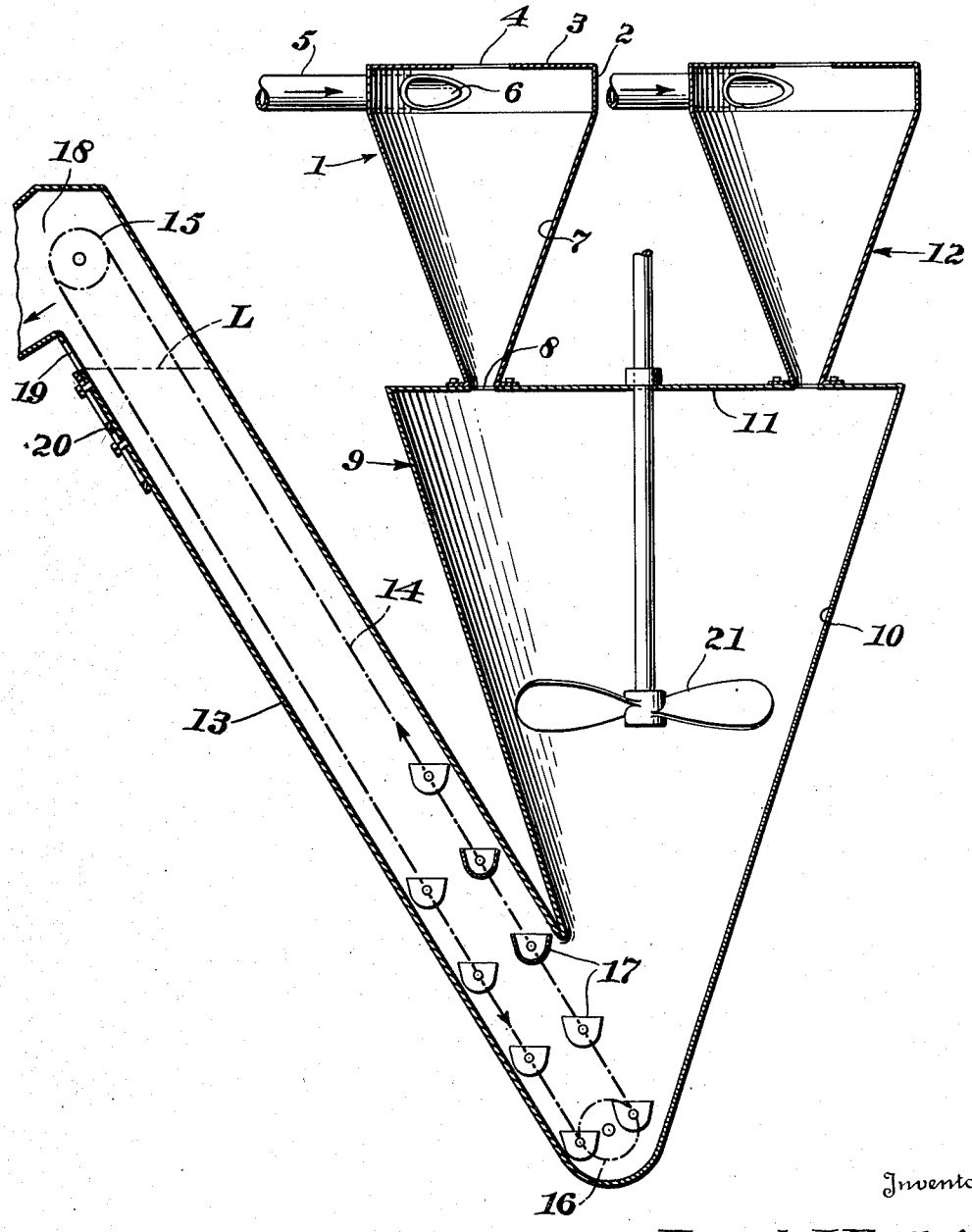
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PROCESS FOR THE SEPARATION OF SOLID SUBSTANCES OF DIFFERENT SPECIFIC GRAVITY AND GRAIN SIZE

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PROCESS FOR THE SEPARATION OF SOLID SUBSTANCES OF DIFFERENT SPECIFIC GRAVITY AND GRAIN SIZE

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1

In the applications for United States patent, Serial No. 664,320, filed April 23, 1946, Patent #2,543,689 by M. G. Driessen, C. Krijgsman and J. N. J. Leeman, Process for the Separation of Solids of Different Specific Gravity and Grain Size, and Serial No. 654,365, filed March 14, 1946, now abandoned, by C. Krijgsman for Separating Method and Apparatus, there are disclosed processes of separating mixtures of particles of different grain size and specific gravity utilizing relatively fine particles, added or already present, of a specific gravity higher than a predetermined specific gravity of separation of the granular particles. Both processes involve the tangential feeding under pressure of the suspension into the base end of a generally conical cyclone, the heavier components of the mixture to be separated together with the majority of the relatively fine particles leaving the cyclone at the apex opening and the lighter mixture components together with the very finest of the relatively fine particles leaving the cyclone at the base opening. For economical operation, if for no other reason, it is necessary to recover the relatively fine particles in the apex discharge. This separation presents difficulties which increase as the size of the materials to be separated is smaller. The main object of the present invention is to facilitate the ultimate separation of the constituents of the apex discharge by effecting a preliminary separation immediately outwardly of the apex opening, and the object is attained by immediately receiving the particles leaving the apex opening in a bath. The materials discharging through the apex opening are in rapid rotation which continues for some distance into the bath. As a result, the coarser particles are thrown outwardly by centrifugal force whereas the smaller particles are much more affected by the resistance of the bath so that they tend to stay in the middle and are drawn back in to the cyclone by the central current or vortex which extends into the bath.

