Aug. 20, 1963 F. BRINKMANN 3,101,312

DRUM SINK SEPARATORS

Filed April 28, 1959 3 Sheets-Sheet 1

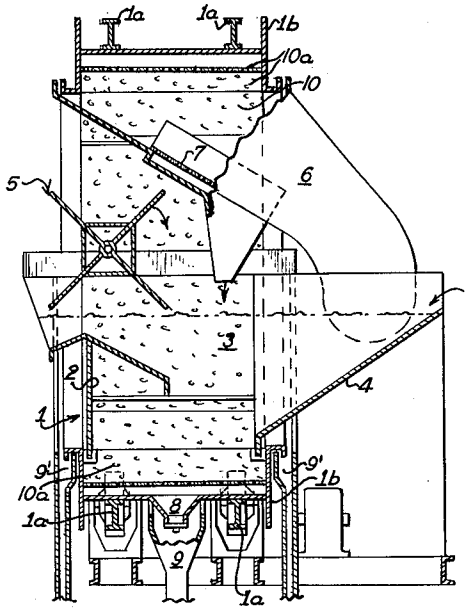


Fig. 1

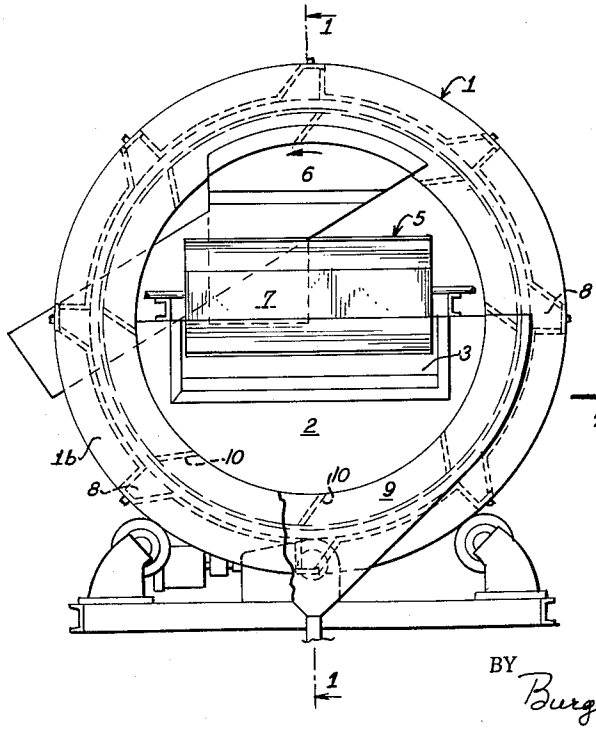


Fig. 2

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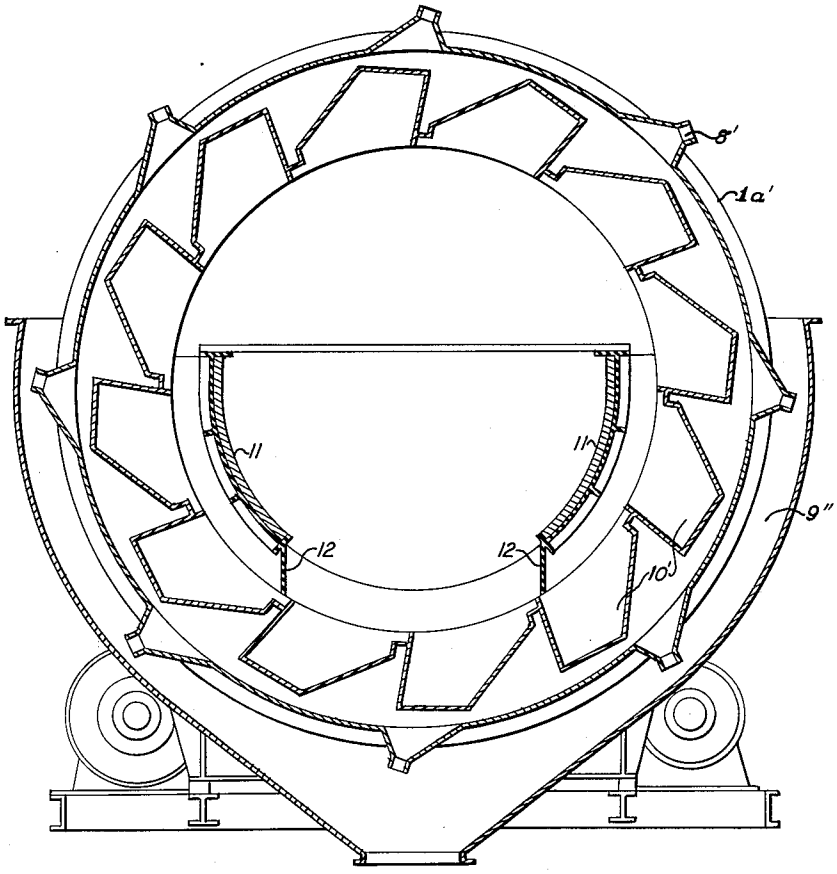


