

Dec. 16, 1952

E. C. BITZER

2,621,791

HEAVY MEDIA SEPARATION APPARATUS AND METHOD

Filed Nov. 27, 1950

4 Sheets-Sheet 1

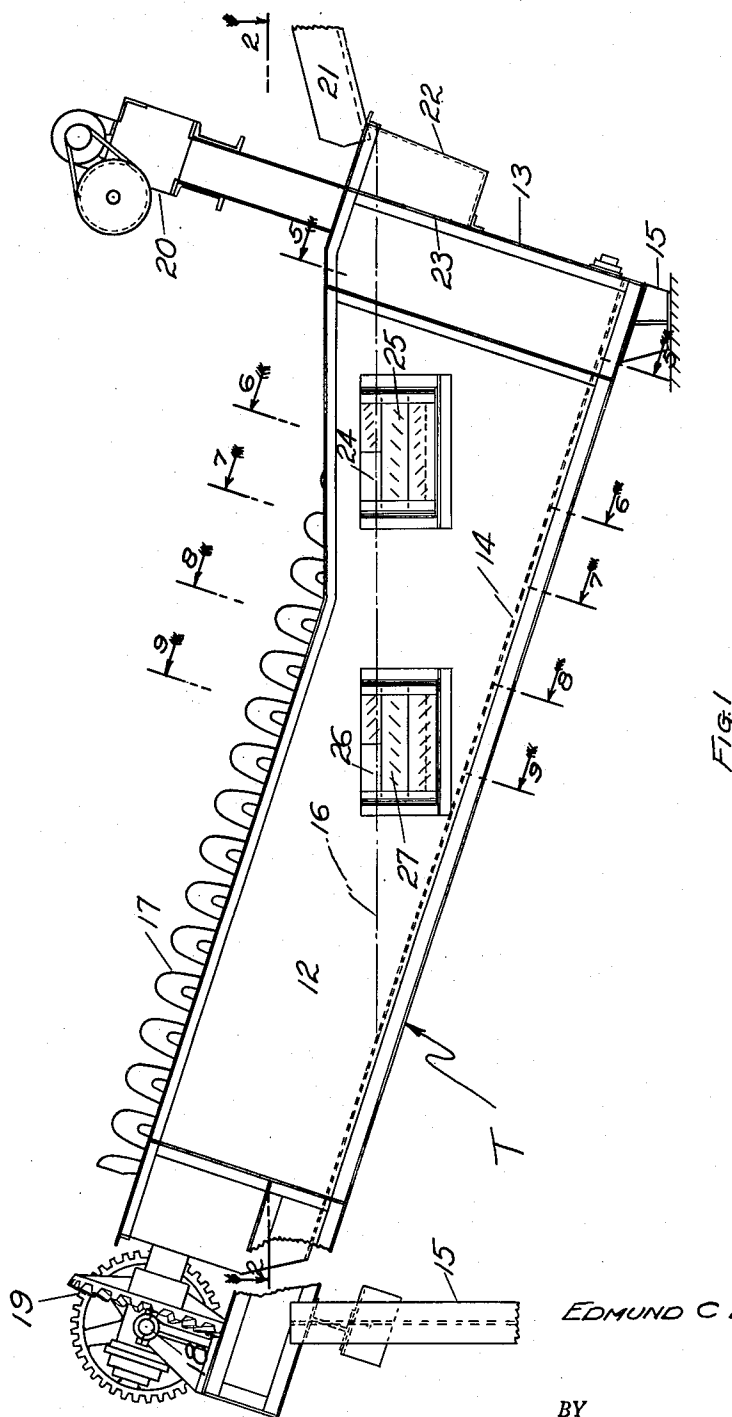


Fig. 1

EDMUND C BITZER
INVENTOR.

