Nov. 29, 1938. L. D. JONES 2,138,476

CENTRIFUGAL SEPARATION

Filed Nov. 15, 1937

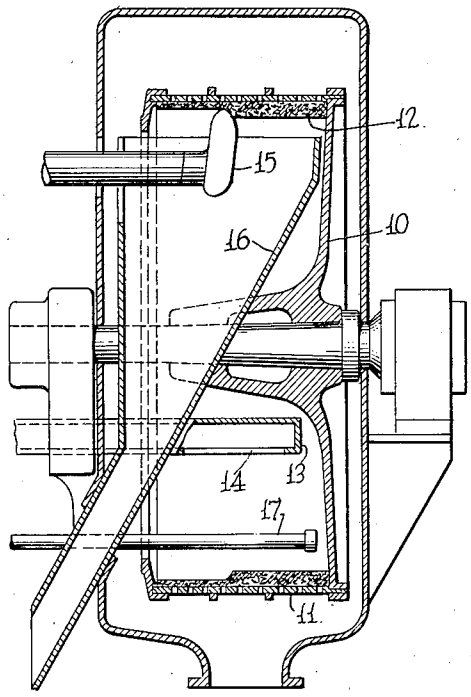


FIG. 1

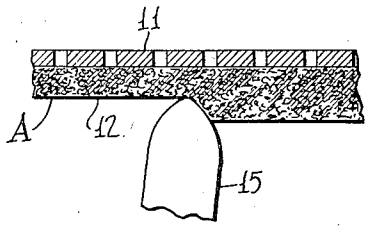


FIG. 2

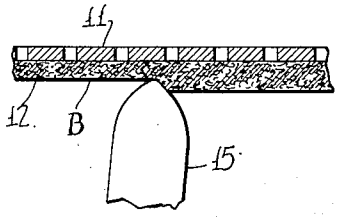
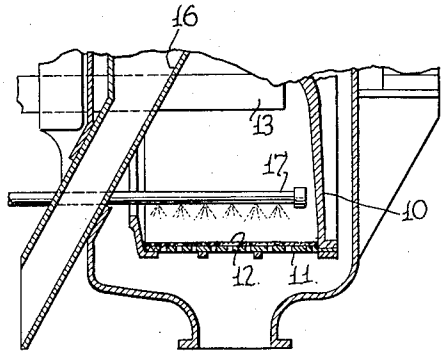


FIG. 3

FIG. 5



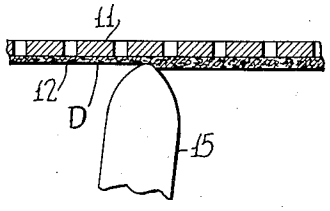


FIG. 4

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CENTRIFUGAL SEPARATION

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Application November 15, 1937, Serial No. 174,630

7 Claims. (Cl. 210—70)

The present invention pertains to the dehydration of solids and is concerned with the performance of such dehydrating operations by the application of centrifugal force to mixtures of liquids and solids by rotation thereof in a centrifugal rotor provided with a pervious peripheral wall adapted to permit the discharge of liquids but having openings small enough to retain the dehydrated solids within the rotor.

In the common performance of dehydrating operations of this character, a slurry of liquid and solids is fed to the centrifugal rotor during the rotation thereof and the liquid is discharged through the peripheral wall of the rotor. Rinse liquid may then be applied to the solids during the continued rotation thereof. If such rinse liquid is applied, the solids are rotated for a short period of time after the application of such rinse liquid in order to remove residual rinse liquid which may adhere thereto. Solids remaining in the rotor are then removed from the rotor by the application of a non-rotating dislodging tool to such solids during the continued full speed rotation of the rotor, this dislodging tool penetrating the solids to the depth desired and effecting dislodgment thereof. In the dislodging of many types of solids, and particularly of crystals, it is frequently desirable to perform the dislodging operation in a series of steps in which the dislodging tool is moved progressively closer to the peripheral wall of the rotor during successive dislodging operations.

Some of the solid material contacted by the dislodging tool is necessarily broken up into a finer form and the dislodging tool has a tendency to spread this broken up material along the surface lying without the tool and to cause glazing of that surface, which renders penetration of the surface by liquids more difficult.

