March 4, 1969 L. E. GILREATH 3,430,850

CENTRIFUGAL SEPARATOR

Filed Nov. 13, 1967 Sheet 1 of 2

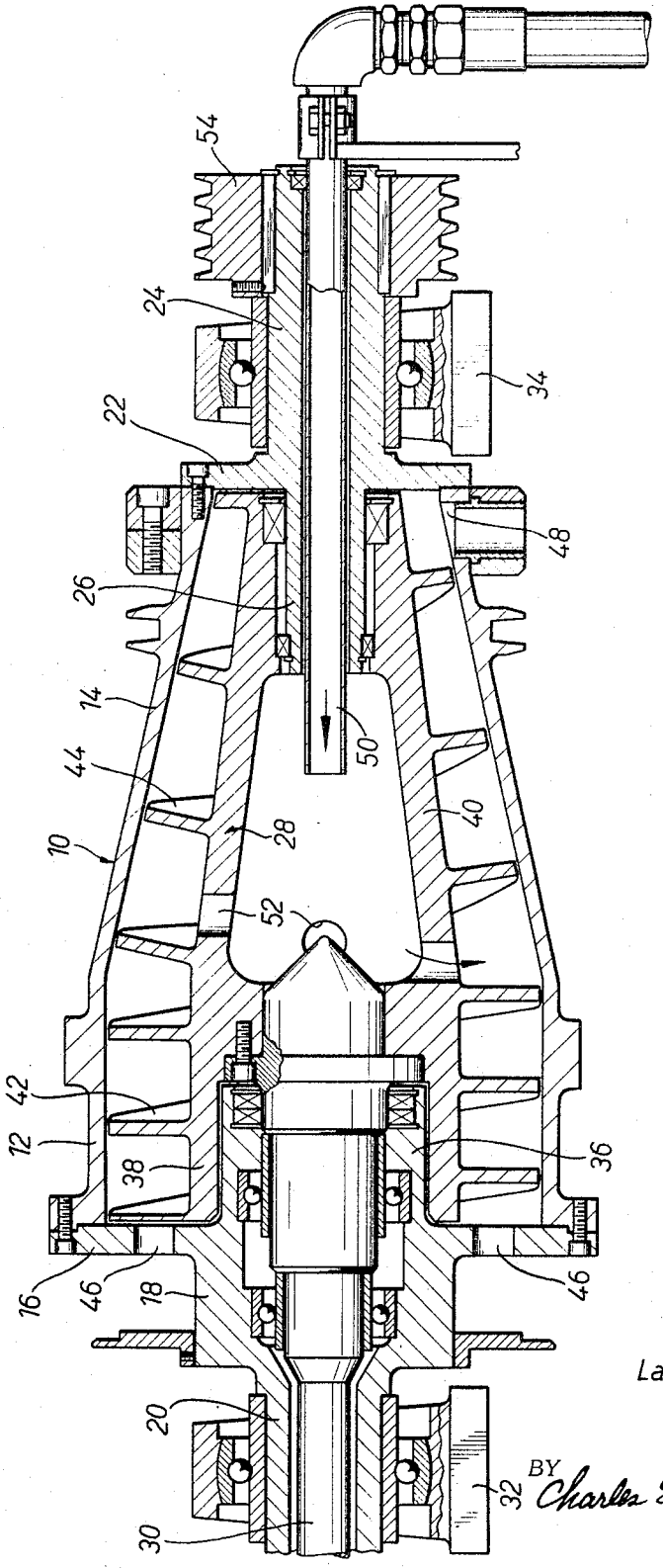

FIG. 1

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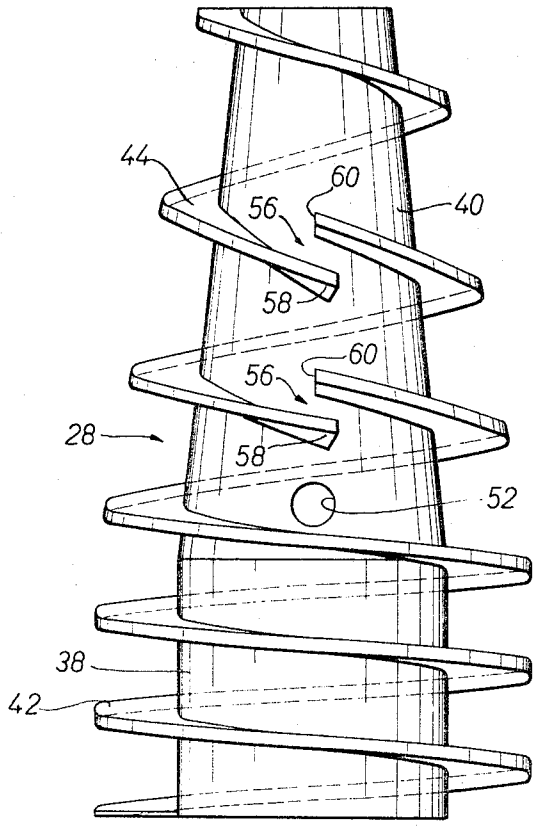

