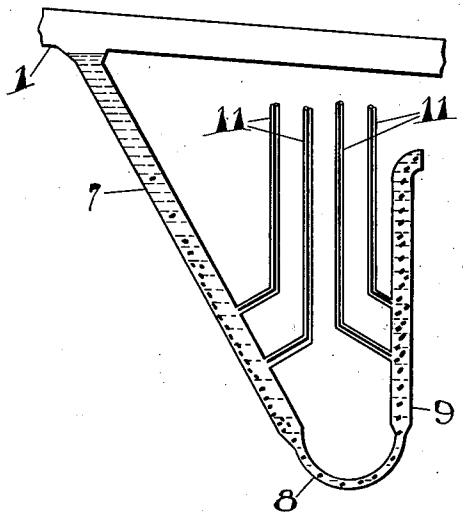


FIG. 3.

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Patented Jan. 8, 1929. 1,697,867

UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR INDICATING THE SIZE OF THE PARTICLES IN ORE PULP FLOWING IN CONDUITS.

Application filed September 12, 1922. Serial No. 587,763.

It is desirable for certain purposes to be able to determine approximately the average size of the particles in an ore pulp flowing in a closed circuit or passing from one apparatus to another, and my object is to devise a process of and automatic apparatus for giving continuous indications of the changes which may occur in the average size of the ore particles in pulp, and which will, if desired, record such changes.

I attain my object by constantly and regularly withdrawing the flowing pulp or a small proportion of the pulp and effecting a concentration or a separation more or less complete of the coarser particles therein in a downwardly and upwardly extending tube in such a way that the apparent specific gravity of the contents of the tube or a stratum thereof may be taken or constantly indicated by suitable apparatus.

The apparatus used is illustrated in the accompanying drawings in which

Fig. 1 is a vertical section of one form of the apparatus;

Fig. 2 a similar view showing the specific gravity indcating apparatus; and

Fig. 3 a similar view of a further modification.

In the drawings like numerals of reference indicate corresponding parts in the different figures.

1 represents a launder or other conduit through which an ore pulp is flowing. Extending down from this launder is a substantially vertical pipe or conduit 2 having a valve controlled opening 3 at its lower end. A lateral outlet 4 communicates with a vertical conduit 5 which is preferably adapted to discharge into the launder and is provided at its lower end with the valve controlled hydraulic jet 6.

Ore pulps usually contain particles of different sizes. In certain metallurgical operations it is necessary that the average size of the ore particles shall not vary very greatly from a predetermined standard. It is important therefore to know at any time if and to what extent any variation has taken place. It is further found that if there is an increase in the average size of the particles that there is a proportional increase in the size of all the particles in the ore. Therefore, if the larger particles be separated out from the smaller particles a change in their size will be a substantially accurate indication of the change in the average size of the particles of the ore.

If now, in the apparatus illustrated in Fig. 1, an upward flow be created in the conduit 2 by admitting water through the valve-controlled opening 3, the rate of travel of the water being predetermined and definite, but less than the falling rate of the larger particles which settle down through it, it is found that the finer constituents of the pulp do not pass down into the conduit at all, or to but a small extent, in the main passing up with the water, and that the conduit contains a pulp including only the larger constituents of the ore. It is further found, under such conditions, that any change in the size of the larger particles in the ore pulp in the launder results in corresponding changes in the specific gravity of the pulp in the conduit 2 so that by measuring the specific gravity of this column or a predetermined stratum thereof, indications may be obtained of changes in the average size of the larger particles and therefore of the average size of the particles in the pulp flowing in the launder 1.

To make the apparatus continuously operating, it is necessary to constantly remove pulp from the conduit 2 and thus change its contents so that at any given time they represent a fair sample of the larger ore particles in the pulp flowing in the launder. For this purpose water is admitted to the valve controlled hydraulic jet 6 which creates an upward current in the conduit 5 which will carry upward the heavier ore particles which pass into it by gravity from the bottom of the conduit 2.

The apparatus for indicating the specific gravity of the pulp in the conduit 2 may be of any known form, but is preferably as illustrated, comprising an inverted U-tube 10, the legs of which are connected to the conduit 2 at different levels. The legs of the U-tube are filled with water or other liquid and the bend with a different liquid. This apparatus will indicate the mean specific gravity of the stratum of pulp between the points of communication of the legs with the conduit and any change is readily noted.

It will be seen that the principle of opera-

tion of the apparatus is that the pulp sample is acted on by gravity against an upward flow of liquid.

The same principle of operation is embodied in the construction shown in Fig. 2, in which a conduit 7 is shown as connected with the launder, which conduit is connected by means of U-tube 8, preferably of smaller diameter, with an upwardly extending conduit 9. The pulp drawn from the launder through the conduit 7 rises through the conduit 9, where it is subjected to the influence of gravity acting against the flow, and flows out of the top of the conduit. The result is that there is more or less of a concentration of the larger particles at any time, as the smaller particles rise more rapidly. A measurement of the specific gravity of a stratum of the column of pulp in this conduit will therefore give an indication of the size of the particles therein as in the case of the construction shown in Fig. 1 as long as the liquid-solid ratio of the pulp remains fairly constant.