It is impracticable in the performance of dislodging operations of this character to dislodge all of the solid material from the rotor. In cases in which the thin beds of solids remaining in the rotor after the dislodging operation are of such character that moisture can still penetrate them to the desired degree, it is customary to repeat the cycle of operations discussed above after the dislodging tool has removed solids to the maximum depth desired. The repetition of the cycle of operations aggravates the glazing effect at the level reached by the tool at its outermost depth, however, and the undesired glazing effect becomes worse upon repetition of the cycle of operations until, at some stage of such repetition, it becomes necessary to remove the underlying bed of solids from the rotor by a cleaning operation. In this connection, it is pointed out that the tendency of repetition of the cycle of operations to render the unremoved bed of solids impervious to moisture is also aggravated by the gradual accumulation of fine particles of solids between larger particles constituting this bed. For the sake of convenience, the physical changes causing the unremoved bed of solids to tend to become impervious will be jointly referred to as "glazing" hereinafter.

The purposes of the present invention have been to obviate difficulties caused by glazing encountered in the performance of centrifugal dehydrating operations of this character and to prolong the cycle of operations which can be performed prior to the necessity of removing the residual bed of solids.

The manner in which the objects of the invention have been attained will be best understood by reference to the accompanying drawing, in which,

Fig. 1 illustrates a centrifugal rotor of conventional design in which the process is adapted to be performed,

Fig. 2 illustrates, on an enlarged scale, one stage of the dislodging operation,

Fig. 3 illustrates a second stage of the dislodging operation,

Fig. 4 illustrates a third stage of the dislodging operation, and

Fig. 5 illustrates the cleaning of the residual bed of solids from the rotor.

Referring to the drawing by reference characters, the numeral 10 designates a centrifugal rotor having a pervious peripheral wall 11 which may be a screen or similar pervious member adapted to retain within the rotor dehydrated solids 12 while allowing liquids to pass through the openings in the rotor wall. The slurry of solids and liquids is fed to the rotor by means of a feed conduit 13 which may be provided with an opening 14 through which the slurry is discharged into the rotor from the conduit. A non-rotating dislodging tool 15 is adapted to be moved to a desired depth into the bed of solids lying along the rotor wall after the conclusion of a dehydrating operation and to be longitudinally moved in that radial position to cause such solids to be dislodged and to fall into a discharge trough 16.

In the practice of the conventional prior art practice of dehydrating crystals in a rotor of the type illustrated, the slurry of crystals and mother liquor is fed to the rotor through the conduit 13 during the rotation thereof. When the solids

have remained in the rotor for a sufficient length of time to effect adequate dehydration thereof, rinse liquid is applied to the solids and discharged from the rotor through the solids. The dislodging tool is then moved into contact with the solids and may effect a series of dislodging operations of progressively increasing depth. At the conclusion of the deepest dislodging operation, the dislodging tool is moved into inoperative position and the cycle may be repeated in case the dislodging tool has not caused such glazing as to render further effective dehydrating operations through the bed of remaining solids impracticable. When the bed of solids remaining in the rotor at the innermost depth reached by the dislodging tool has become so glazed by reason of the repetition of operations as to render further adequate passage of liquid through that bed impossible, a cleaning or rinse liquid is introduced into the rotor through the conduit 17 and effects removal of the residual bed of solids.

The present invention follows the above conventional procedure to a considerable extent, but it embodies a sequence of dislodging operations of such character as to improve the efficiency of the dehydrating operation and/or prolong the period of operation during the cycles following the first cycle described above.

In the practice of the present invention, the initial stages of operation involve feeding and dislodging steps similar to those performed in the conventional feeding and dislodging operations discussed above, and the solids are rinsed as discussed above, if such rinsing is found to be desirable. In the practice of the present invention, however, the dislodgment of solids is conducted in such a manner as to leave a bed of solids within the rotor which may be of somewhat greater depth than the bed of solids left after the maximum depth dislodging step of the prior art. Just before the point in the repetition of the cycle of operations at which the undesired glazing effect would begin to impair the efficiency of the dehydrating operation, the dislodging step is modified to cause the dislodging tool to effect a deeper cut into the bed of solids than the deepest cut taken during the earlier stages of the repetition of such cycle. The loading and dislodging cycle is then repeated at this deeper surface, the cycle of operations being repeated as many times as feasible at such surface. Just before the glazing effect becomes undesirable at this deeper surface, the dislodging operation may be modified to cause the deepest cut made by the dislodging tool to be still deeper. The number of series of repetitions of the cycle which can be performed at progressively deeper zones of dislodgment will depend upon the nature of the particular centrifugal in use, the nature of material being dehydrated and the maximum depth attained by the dislodging tool in connection with the earlier repetitions of the cycle. A series of dislodging operations of this character is illustrated in Figs. 2, 3 and 4.