BY

H. A. Taylor
Attorney

Dec. 16, 1952

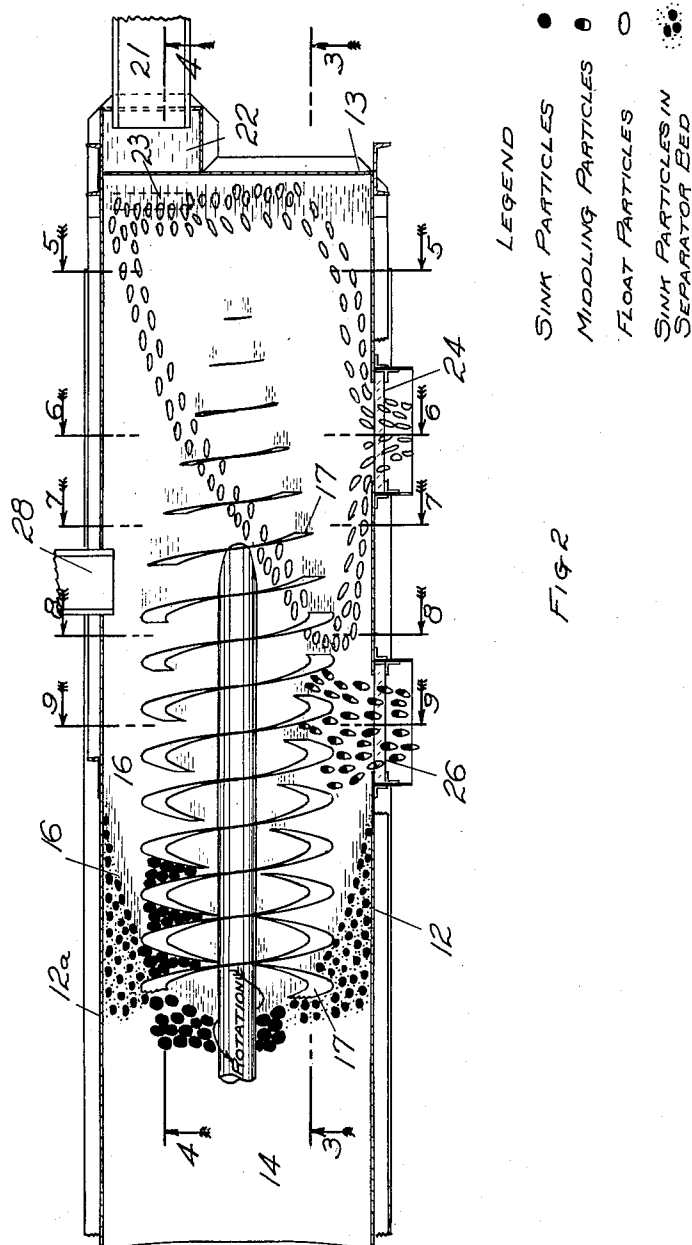
E. C. BITZER

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4 Sheets-Sheet 2



EDMUND C. BITZER
INVENTOR.

BY

BY *M. A. S. & Co*
Attorney.