In Fig. 1 the heavier ore particles are passed off at a constant rate by the water jet 6. In the constructions of Figs. 2 and 3 there is also constant passing off of the heavier ore particles. The heavier particles tend to fall faster in the conduit 7 than the lighter particles and to rise more slowly in the conduit 9. Consequently there is separating out of the heavier particles at the bottoms of these conduits. After a certain condensation has been reached, the heavier particles pass away through the upper end of the conduit 9 at a rate substantially proportionate to quantitative ratios between the light and heavy particles.

The preferred arrangement, however, is to obtain an indication of the difference of the specific gravity of a stratum of the pulp in the conduit 7 and a stratum of the pulp in the conduit 9, as in that case the effect of differences in the liquid-solid ratio is substantially eliminated. This can be effected by employing the apparatus shown. Two inverted U-tubes 10 are employed, the legs 11 of which are connected with the conduits 7 and 9 at different levels, the legs of the U-tubes being filled with water or other liquid and the bends with a different liquid. It is found that the difference in level of the water in the two legs of the U-tube is a measure of the specific gravity of the stratum of the pulp in the conduit between the lower ends of the two legs.

The difference in the specific gravity between the two legs may be indicated and recorded in the following manner. A movable member 12 is provided and means are provided whereby the pressures existing in the long leg of one U tube and the short leg of the other U tube act on this member in one direction and the pressure existing in the other legs of the U tubes acts on this member in the opposite direction. The resulting position of the part 12 thus is an indication of the difference of the specific gravity between the two strata in the two conduits.

Each leg of each U tube is provided with a chamber 13 and these chambers are provided with flexible diaphragms 14 of known type. The diaphragms of the chambers connected with the longer legs of the U tubes are shown as facing in opposite directions and are connected respectively with the arms 15 and 16 formed on the movable member 12. The diaphragms of the shorter legs of the U-tubes face one another and engage the arm 17 on the member 12, all the diaphragms acting lengthwise of the movable member 12. This member may be connected by a link 18 with a stylus 19 fulcrumed at 20 on a suitable stationary part. This stylus may be used to record movements of the movable member 12 on a movable web of paper as is common with recording measuring instruments.

It should be borne in mind that pressure to operate the part 12 is obtained by a difference of level between the liquid in the two legs of one of the U-tubes. The greater the difference in level between the upper ends of the liquid columns the greater the pressure. It will be noted that the difference in level between the upper ends of the liquid columns in the two legs of the U-tube at the right hand of Fig. 2 is considerably greater than the difference in level at the upper ends of the two columns at the left hand side of the figure because the specific gravity near the bottom of the conduit 9 is greater than in the same part of the conduit 7. Consequently there is an excess of pressure tending to move the part 12 to the right. To put it in another way, it will be noted that the level in the right hand longer column is higher than that of the left hand longer column. Consequently between these two a balance of pressure exists tending to move the part 12 to the right. The left hand shorter column shows a higher liquid level than the right hand shorter column. However, again a balance of pressure exists tending to move the part 12 to the right.

A further modification of the conduits is shown in Fig. 3, the conduit 7 being shown as inclined so that the heavier particles tend to settle against the lower side of the tube and thus reduce the specific gravity of the column as a whole. Various modifications of this arrangement are possible.

In Figs. 2 and 3 it will be noted that all the pulp flow, if it is not too heavy, may pass through the conduits 7 and 9, though, as a rule, the apparatus will usually be made of small dimensions and a portion only of the pulp flow led through it.

The apparatus described will be found to give very satisfactory results with ore pulps

in which the proportions of the fine and coarse ore particles does not vary greatly but only the average size of the particles, which condition usually obtains in ordinary plants.

What I claim as my invention is:—

1. A method of determining variations in the average size of the ore particles in an ore pulp flow which consists in continuously separating out the finer particles from said pulp while in motion in a conduit, and determining the variations, if any, in specific gravity of the pulp containing the coarser particles.

2. The method of determining variations in the average size of the ore particles in an ore pulp flow which consists in causing a liquid in which the particles are suspended to flow continuously in a suitable conduit first downwardly and then upwardly to cause a separation of the finer and coarser particles and determining the specific gravity of a stratum of both the upflowing and down flowing pulp.

3. Apparatus for determining variations in the average size of the ore particles in a flow of ore pulp comprising a launder for the main pulp flow; a conduit communicating therewith and depending therefrom adapted to draw off a portion of the pulp flow; an upwardly extending conduit communicating at its lower end with the lower end of the first conduit; and means for determining the specific gravity of a stratum of the pulp in one of the conduits.

4. Apparatus constructed as set forth in claim 3 provided also with means for determining the specific gravity of a stratum of pulp in the other conduit.

Signed at Toronto, Canada, this 6th day of September, 1922.

HERBERT E. T. HAULTAIN.