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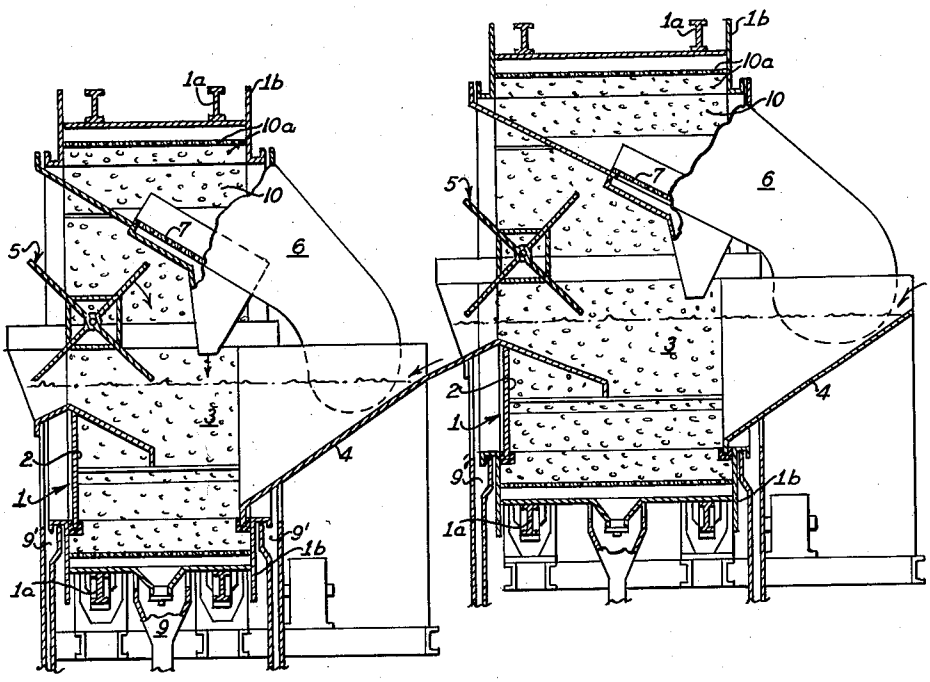


Fig 4

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DRUM SINK SEPARATORS

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10 Claims. (Cl. 209—172)

This invention relates to improvements in the working up of ores, minerals, coal, and the like.

It more particularly relates to an apparatus for working up ores, minerals, coal, and the like, for example minerals and coal in granular form, in accordance with the float and sink method in a heavy liquid.

This application is a continuation-in-part application of co-pending U.S. application Serial No. 775,678, filed November 20, 1958, now abandoned.

The separation of ores, minerals and coal with heavy liquids is well known. German Patent 968,121 describes a drum sink separator useful for such working up of minerals and coal in a heavy liquid. Specifically, the sink separator according to the present invention comprises a separating trough apparatus, a portion of which simultaneously defines a rotating drum. The rotating drum portion of the trough is provided with scoop blades for the removal of the sediments, and the stationary portion is provided with weirs, arranged on the front and rear ends of the trough, which act as the overflow weir and charging weir, respectively. These weirs are adjacent yet dammed off from the rotating drum front and rear walls.

It is an object of the present invention to provide a simplified construction of such drum sink separators, particularly in the case where large coarse grained material is to be treated. Another object of this invention is to make possible the reduction of the portion of the masses being rotated without decreasing the dimensions of the trough wherein separation occurs. Another object of the invention is to provide several sink separators arranged in series so that minerals and coal of different particle sizes can be advantageously worked up in one over-all operation.