Dec. 16, 1952

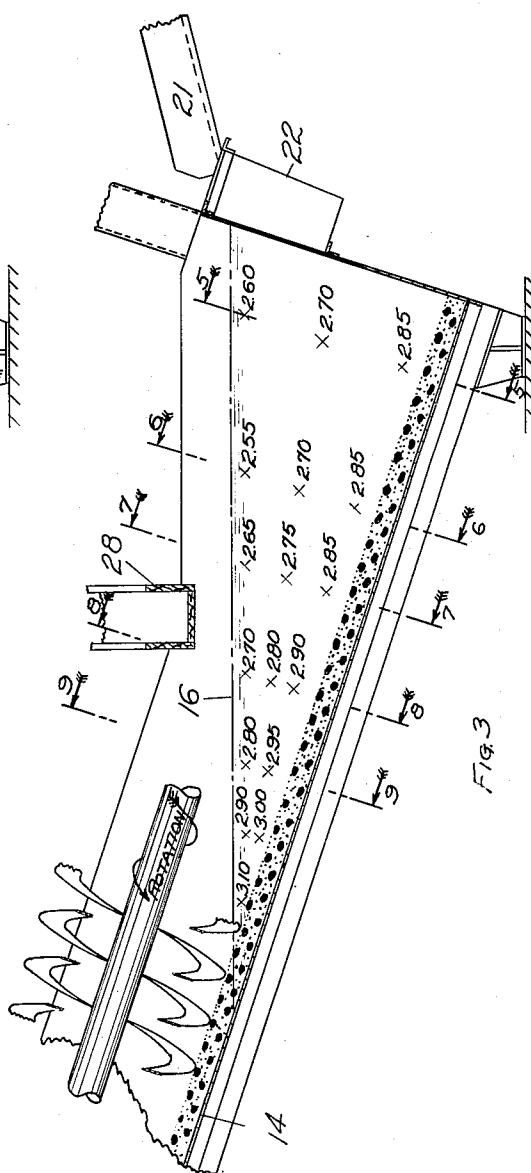
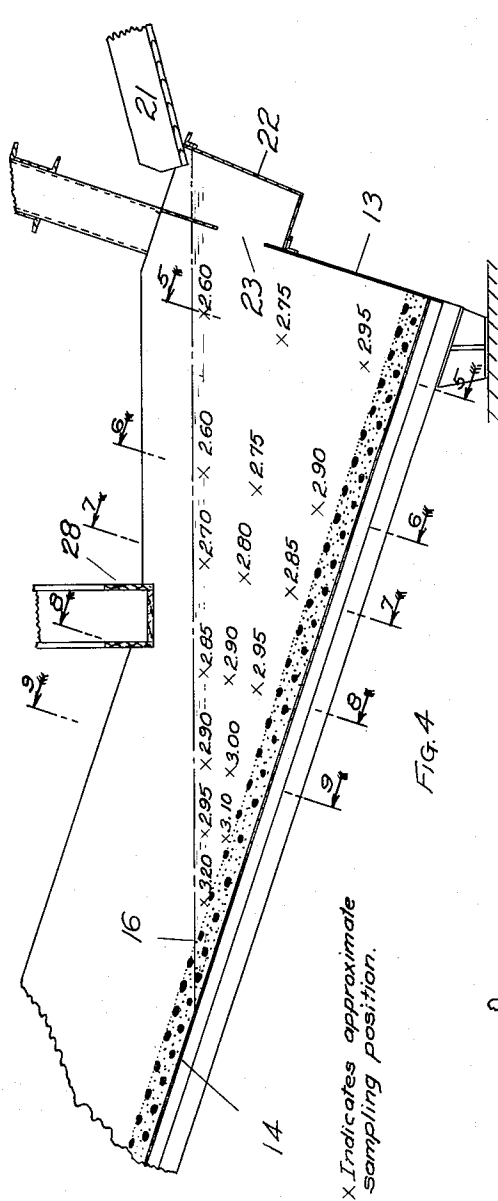
E. C. BITZER

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HEAVY MEDIA SEPARATION APPARATUS AND METHOD

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4 Sheets-Sheet 3



EDMUND C. BITZER
INVENTOR.

BY

M. A. W. Grew
attorney.

Dec. 16, 1952

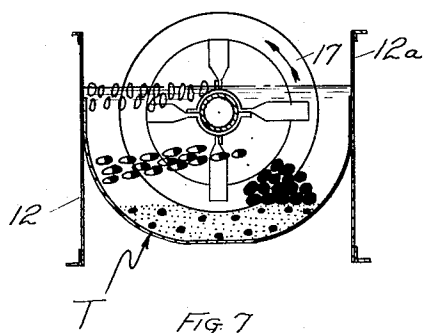
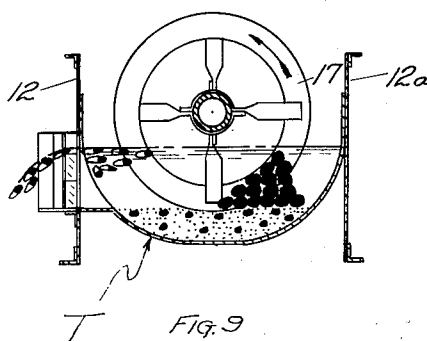
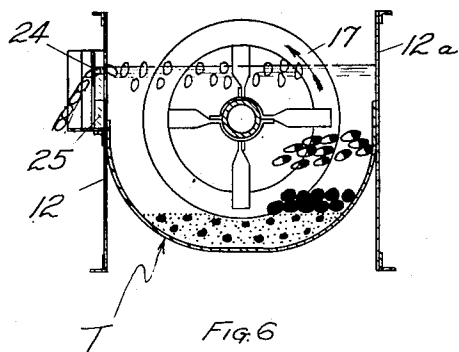
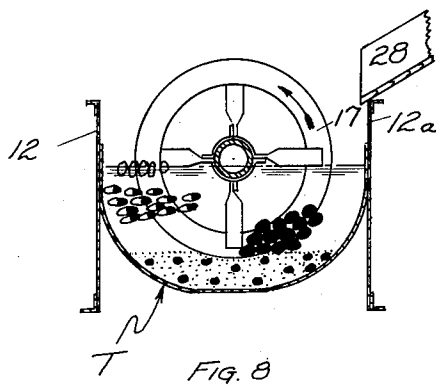
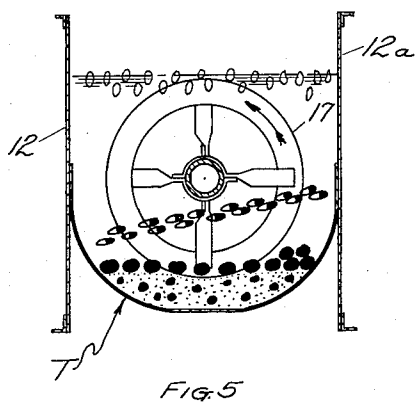
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HEAVY MEDIA SEPARATION APPARATUS AND METHOD