FIG. 2

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CENTRIFUGAL SEPARATOR

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Int. Cl. B04b 1/12, 3/04, 5/00

ABSTRACT OF THE DISCLOSURE

A centrifugal separator of the type having an outer, rotatably mounted barrel formed with a cylindrical portion terminating at one end of the barrel and a longitudinally tapering portion extending from the inner end of the cylindrical portion to the other end of the barrel, and an inner rotor in the barrel rotatable relative thereto and provided with a spiral flight extending from end to end thereof, the flight having a portion of constant pitch located in the cylindrical portion of the barrel to form therewith a spiral chamber portion providing a separating zone for material under treatment, and a portion of varying pitch extending throughout the tapered portion of the barrel, to form therewith a spiral chamber portion providing dehydrating zone and solids feeding zone, the volume of any portion of said solids feeding zone throughout the length thereof being the same as the volume of any other portion of the same length of said solids feeding zone. The barrel and rotor are adapted to rotate together at somewhat different speeds to cause the flight to move solid material, separated from the material under treatment, toward one end of the barrel. The flight of the rotor in the tapered portion of the barrel is interrupted to provide openings through which the separated liquid may flow in a direction to allow the liquid to move away from the solids as the solids move toward one end of the barrel.

BACKGROUND OF THE INVENTION

The invention relates to the separation of solid particles from fluids and more particularly to separator mechanism of the centrifugal type for the rapid removal of solid particles from liquids.

In the separation of solid particles from liquids it is customary to employ separator mechanism of the type having an outer rotatably mounted barrel formed with a longitudinally tapering portion and within which a rotor is mounted for independent rotation, which rotor has a spiral flight extending about its exterior to move the separated solids toward one end of the barrel for discharge therefrom while allowing separated liquid to flow toward the other end of the barrel. The barrels of separators of this type are sometimes formed with a straight cylindrical portion as well as a longitudinally tapering portion and the flight of the rotor is then provided with correspondingly shaped portions to fit the barrel, so that the separated solids will be moved rapidly toward the solids discharging end of the barrel, while liquid may readily flow back toward the other end.

The barrel and rotor of such separators are rotatable at high speeds to cause centrifugal separation of the solids from the liquid of the material under treatment, the material being usually introduced at some point mediate the ends of the barrel and rotor being rotated at somewhat different speeds to cause the separated solids to be fed toward one end of the barrel while the liquid flows toward the opposite end.

In the operation of separators of this kind, there is often a tendency for the separated solids to clog the spiral passageway formed by the flight of the rotor between the barrel and rotor, making it difficult to control the mechanism to obtain the most efficient separation while preventing such clogging. Under some conditions it becomes necessary to greatly diminish the volume of material under treatment which is fed into the separator, or to substantially reduce the difference in the speed of rotation of the barrel and rotor, thus making it necessary to maintain critical control of the equipment in order to avoid clogging. The danger of clogging is especially likely under conditions in which the solids content of the material under treatment is high or is subject to great variation.

Moreover, the flights of the rotor of separators of this type are usually uninterrupted from end to end of the device, so that the cross-sectional area of the spiral passageway between the barrel and rotor is substantially reduced by the separated solids when the percentage of solids in the material under treatment is high, thus reducing the free flow of separated liquid toward the liquid discharge outlet of the apparatus.

The present invention has for an important object the provision of centrifugal separator mechanism of the type mentioned, which is designed to facilitate the draining away of the liquid from the location in which separation takes place and to reduce the likelihood of clogging of the apparatus by the separated solids as the same are moved away from such location.

Another object of the invention is to provide a centrifugal separator of the type having an outer barrel and an inner rotor which are independently rotatable and in which the barrel has a portion which tapers away from the zone in which separation is principally accomplished toward one end of the barrel and the rotor is provided with a spiral flight whose pitch increases from the zone of separation toward said one end of the barrel to form a spiral passageway between the barrel and rotor in which the volume of any portion of the passageway between said zone and said one end is at least equal to the volume of any portion of equal length lying closer to or within said zone of separation.

A further object of the invention is the provision in centrifugal separator mechanism of the type referred to, having a spiral flight of the kind described, of means for allowing a flow of liquid through a shortened path through said passageway while preventing the movement of separated solids along such path.