These and still further objects will become apparent from the following description and accompanying drawings in which FIG. 1 is an end view of a separator drum apparatus in accordance with an embodiment of the invention; FIG. 2 is a side view of the embodiment of FIG. 1 as seen from the overflow side; FIG. 3 is a side view of a drum similar to the embodiment shown in FIG. 1, partially in section; and FIG. 4 is a view showing two drums of the type shown in FIG. 1 arranged in series.

In accordance with the present invention, a rotatable drum is provided having a plurality of spaced scoop receptacles disposed on the inside circular wall thereof capable of scooping material to be treated during each cycle of the drum. A rim flange extends along the peripheral portion of the circumferences at each side of the drum, the radially inward portion of each said side being open. Adjacent the radial opening at the input side of the drum, a stationary charging weir is provided which preferably defines a side extension of the trough zone continuously formed by the lower portion of the rotating drum. Adjacent the radial opening at the other side of the drum, a stationary overflow weir is positioned which also preferably defines a similar side extension of said continuously formed trough zone. At least one of said side extensions is advantageously extended substantially axially outwardly with respect to the rotating drum to increase the volume of the trough zone without correspondingly increasing the size of the drum itself. Means are provided advantageously for continuous removal of floating material from said trough zone. Additional means are provided for continuous removal of the large or small solid lumps or particles taken up by said scoop receptacles during rotation through said trough zone the lower portion of the cycle and released by gravity therefrom during rotation about the upper portion of the cycle.

It will be seen that because of the dimensions of the radial side openings, said at least one side extension which extends substantially axially outwardly with respect to the rotating drum will be approximately either semi-conical or pyramidal in configuration. This enables a larger proportion of material to be treated in the trough zone defined by said conical or pyramidal extension and a given size drum than would be possible in said drum alone. Moreover, a corresponding reduction of the portion of the material being rotated is achieved in the continuous trough zone which results in a lower consumption of operating energy and less wear on the moving parts. The axial width of the revolving drum can, therefore, be determined so that a sufficient capacity of charged liquid containing very large sizes of solid particles or lumps can still be conveniently accommodated.

According to one embodiment of the invention, drum sink separators of this type can be arranged in series in a particularly favorable manner so that minerals of different particle sizes may be worked up. Depending on the type and nature of the material to be worked up, such as fine particles or coarse lumps, the weirs of each of the different separator units which are arranged in series and which are preferably of the same size, can be combined advantageously with drums of different axial widths.

Referring to the drawing, the drum sink separator in accordance with the invention shown in FIG. 1 comprises a rotating drum 1 which is constructed with a plurality of spaced scoop recesses 10 disposed on its inside surface, said drum being suitably mounted for rotational travel along tracks 1*a*. A rim flange 1*b* extends along the peripheral portion of the circumference at each side of the drum, the radially inward portion of each said side being open. Adjacent the radial opening at the input side of the drum, a stationary charging weir 4 is provided, while adjacent the radial opening at the other side, a stationary overflow weir 2 is provided. Each of these weirs defines a stationary side extension of trough zone 3 continuously formed by the lower portion of rotating drum 1. It is seen that a portion of each side extension is advantageously extended substantially axially outwardly with respect to rotating drum 1, whereby to increase the volume of trough zone 3 without correspondingly increasing the dimensions of the drum itself. The extension formed by charging weir 4 is approximately semi-conical in configuration.

The material to be treated is passed over the suitably inclined charging weir 4 into trough zone 3, whereupon it is taken up by scoop recesses 10. Above overflow weir 2 is advantageously positioned a paddle wheel 5, or other suitable conventional device, such as rotating scraper chain means, which serves to remove any floating material in the charge rising to the surface of the heavy liquid. The material carried upwardly by scoop recesses 10 during rotation through trough zone 3 is released therefrom by gravity at the uppermost portion of the cycle and carried off by chute 6, positioned along the axial width of the drum through the upper portion of the radial space within said radial openings. Chute 6 advantageously extends outwardly and downwardly away from said space on the charging weir side; thus permitting greater freedom of operation of paddle wheel 5 on the opposite side. A screen portion 7 is conveniently provided along a portion of chute 6 within the radial space of drum 1 through which a preliminary separation of the

finer solid particles from the larger particles or chunks can be obtained. These finer particles can be refed directly back into trough zone 3 in a simple manner as indicated by the arrow located at the lower end of screen portion 7.