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LEGEND

- SINK PARTICLES ●
- MIDDLING PARTICLES ○
- FLOAT PARTICLES 0
- SINK PARTICLES IN SEPARATOR BED ●●●

EDMUND C. BITZER
INVENTOR.

BY
H. A. McNew
Attorney

UNITED STATES PATENT OFFICE

2,621,791

HEAVY MEDIA SEPARATION APPARATUS
AND METHODEdmund C. Bitzer, Golden, Colo., assignor to
Colorado Iron Works Company, Denver, Colo.,
a corporation of Maine

Application November 27, 1950, Serial No. 197,772

21 Claims. (Cl. 209—173)

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This invention relates to a heavy media process of separating mineral from the gangue or rock with which it has been associated in its natural formation, and is a continuation of my co-pending application for Letters Patent, Serial No. 694,531, filed September 3, 1946.

In my co-pending application Serial No. 645,575, filed February 5, 1946, for Separation Apparatus and Method, an iron ore treatment is disclosed, in which a substantially uniform density is maintained throughout the pool in which the separation is performed. In that treatment, the lack of differential in gravity is probably due to the presence of a very fine slime originating in the feed which stabilizes the medium and prevents settling of ferro-silicon particles.

However, when apparatus of the Akins classifier type is used in which no appreciable quantity of slimes are present, the medium is less viscous and the specific gravity of material in the pool will be higher at the bottom than at the top and also increases progressively from the point of pulp and medium introduction to the point of sink product emergence at the opposite end of the pool. The highest medium gravity at the bottom of the pool determines the critical separation point with respect to the gravity of material, as a particle having a specific gravity intermediate that of the medium at the top and bottom of the pool will sink only to a point where the effect of the medium specific gravity and the velocity of currents will equalize the force of gravity. Therefore, the particle sinks no deeper, although it will move forward through the pool under the action of the spiral.

In this forward movement, the particle encounters medium of progressively higher specific gravity, which causes it to rise until it finally reaches the surface. As it emerges, it encounters a current caused by the drainage of high specific gravity medium from the sloping bottom of the separating tank extending above the pool. This current traveling countercurrent to the normal movement of material entrains the particle and carries it back through the pool until it encounters a medium gravity sufficiently low to allow it to sink. Thus, only particles having a specific gravity higher than the highest specific gravity medium in the tank are able to settle to the raked product bed and pass out of the pool under the raking action of the spiral mechanism.

Most ores amenable to the present treatment include appreciable quantities of middlings particles. These particles contain mineral attached to gangue or waste matter and consequently will

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have a specific gravity intermediate the gravities of the sink and float products of the treatment. If the middlings are allowed to separate with either the sink or float products, the efficiency of the separation will be lowered as the gangue portion is a contaminate of the sink product on the one hand, and the mineral passing out with the float product is lost to the treatment in the other instance. In the present treatment, provision is made for the recovery of the middlings product separate from the sink and float products, thus permitting regrinding where desired in order to finally recover a sink product and a float product, each of which is substantially free of the other constituent.

It is an object of the present invention to provide a simple, economical and efficient heavy-media separation by which middlings constituents are segregated, in addition to the usual sink and float products.

Another object of the invention is to provide a sink and float separation in which the specific gravity of the media of the treatment is so controlled as to eliminate contaminants such as middlings from the sink product discharge.

A further object of the invention is to provide a sink and float separation in which the specific gravity of the media of the treatment is so controlled as to eliminate contaminants such as middlings from the float produce discharge.

Other objects reside in the provision of novel steps and treatments in sink-float separations, all of which will be fully described in the course of the following description.