In an illustrative example of the practice of the invention, a mixture of crystals and mother liquor may be passed to the rotor illustrated in Fig. 1, dehydrated and rinsed as described above. The solids remaining in the rotor are then dislodged by one or a series of successive dislodging steps in which the dislodging tool 15 penetrates the solids during continued rotation of the rotor. The maximum depth reached by the dislodging tool in connection with this series of operations is indicated by the surface A in Fig. 2 of the drawing. Before the point in the repetition of the cycle of operations is reached at which the surface A would become glazed to an undesired degree, the cycle of dislodging operations is modified to cause the dislodging tool to penetrate the solid material within the rotor to the depth indicated by the reference character B in Fig. 3. Before this surface becomes glazed to an undesired degree in the repetition of the cycle involving dislodgment at this surface, the dislodging operation is modified to penetrate the bed of solids to the maximum depth D indicated in Fig. 4. Before the surface D becomes glazed to an undesired degree, cleaning fluid such as water is admitted through the conduit 17 and effects removal of the residual bed of solids, as indicated in Fig. 5. After removal of this residual bed of solids, the entire series of repetitions of the cycle of operations may be repeated, slurry being admitted and dehydrated and solids removed to the level A in one, or a larger number of successive operations, slurry being then again admitted and dehydrated and removed to the level B in one or a series of operations, etc.

Modifications will be obvious to those skilled in the art and I do not therefore wish to be limited except by the scope of my sub-joined claims. For example, the invention has been described as applied to the dehydration of a succession of batches of solid material contaminated with liquid. It will be understood that the invention is also applicable to continuous dehydrating operations in which solids are continuously impelled along a rotating pervious surface by means of scrapers or plows lying adjacent such surfaces and rotating at a slightly different speed from the surface against which the solids lie. In the application of the invention to such a continuous dehydrating process, the plows are operated in such a manner as to remove solids to a depth closer to the wall of the rotor during a part of the cycle of operations than during another part of such cycle.

I claim:

1. A process of dehydrating solids comprising the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, and dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the bed of solids within the rotor just prior to the passage of said further mixture thereto.

2. A process of dehydrating solids comprising the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor by a series of dislodging operations of progressively greater depth while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, and dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the bed of solids of minimum depth within the rotor just prior to the passage of said further mixture thereto.

3. A process of dehydrating solids comprising

the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the bed of solids within the rotor just prior to the passage of said further mixture thereto, and cleaning said rotor to effect the removal of the residual bed of solids therefrom.

4. A process of dehydrating solids comprising the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the bed of solids within the rotor just prior to the passage of said further mixture thereto, and applying cleaning fluid to the residual bed of solids in the rotor to effect removal thereof.

5. A process of dehydrating solids comprising the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the bed of solids within the rotor just prior to the passage of said further mixture thereto, and applying water to the residual bed of solids in the rotor to effect removal thereof.

6. A process of dehydrating solids comprising the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor by a series of dislodging operations of progressively greater depth while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the bed of solids of minimum depth within the rotor just prior to the passage of said further mixture thereto, and cleaning said rotor to effect the removal of the residual bed of solids therefrom.

7. A process of dehydrating solids comprising the steps of passing a mixture of solids and liquid to a pervious centrifugal rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids from the rotor while retaining a bed of solids within the rotor, thereafter passing a further mixture of solids and liquid to the bed of solids remaining in the rotor and effecting removal of liquid through the pervious wall of the rotor, dislodging solids remaining in the rotor while retaining a bed of solids within the rotor of less depth than the aforementioned bed of solids within the rotor just prior to the passage of said further mixture thereto, thereafter passing a third mixture of solids and liquid to the bed of solids remaining in the rotor after removal of said second mentioned bed of solids therefrom and effecting removal of liquid through the pervious wall of the rotor, and dislodging solids remaining in the rotor after dehydration of said third mixture of solids and liquid while retaining a bed of solids within the rotor of less depth than the bed of solids remaining within the rotor just prior to the passage of said third mixture of liquid and solids thereto.

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