In FIG. 2, drum 1 is shown from the overflow side. Scoop recesses 10 are situated preferably with their bottom portions at an angle with the radius of the drum, being biased in a forward direction, for efficient scooping action. These recesses 10 contain preferably a plurality of perforations or openings 10*a* throughout their entirety in order to permit the heavy-density liquid taken up during rotation to pass through as the recesses travel upwardly.

According to another embodiment of the invention, weir 4, which serves as a charging chute, instead of being conically shaped, has the shape of a truncated pyramid with a rectangular base. This embodiment has the further advantage that it allows a uniform distribution of the charged material over the whole cross-section of the trough zone 3.

It is, of course, advantageous to provide the edges and corners of the sink separator apparatus with suitable means for protection against abrasion in order to prevent the premature failure of these parts which are subjected to heavy wear.

The drum sink separator in accordance with the invention can be provided with drum outlets 8 for the exit of the heavy-density liquid which is retained in the peripheral portions of the drum. For the collection of the heavy-density liquid emerging from these outlets, provision is made for a corresponding receiving trough 9 which extends about a portion of the circumference of the drum to approximately the liquid level in the trough zone or somewhat above said level. Also, side troughs 9′ (see FIGS. 1 and 2) may be provided at the sides of the drum to receive any liquid seeping out between the corresponding flange 1*b* and the adjacent weir portion at the lower half of the drum.

The cross-section of these openings 8 which act as outlets for the heavy-density liquid may be adjusted according to the liquid used, by means of nozzles, valves, and other suitable means well known in the art.

In FIG. 3, the trough zone is provided with guideplates 11 for the floating material. These plates are advantageously axially arranged along a portion of the cross-section of the drum in order to increase the efficiency of the separation space. At their lower ends the guideplates are provided with a "covering" made of a resilient elastic material, which acts as an apron, as shown at 12.

The advantage of these aprons made of resilient material is that, even if some of the floating particles of near gravity material happen to stick to the weir, they will be either pushed through, perhaps passing onto upwardly moving receptacles 10 or guided upwardly within the space defined by said guideplates 11 and hence out through the overflow weir, due to the action of this resilient elastic apron when the drum is being rotated. In this construction, the drum revolves on tracks 1*a*′, so that scoop recesses 10′ may take up the desired material and outlets 8′ may permit the exit of heavy liquid into receiving trough 9″, in the same general manner as in FIGS. 1 and 2.

In many cases, it may be advantageous to have the walls of the guideplates made completely of elastic material on the overflow side of the drum so that no damage to the walls of the trough zone will result even when pieces of rock are present. The elastic guide walls can be made of rubber or of metal, that is in the form of resilient metal such as spring metal.

The diameter of the drum is dependent upon the amount and particle size of the charged material, the usual drum diameter being between 3.5 and 7.0 meters. The width of the weirs is mainly dependent on the charge capacity. As a guide to the width of the weir to be used, a width

of about 1.0 meter normally corresponds to a charge capacity of 100 long tons. Correspondingly larger and smaller dimensions may be employed in the light of this relationship. The width of the drum is mainly dependent on the maximum size of material. When treating coarse grained material, such as in the work-up of large sizes of coal, this width is generally 1.2 to 1.6 times the size of the maximum particle size. On the other hand, in the event small size particles are handled, the width of the weir is usually dependent upon the throughput desired, wherein particular consideration must be given to the percentage of refuse present in the feed material. The drum capacity generally may be ascertained in accordance with the known formulae and rules of calculation applying to bucket elevators.

In FIG. 4, the left-hand drum has a smaller axial width than the right-hand drum arranged in series therewith, whereby particles of smaller sizes may be further worked up in said left-hand drum after separation of the larger particles in the right-hand drum.

What is claimed is:

1. A drum sink separator for separating solids by means of a heavy liquid, which comprises a rotatable drum means, said drum means having a central charging opening defined in one side and a central overflow opening in the other side, scoop means disposed on the inside peripheral wall of said drum means and rotatable therewith, a stationary charging weir means adjacent and extending from said central charging opening and a stationary overflow weir means adjacent and extending from said central overflow opening, at least a portion of at least one of said weir means extending axially outwardly from the corresponding central opening of said drum means, the entirety of the lower portion of said rotatable drum means continuously defining a common trough zone with both said weir means extending from the central openings, and means for continuously removing the separated solids portion from the remainder of the charged material.