Briefly stated, the process of the present invention involves the treatment of a body of pulp in a pool having a sloping bottom along which settled solids are moved to an elevated point of discharge above the pool. A body of medium is maintained in suspension in the pool and varies in specific gravity from a low gravity value near the surface at the rear of the pool to a high gravity value near the bottom of the pool near the point of emergence of raked solids therefrom. Float material is caused to overflow from the surface of the pool at a side thereof opposite that toward which the solids are raked by the spiral, and middlings are caused to overflow from the pool at the same side as the float product at the opposite end thereof. Medium is fed to the pool at the side opposite the overflows and intermediate said overflows lengthwise of said pool to segregate float product and middlings so that each passes to its overflow point without contaminating the other, while the sink product penetrates the medium

and is removed from the treatment by the raking action.

The practice of the invention will be best understood by reference of the accompanying drawings. In the drawings, in the several views of which like parts have been designated similarly,

Fig. 1 is a fragmentary side elevation of apparatus designed to perform the process of the present invention and partially broken away to show interior parts;

Fig. 2 is a plan view of the treatment tank shown in Fig. 1, with only a fragmentary representation of the raking mechanism shown therein, in order to show flow lines more clearly;

Fig. 3 is a fragmentary vertical section taken along the line 3—3, Fig. 2 and showing various sampling points to be described hereinafter;

Fig. 4 is a fragmentary vertical section taken along the line 4—4, Fig. 2 and showing various sampling points to be described hereinafter;

Fig. 5 is a fragmentary section taken in the approximate positions of the lines 5—5 of Figs. 1, 2, 3 and 4 and illustrating the relationship of constituent materials at one stage of the treatment;

Fig. 6 is a fragmentary section taken in the approximate positions of the lines 6—6 of Figs. 1, 2, 3 and 4 and illustrating the relationship of constituent materials at another stage in the treatment;

Fig. 7 is a fragmentary section taken in the approximate positions of the lines 7—7 of Figs. 1, 2, 3 and 4 and illustrating the relationship of constituent materials at another stage in the treatment;

Fig. 8 is a fragmentary section taken in the approximate positions of the lines 8—8 of Figs. 1, 2, 3 and 4 and illustrating the relationship of constituent materials at another stage in the treatment; and

Fig. 9 is a fragmentary section taken in the approximate positions of the lines 9—9 of Figs. 1, 2, 3 and 4 and illustrating the relationship of constituent materials at still another stage in the treatment.

In performing the process of the present invention in apparatus such as shown in Figs. 1 and 2, a tank T having side walls 12 and 12a, an end wall 13, and a sloping bottom 14 is mounted on suitable superstructure 15 so that a pool 16 is formed at the lower end of the tank. This tank is provided with raking mechanism including a spiral conveyor 17 journaled in a swivel bearing 18 at its upper end and driven by suitable gearing 19 while elevating mechanism 20 is provided at the opposite end of said spiral to raise and lower same angularly about said swivel bearing.

Feed to the tank is delivered by a launder 21 or other type of conduit into feed box 22, from which it flows into tank T through a suitable inlet 23 (Fig. 2), which preferably is located adjacent side wall 12a. A float product overflow weir 24 comprising a series of adjustable slats 25 cooperates with the feed box 22 in determining the level of pool 16 in the tank. Preferably, some medium is introduced into the treatment through feed box 22.

Due to the maintenance of a body of medium in the tank, which remains in suspension under the agitative influence of spiral 17, the float product content of the feed material introduced through box 22 remains in suspension on top of the body of medium and passes from the treatment across weir 24. The initial segregation of

float material is indicated by the sectional view Fig. 5 while the overflow position is indicated by Fig. 6.

It should be noted that whereas the middlings particles initially spread completely across the tank, the raking action of the spiral 17 is moving settled solids toward side wall 12a also causes the middlings portion of the pulp to swing and travel lengthwise along wall 12a. While this condition tends to cause a clean separation in that the middlings are segregated from the overflow product, the final separation is complicated by the fact that a considerable portion of the float product does not travel directly to the overflow point, but remains on the surface and travels beyond said overflow point, as will be best understood by reference to Fig. 2.

A middlings overflow weir 26, the elevation of which may be varied by a series of slots 27, is located in wall 12 at a substantial distance from weir 24. However, some of the float product which travels beyond weir 24 tends to pass from the treatment across weir 26 and to prevent such overflow, a stream of medium is introduced into the treatment through a launder or box 28, and forms a current in the pool which entrains float material and draws same back across overflow weir 24. This serves to clean the middlings to such an extent that the product overflowed at 26 consists essentially of middlings with only minor quantities of contaminant. Figs. 7 and 8 illustrate the effect of the medium introduction on the float product while Fig. 9 illustrates the elevating effect of the medium on the middlings.