Suitable apparatus for carrying out the invention is shown by way of example in the accompanying drawing, which is a vertical section of the apparatus.

Referring to the drawing, reference numeral 1 generally designates a cyclone having a shallow top cylindrical portion 2 provided with a top wall 3 which has a circular axial opening 4. Reference numeral 5 designates a feed conduit debouching tangentially into the portion 2 through an opening 6. Reference numeral 7 designates a conical portion whose large end is joined

2

to the lower edge of portion 2, the two portions being coaxial and the conical portion having an apex opening 8 coaxial with the opening 4.

Reference numeral 9 generally designates a receiver, here shown as a tank having a conical portion 10 and a top wall 11 provided with an opening registering with the apex opening 8, the bottom of the cyclone being sealed to the wall 11. Reference numeral 12 designates a second cyclone like the cyclone 1 and similarly associated with the receiver 9.

Reference numeral 13 designates an upwardly extending housing in communication at its lower end with the lower end of the receiver. An endless chain 14 engages top and bottom sprockets 15 and 16 and carries buckets 17 which, when the chain is driven, are adapted to gather material in the sump at the bottom of the receiver and discharge it through an opening 18 at the upper end of the housing. Reference numeral 19 designates an overflow opening in the housing controlled by a slidable weir 20.

In the operation of the apparatus, the tank is filled with liquid and the liquid stands in housing 13 at a level L determined by the weir 20, this level being ordinarily somewhat above the top 11 of the receiver. The material to be separated, together with the relatively fine particles, is mixed with water and fed to the two cyclones. The heavier constituents of the mixture to be separated, together with the majority of the relatively fine particles, move outwardly due to centrifugal effect to the wall of the cone and move downwardly and through the apex opening 8 into the bath. The lighter constituents of the mixture to be separated move into a central rising column and leave the cyclone through the opening 4, this effluent containing also some of the finest particles of specific gravity higher than the specific gravity of separation.

The material entering the receiver from the opening 8 is rapidly rotating as a result of the vortical action in the cyclone and the larger particles are thrown outwardly since they are able to overcome the resistance offered by the bath. The relatively fine particles, however, tend to stay in the middle and are caught by the ascending central vortex, which extends a distance into the bath, and are thus returned to the cyclone. These returned particles tend to migrate outwardly and again join the outer descending stratum in the cyclone.

Due to this return, any need for the addition of relatively fine particles to the mixture to be

separated is correspondingly reduced so that the specific gravity of the suspension supplied to the cyclones can thus be lower. For example, if using only the cyclones, the supplied suspension has to have a specific gravity of 1.3 to maintain a specific gravity of separation of 1.45, a specific gravity of the supplied suspension of 1.05 will be sufficient to maintain this specific gravity of separation when using the receiver of the present invention.

Another advantage arising in the practice of the invention is that the apex of the cyclone can have a greater diameter without unfavorably affecting the specific gravity of separation. Consequently, particles which would otherwise tend to clog or unfavorably narrow the apex opening are readily passed and larger sizes of materials can be separated.

The bath in the receiver is ordinarily in the form of a suspension of particles of the same type as the mentioned relatively fine particles. If the bath is originally not a suspension, but simply water, it will become a suspension in the course of operation due to the relatively fine particles not returned to the cyclone. In order to maintain the stability of the suspension, agitating means as at 21 may be provided.

While only one cyclone could be associated with the receiver, it is a feature of the invention that any desired number of cyclones can be associated with a single receiver, two being shown by way of example.

It will be understood that the herein described procedure and apparatus are susceptible of variation without departing from the invention as defined in the following claims.

I claim:

1. The continuous method of separating solid particles of different specific gravity and particle size comprising simultaneously feeding under pressure tangentially into one end portion of each of a plurality of confined circular spaces a suspension in a liquid of a mass of such particles to move in a cyclonic vortex within the circular space wherein centrifugal forces will be substantially in excess of gravtitational forces, a portion of the mass of particles being of substantially finer size than the remainder of the particles and of a specific gravity higher than a predetermined specific gravity of separation, discharging liquid and separated particles under pressure created by said feed from two outlets coaxial of each circular space, one of the outlets of each space opening directly from the end portion of the space which is adjacent the point of infeed while the second outlet is located at the non-infeed end of the circular space, said portion of substantially finer particles being supplied in such quantity

and the discharge from the second outlet being so restricted that a concentration of the substantially finer and higher specific gravity particles will be created and maintained in a zone adjacent the second outlet of each circular space to obstruct discharge of the particles of a specific gravity lower than said specific gravity of separation from the second discharge outlet so that the fraction discharged from each of said first discharge outlets will contain substantially all particles of a specific gravity lower than said specific gravity of separation and the fraction discharged at each of the second discharge outlets will contain substantially only particles of a specific gravity higher than said specific gravity of separation, receiving the fraction discharged from each of said second discharge outlets in a larger confined pressure zone surrounding all of said second discharge outlets and filled with a bath of such specific gravity that larger particles received therein will settle, and continuously removing such larger particles from the confined pressure zone.

2. A method of the character described in claim 1 wherein the bath which fills the larger confined pressure zone is a suspension of particles of the character of said particles of substantially finer size.

3. A method of the character described in claim 1 wherein the confined circular spaces are conical and the suspension is fed into the base end of such spaces.

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