SUMMARY OF THE INVENTION

Briefly described the invention comprises a centrifugal separator having a barrel mounted for rotation about its longitudinal axis and formed with a straight cylindrical portion extending from one end to a location mediate the ends of the barrel, and a portion which tapers from said intermediate location toward the other end of the barrel and a rotor rotatably mounted in the barrel for rotation about said axis and having portions shaped to conform to the shape of the barrel, and provided with a spiral flight from end to end thereof which is formed with a portion of constant pitch located in said cylindrical portion to form therein a liquid feeding zone, and a portion of varying pitch located in said tapering portion to form therein a solids feeding zone, the barrel having an inlet for material to be treated which is located in a separating zone or region in the vicinity of the location where the liquid feeding zone and solids feeding zone are in communication. The apparatus is also provided at said one end of the barrel with a liquid discharge outlet and at said other end of the barrel with a solids discharge outlet, and the barrel and rotor are adapted to be rotated simultaneously and at somewhat different speeds to cause centrifugal separation of the solids from the liquid in said separation zone and feeding of the separated solids toward the solids discharge outlet while permitting the flow of separated liquid from said separation zone toward said

liquid discharge outlet. Due to the tapering of the barrel and rotor in the solids feeding zone and the increasing pitch of the flight from the separating zone toward the solids discharging end of the barrel, the barrel and rotor may be rotated at high speed to accomplish substantial centrifugal separation of the solids from the liquid and the difference between the speed of rotation of the barrel and that of the rotor may be relatively great to permit rapid feeding of the solids away from the zone of separation, while allowing the free flow of the separated liquid toward the liquid discharge end of the barrel without danger of clogging the apparatus. The flight of the rotor is also interrupted at one or more locations in the portion of varying pitch, the flight having portions which overlap circumferentially at such locations, to provide openings through which the liquid may pass toward the liquid discharge end of the barrel, while preventing such passage of the solids which are being moved toward the solids discharge end of the barrel.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWINGS

In the drawings:

FIGURE 1 is a side elevational view, partly broken away and partly in cross-section illustrating a preferred embodiment of the centrifugal separator mechanism of the invention; and

FIGURE 2 is a side elevational view of the rotor of the invention separated from the barrel and the surrounding parts of the mechanism.

DESCRIPTION OF A SPECIFIC EMBODIMENT OF THE INVENTION

Referring now to the drawings in greater detail the centrifugal separator of the invention as shown in the present illustration comprises an outer barrel, generally designated **10**, formed with a straight cylindrical portion **12** extending from one end of the barrel toward its mid-portion and with a longitudinally tapering portion **14** extending from the inner end of said straight portion toward the other end of the barrel. The barrel is provided at one end with a closure plate **16**, suitably secured thereto and which is formed with a central tubular extension **18** whose outer end portion **20** serves as a bearing shaft for the barrel.

The barrel is suitably attached at its other end to a closure plate **22**, formed with a central external tubular extension **24** providing a bearing for the barrel, and an internal central, tubular extension **26** upon which the hollow rotor **28** of the apparatus is rotatably journalled.

The extension portion **20** may be rotatably carried in a bearing block **32**, while the extension **24** is similarly carried in a bearing block **34**.

The closure plate **16** also has a central, internal tubular extension **36** to provide a counterbore within which the shaft **30** is suitably journalled to support the rotor for rotation independently of the barrel.

The rotor has a straight cylindrically shaped portion **38**, corresponding to the portion **12** of the barrel and a tapered portion **40** corresponding to the tapered portion **14** of the barrel to form a solids feeding zone therein.

The barrel has at one end, one or more liquid discharge outlets **46** in the plate **16** and is provided at the other end with one or more solids discharge outlets **48**.

A stationary inlet pipe **50** is extended centrally through the external extension **24** and internal extension **26** into the interior of the rotor, and the rotor is provided with one or more outlets **52** located mediate its ends through which material to be treated may flow from the rotor into the spiral passageway formed by the flight of the rotor into a separating zone located generally in the region of the inner end portions of the tapered and straight cylindrical portions of the barrel.

Due to the diminishing radial width of the flight portion **44** from the straight cylindrical portion **12** of the barrel toward the solids discharge end of the same and the increase in the pitch of the flight throughout this portion of the flight, the cross-sectional area of the spiral passageway between the barrel and rotor may be maintained constant or may be somewhat increased throughout the solids feeding zone of the apparatus, to prevent any clogging of the apparatus by separated solids.

The barrel may be rotated by any suitable means, such as the pulley **54**, suitably attached to the extension **24** for rotation therewith, which pulley is driven from any suitable source of power, and the shaft **30** may be similarly rotated by means, not shown, to rotate the rotor with, but at a speed different from the speed of rotation of the barrel, from the same or some other power source.