In this connection, the high specific gravity medium that drains from the upper part of the tank bottom flows into the pool 16 and travels toward the middlings overflow 26. This prevents an increase in the specific gravity at the float product overflow, which if unrestricted would cause a mechanical crowding that in time would cause a considerable quantity of middlings to overflow with the float product.

The sink product settles readily in the pool due to the fact that the specific gravity of the medium near the feed end is substantially lower than it is near the shore line at the opposite end of the pool. These changes in specific gravity of the medium will be best understood by reference to Figs. 3 and 4 which depict the sampling positions and results of an actual operation on a lead-zinc ore from the Tri-State field. When it is necessary to change the density conditions in the pool, the rate of spiral rotation may be increased or decreased to reduce or raise the density of the media.

In the aforesaid treatment, a separation at from 2.65 to 2.70 sp. gr. was selected after an initial analysis of the ore. The introduction of medium at launder 28 was calculated to balance the amount discharging with the float, sink and middlings products in order to maintain a uniform condition during continuous operation. For a time no medium was introduced and later the medium feed was started. It was found that the medium introduction raised the amount of zinc content in the middlings from 3% to 7%.

While the density of media in the pool increases from top to bottom and from feed end to discharge end, the principal separation of middlings is attained by the density differential between the overflow side and the raking side. The action of the spiral rakes a mixture of settled particles comprising sink product, middlings and ferro-silicon away from the overflow side of

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the tank causing a downward current along said side and an upward current along the opposite side. This downward current adds to the settling velocity of the media particles while the upward current opposes said settling velocity, thus causing zones of equal density within the pool to be higher on the side of the pool in which the spiral is rotating upwardly.

The feed of ore pulp into the pool is at its low density end and preferably on the side opposite the float overflow. The feed introduction may be above the surface of the pool, or may be at the surface or submerged. By introducing the feed as aforesaid, the float product is forced to move both laterally and longitudinally of the pool to reach the overflow. Due to the downcast currents at the overflow side, the resulting travel of the float product is directed to the overflow weir.

The media introduction through launder 28 may be above the surface as shown, or at the surface or submerged. On entering the high density zone adjacent said launder, the incoming media forms a surface stream traveling from the high density side to the low density or overflow side, and also because of its specific gravity directs float material which has traveled through the pool beyond the overflow weir to segregate from the middlings and circulate back to said weir.

The increased density at the high density end of said pool occasioned by the introduction of media adjacent thereto causes an elevation of the middlings adjacent the middlings overflow which carries them across the weir and out of the treatment. By having the middlings overflow spaced a substantial distance from the float overflow, it is possible to maintain such a differential in specific gravity of the media adjacent said points as to insure a clean separation throughout long periods of continuous operation.

Thus, the flow and specific gravity controls of the present invention insure a clean separation of sink and float products, and in addition, segregate the middlings portion from the aforesaid products. After removal of each said product, the usual screening operations may be performed for recovery of associated media, with the media thus collected returned to tank T through launder 28. Preferably, the middlings so separated are re-ground and the product of this grinding stage is mixed with the incoming feed delivered into box 22.

I prefer to locate this feed box on the end wall of the tank adjoining side 12a toward which the bed is raked. However, it should be understood that any feed delivery at or near the end of the tank will give workable results, although the introduction of feed at any substantial distance from the end of the tank will impair the flow control. Similarly, some variation in the spacing of overflow weirs 24 and 26 and launder 28 may be resorted to, although any substantial variation from the arrangement shown will impair the flow control.

I have shown the invention as embodied in a simplex type tank, but it should be understood that a duplex (two spiral) arrangement also may be utilized in the practice of the invention. In this case, the float and middlings overflows would be located on each side wall of the tank in substantially spaced relation with a medium introduction launder disposed substantially midway therebetween and the initial feed containing pulp and some medium would be introduced at the end intermediate of the two spirals. Each said spiral would be caused to rotate so as to move the

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raked material toward the center of the tank and in this way substantial duplication of the action heretofore described would be obtained.