2. A drum sink separator according to claim 1 wherein said portion of at least one of said weir means extending axially outwardly from the corresponding central opening of said drum means is substantially frusto-conical in shape.

3. A drum sink separator according to claim 1 wherein said scoop means are provided with a plurality of apertures defined therein capable of permitting the heavy-density-liquid taken up by said scoop means to pass therethrough and return to said trough zone, further means being provided for removing the floatable portion of the charged material from the trough zone.

4. A drum sink separator according to claim 1 wherein said means for continuously recovering said separated solids portion comprises an inclined chute means, the higher portion of which is disposed within said drum means in juxtaposition to the upper portion of said drum means and capable of receiving separated solids released from said scoop means traveling therealong, and the lower portion of which extends outwardly from said drum means, a portion of said chute means disposed within said drum means and above said trough zone being provided with a plurality of apertures defined therein for separating the smaller solids from the larger solids released from said scoop means into said chute, and with means for returning said smaller solids into said trough zone.

5. A drum sink separator according to claim 1 wherein stationary guideplates are provided within the lower portion of said drum means in said trough zone and disposed along the direction of the axis of said drum means, said guideplates being continuously substantially rotatably coextensive at least at one side of said drum means with a portion of the edge of the opening defined in that side, during rotation of said drum means, and said guideplates being capable of increasing the efficiency of removal of the floating material from said trough zone.

6. A drum sink separator according to claim 5 wherein

said guideplates are provided with resilient aprons, said aprons being disposed at least along a portion of the axially directed lower edges of said guideplates.

7. A drum sink separator according to claim 6 wherein said guideplates possess a resilient layer along the portions thereof rotatably coextensive with said edge of the opening defined in that side of the drum.

8. A plurality of drum sink separators arranged in series for separating solids by means of a heavy liquid, each of which comprises a rotatable drum means, said drum means having a central charging opening defined in one side and a central overflow opening in the other side, scoop means disposed on the inside peripheral wall of said drum means and rotatable therewith, a stationary charging weir means adjacent and extending from said central charging opening and a central overflow weir means adjacent and extending from said central overflow opening, at least a portion of at least one of said weir means extending axially outwardly from the corresponding central opening of said drum means, the entirety of the lower portion of said rotatable drum means continuously defining a common trough zone with both said weir means extending from said central openings, and means for continuously removing the separated solids portion from the remainder of the charged material, all said weirs being of a common height, the width of each successive drum means in the series changing in increments, and the overflow opening side of the preceding drum means being adjacent the charging opening side of the next.

9. In a drum sink separator for working up ores, minerals and coal with heavy liquids, having a trough zone for the separation of the solid content from the waste; including a rotatable drum having a central charging opening defined in one side thereof and a central overflow opening defined in the other side thereof, a plurality of spaced scoop receptacles disposed on the inside peripheral wall thereof and rotatable therewith, a plurality of closable outlets disposed on the outside peripheral wall thereof for removal of heavy liquid from said drum, a liquid receiving trough coextensive with the lower portion of said drum during rotation and in line with said outlets, a stationary charging weir adjacent one side of said drum and a stationary overflow weir adjacent the other side, means at said overflow weir side for removing floatable material from said trough zone, a chute for removing solids taken up by said scoop receptacles during rotation

of said drum, the improvement which comprises providing at least a portion of at least one of said weirs outwardly extending axially from the corresponding central opening of said drum, whereby the entirety of the lower portion of said rotatable drum continuously defines a common trough zone with both of said weirs of larger capacity than the lower portions of the drum itself.

10. A drum sink separator for processing minerals, ores, and coal with a heavy liquid, which comprises a rotatable drum means, said drum means having a rim flange means on each side thereof extending substantially radially inwardly along the peripheral portion of the drum means circumference, the centermost portion of each side of said drum means being open to provide a central charging side opening and a central overflow side opening, respectively, spaced scoop means disposed on the inside peripheral wall of said drum means and rotatable therewith, a stationary charging weir means adjacent and extending from the charging side opening of said drum means, a stationary overflow weir means adjacent and extending from the overflow side opening of said drum means, at least a portion of at least one of said weir means extending axially outwardly from the corresponding central opening of said drum means, the entirety of the lower portion of said rotatable drum means continuously defining a common trough zone with both said weir means extending from said central openings, means for continuous removal of floating material from said trough zone and additional means for continuous removal of solids from the upper portion of said drum means.

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