The flight of the rotor may be interrupted at one or more locations in the tapered portion of the barrel, as indicated at **56**, the end portions **58** and **60** of the flight at such locations being arranged in circumferentially overlapping relation to provide passageways **56** through which liquid may flow toward the liquid discharge end of the barrel as the solids are moved toward the solids discharge end thereof. These passageways provide for the flow of the liquid in the opposite direction from the movement of the solids, without the necessity for flowing spirally in conformity with the curvature of the flight about the rotor in the solids feeding zone of the apparatus. The passageways **56** may extend for the full radial width of the flight.

Due to the circumferential overlapping of the end portions of the flight at the location of the interruptions, the separated solids will be moved along the barrel toward the solids discharge end thereof without passing through the passages **56**, while liquid may flow freely through the passages.

In the operation of the separator, the barrel and rotor are rotated simultaneously at high speed and the material to be treated is introduced into the rotor through the inlet pipe **50** from whence it may flow radially outwardly through the outlet **52** into the separation zone of the apparatus. As the solids are separated from the liquid by centrifugal action, the solids will move outwardly toward the inner surface of the barrel, thus causing the liquid to be displaced radially inwardly from the barrel.

By rotating the barrel and rotor at somewhat different speeds, the flight of the rotor may be turned relative to the barrel in a direction to move the separated solids away from the zone of separation, through the solids feeding zone toward the solids discharge end of the barrel, while the liquid is allowed to move in the opposite direction from the separation zone through the liquid discharge zone toward the liquid discharge end of the barrel.

During such movement of the solids toward the solids discharge end of the barrel, liquid which is separated out may flow in a spiral path along the flight about the rotor, as well as through the passages **56**, toward the discharge end of the apparatus, while solids will be prevented from moving through the passages **56**, due to the circumferentially overlapping end portions **58** and **60** of the flight, but will be moved longitudinally along the barrel by the flight toward the solids discharge end.

By properly regulating the relative speeds of rotation of the barrel and rotor the solids may be effectively separated and rapidly discharged without danger of clogging the apparatus.

It will be understood that the full extent of the separating zone longitudinally of the barrel and the length of the liquid discharge zone and solids discharging or feeding zone may vary substantially depending upon the character of the material under treatment, the speed of rotation of the barrel and rotor and the difference which is maintained between the speed of rotation of the barrel and rotor. The zone of separation will, however, include the portion of the length of the barrel at which the straight cylindrical portion **12** merges which the tapering portion **14** and the zones of liquid and solids discharge

will extend from the separating zone toward the liquid discharge end and the solids discharge end respectively of the barrel. It will be appreciated that under some conditions the separating zone may not be clearly distinguished from the liquid discharge zone and the solids discharge zone and that these zones may substantially overlap. For example, a substantial portion of the solid may be separated at a location in the barrel close to the outlets **52**, and further separation may take place as the first separated solids are moved toward the solids discharge end, while further amounts of liquid separated therefrom are allowed to flow back toward the liquid discharge end. Thus, the zone of separation may at times be confined to a region close to the longitudinal midportion of the barrel, while at other times the zone of separation may be extended throughout a substantial portion of the length of the barrel between the outlets **52** and the solids discharge outlets **48**, the liquid discharge zone being likewise extended.

It will thus be seen that the invention constructed and operated as described above provides centrifugal separator apparatus which is efficient in operation and wherein the solids and liquid of the material under treatment may be rapidly separated and separately discharged from the apparatus.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. In a centrifugal separator an elongated barrel having a longitudinally tapering portion extending from a location mediate the ends of the barrel toward one end thereof and having a discharge outlet at each end of the barrel, a rotor in the barrel shaped to conform to the direction of the taper thereof, means supporting the barrel and rotor for rotation at different speeds about a common longitudinal central axis, flight means on said rotor forming a spiral passageway between the rotor and barrel in communication with said outlets, the cross-sectional area transversely of the passageway at any location in said tapering portion being at least equal to such cross-sectional area at any other location closer to the larger end of said tapering portion, means for introducing a material to be treated into said passageway mediate said outlets and means forming an opening in said flight means in said tapering portion through which liquid may flow away from said one end of the barrel.

2. The centrifugal separator as claimed in claim **1**, wherein said means forming said opening includes end portions on said flight means disposed in longitudinally spaced apart and circumferentially overlapping relation.

3. The centrifugal separator as claimed in claim **1**, wherein said spiral passageway includes a portion of constant cross-sectional area transversely of the passageway extending from said tapering portion to the outlet at the other end of the barrel.

4. The centrifugal separator as claimed in claim **1**, wherein said opening is shaped to allow the flow of liquid and to prevent the movement of solids therethrough away from said one end of the barrel during relative rotation of the barrel and rotor in a direction to cause said flight means to move the solids toward said one end.

5. The centrifugal separator as claimed in claim **1**, wherein said barrel and rotor are formed with cylindrically shaped portions extending from said tapering portion to the other end of the barrel.

6. The centrifugal separator as claimed in claim **1**, wherein said opening extends radially entirely across said passageway.

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