It will be understood that in the usual treatment of a metal-bearing ore, the sink product will be the valuable constituent and the float product will be gangue. However, in other treatments, as a coal-slate separation, for example, the float product will be the valuable constituent. The present invention is well-suited for use in performing either type of separation.

What I claim and desire to secure by Letters Patent is:

1. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp and some media into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank for movement of the sink product through the pool along one side of said tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of said tank, and means for introducing media into the tank from the side toward which the sink product is raked at a point intermediate said overflows.

2. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp and some media into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank for movement of the sink product through the pool along one side of said tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of said tank, means for varying the overflow level of the float material overflow and means for introducing media into the tank from the side toward which the sink product is raked at a point intermediate said overflows.

3. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp and some media into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank for movement of the sink product through the pool along one side of said tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of the tank, means for varying the overflow level of the middlings product, and means for introducing media into the tank from the side toward which the sink product is raked at a point intermediate said overflows.

4. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp and some media into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank for movement of the sink product through the pool along one side of said tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side

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of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of the tank, means for varying the effective level of each said overflow, and means for introducing media into the tank from the side toward which the sink product is raked at a point intermediate said overflows.

5. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp and some media into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank for movement of the sink product through the pool along one side of said tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of the tank, and means for introducing media into the tank from the side toward which the sink product is raked at a point substantially midway between said overflows.

6. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp and some media into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank for movement of the sink product through the pool along one side of said tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of said tank, and means for introducing media into the tank from the side toward which the sink product is raked at a point intermediate said overflows, the action of said spiral causing a downcast current on the side of said tank in which the overflows are located and an upcast current on the opposite side of the tank, and the float product weir being located at an elevation at which the float product overflows readily from said downcast current.

7. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media along the side of the pool toward which the settled matter is being raked, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal from the pool at separate spaced points along the side of the pool away from which the raking action is directed by inducing a cross current through the introduction of a surface flow of media into the pool.

8. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp

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in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media along the side of the pool toward which the settled matter is being raked, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal from the pool at separate spaced points along the side of the pool away from which the raking action is directed by the cross current introduction of additional media into the pool.

9. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media along the side of the pool toward which the settled matter is being raked, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal through separate points of overflow at the low density side of the pool opposite said side of increased density by introducing a cross current flow of additional media into the high density side of the pool.

10. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media along the side of the pool toward which the settled matter is being raked, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal through points of overflow at separated positions along the low density side of the pool opposite said side of increased density by introducing a cross current surface flow of additional media into the pool substantially midway between said overflows but from the opposite high density side of the pool.

11. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media from one end of the pool to the other, whereby the separation of float and middlings is accelerated, and further

separating middlings and float products before removal from the pool at separate spaced points along the side of the pool away from which the raking action is directed by inducing a cross current in said pool through the introduction of a surface flow of media into the pool.

12. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media from the top to the bottom of the pool, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal from the pool at separate spaced points along the side of the pool away from which the raking action is directed by inducing a cross current in said pool through the introduction of a surface flow of media into the pool.

13. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher portion on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the specific gravity of the media from one end to the other and from the top to the bottom of the pool, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal from the pool at separate spaced points along the side of the pool away from which the raking action is directed by inducing a cross current in said pool through the introduction of a surface flow of media into the pool.

14. The heavy media separation process for the treatment of an ore pulp containing float and middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media along the side of the pool toward which the settled matter is being raked, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal through separate points of overflow at the low density side of the pool opposite said side of increased density by introducing a cross current surface flow of additional media into the pool from the high density side thereof adjacent a density zone at the surface which is approximately the density of the middlings products.

15. The heavy media separation process for the treatment of an ore pulp containing float and

middlings products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed toward one side of said pool and toward a higher position on the sloping bottom, such raking action tending to move settled sink products up the sloping bottom to an elevated point of discharge above the pool and tending to increase the density of the media along the side of the pool toward which the settled matter is being raked, whereby the separation of float and middlings is accelerated, and further separating middlings and float products before removal at points of overflow at separated positions along the low density side of the pool opposite said side of increased density by introducing a surface stream of media into the pool from the high density side thereof causing a float entraining current to flow to the low density zone at the point of float overflow.

16. A method of producing three products from fragmentary material having products of three different gravities by means of a heavy medium consisting of a suspension of finely divided, high gravity solids in a liquid, which comprises introducing the material to be separated into an elongated wedge-shaped pool of heavy medium at the deep end thereof, agitating the heavy media in the pool from the low point of the pool to the shallow end, introducing makeup media at one side of the pool, discharging float and middlings products from the opposite side of the pool at spaced points, discharging sink material from the shallow end of the pool by said agitation, and adjusting the rate of agitation of said pool such that the resultant of the forces acting on the products as determined by the forces of agitation, of buoyancy and of those resulting from the makeup media introduction produce an average float particle trajectory from the feed inlet to the float discharge point, and an average middling particle trajectory from the feed inlet to the middlings discharge point.

17. In apparatus for heavy media separations, including a tank having two sides, an end and an inclined bottom defining a pool, and means for feeding an ore pulp into the pool near said end, the improvement which comprises two overflow weirs positioned at a common elevation on one side of the tank and in spaced relation lengthwise of the pool for determining the effective level of the pool and permitting separate overflow of float and middlings constituents therefrom, a spiral conveyor mechanism in the tank for moving settled solids through the pool and upwardly along the inclined bottom to an elevated point of discharge and rotating in a direction in which the settled solids are raked toward the side opposite said overflow, thereby increasing the density of the pulp along said side, means for feeding a fluent media having a density greater than water into the tank at a point distant from said overflow in such quantity and at such a velocity as to induce a continuous flow of segregated float and middlings constituents to the respective overflows, and the upper surfaces of the flights of the spiral conveyor being above the liquid level throughout substantially the entire length of the pool and directing a surface flow toward the overflows so as to assist in segregating the float and middlings products.

18. The heavy media separation process for the treatment of an ore pulp containing sink, float, and middling products which comprises

treating the pulp in the presence of a media in a pool having a sloping bottom and opposed first and second margins, introducing ore pulp into the pool near one end thereof, subjecting the pulp in the pool to a rotary spiral raking action directed towards a higher position on the sloping bottom, such raking action tending to move the settled sink products up the sloping bottom to an elevated point of discharge above the pool and also tending to increase the density of the media along said first margin of the pool towards which the settled product is moved by rotation, whereby separation of float product and middling product is accelerated, and further separating the middling product and float product before removal thereof at spaced points along the second of said margins of the pool by introducing a flow of media into the pool near the said first margin directed towards said second margin.

19. The heavy media separation process for the treatment of an ore pulp containing sink, float, and middling products which comprises treating the pulp in the presence of a media in a pool having a sloping bottom and opposed first and second margins, introducing the ore pulp into the pool at one end thereof, subjecting the pulp in the pool to a rotary raking action directed towards a higher position on the sloping bottom, such raking action tending to move the settled sink product to an elevated point of discharge above the pool and also tending to increase the density of the media along the first margin of the pool towards which the sink product is being raked, whereby separation of the float and middling products along said first margin is accelerated, and further separating the middling and float products before removal thereof at separate spaced points along the second margin of said pool by introducing a flow of media along said first margin of the pool directed towards the said points of discharge on the second margin of the pool.

20. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp into the pool at the lower end of the tank, a spiral raking mechanism arranged in the tank having the upper portions of the separate spiral flights exposed above the pool throughout a substantial portion thereof for

movement of the sink product through the pool along one side of the tank to an elevated point of discharge on said bottom, said raking action tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of said tank to determine the upper surface of said pool, and means for introducing media into the tank from the side toward which the sink product is raked.

21. Apparatus for heavy media separations, comprising a tank having three sides and an inclined bottom defining a pool, means for feeding an ore pulp into the pool at the lower end of the tank, said float material overflow being nearest to the lower end of the pool, a spiral raking mechanism arranged in the tank having the upper portions of the separate spiral flights exposed above the pool from a position in the pool adjacent the lower end thereof and below the float overflow throughout the remainder of the pool, said raking action tending to move the sink product through the pool along one side of the tank to an elevated point of discharge on said bottom and further tending to increase the density of the media along the side of the pool toward which the sink product is raked, overflow weirs for float material and middlings disposed at intervals along the lower density side of said tank to determine the upper surface of said pool, and means for introducing media into the tank from the side toward which the sink product is raked.

EDMUND C. BITZER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,777,182	Rothelius	Sept. 30, 1930
2,353,152	Erck	July 11, 1944
2,373,662	Dickson	Apr. 17, 1945
2,468,005	Walker	Apr. 19, 1949

FOREIGN PATENTS

Number	Country	Date
563,754	Great Britain	Sept. 13, 1944