April 2, 1957 E. M. BATTEY 2,787,378

SLURRY TYPE LIQUID TREATING APPARATUS

Filed May 26, 1952

Figure 1

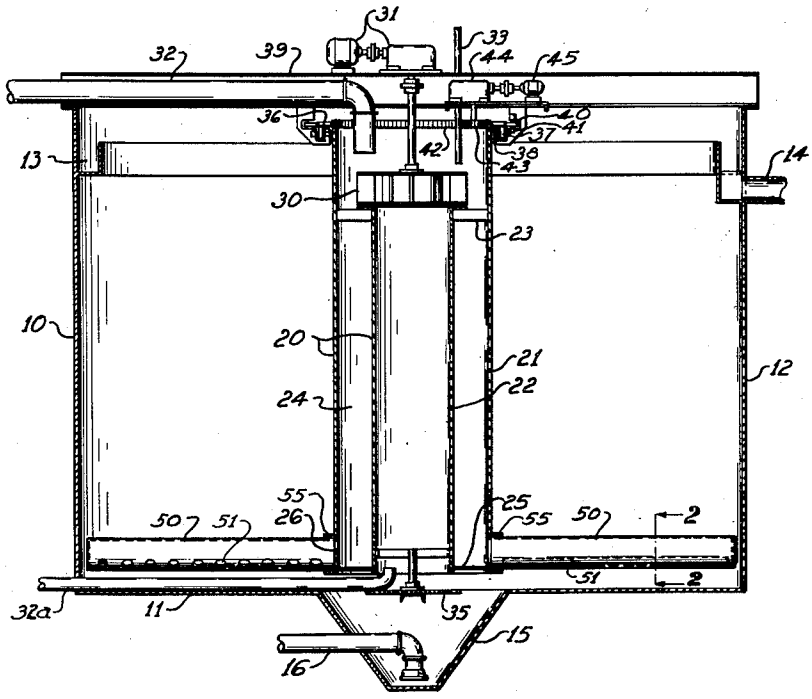


Figure 3

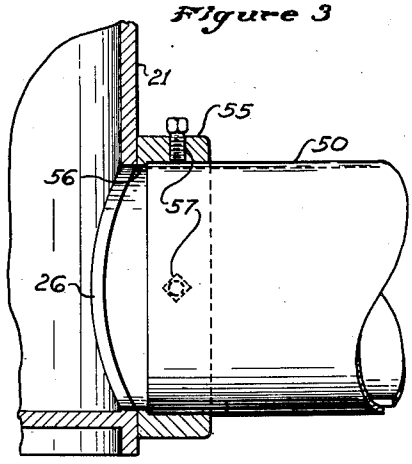
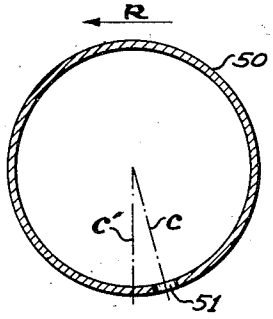


Figure 2



INVENTOR.
Everett M. Battey
BY J. Gunz
Agent

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2,787,378

SLURRY TYPE LIQUID TREATING APPARATUS

Everett M. Battey, Falls Church, Va., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Army

Application May 26, 1952, Serial No. 290,042

1 Claim. (Cl. 210—512)

This invention relates to slurry type liquid treating apparatus and process. More particularly it relates to apparatus and process of this general type wherein a mixture of slurry, liquid to be treated, and reagent is discharged from a central mixing zone or chamber through rotating arms across the outer portion of the tank. In such an apparatus the distributing arms rotate below a suspended slurry blanket or pool through which a throughput portion of the liquid discharged from the arms flows upwardly toward a treated liquid outlet, whereas the balance of the liquid discharged from the arms flows inwardly across the bottom of the tank and returns to the mixing zone.

In apparatus of this type the arms are rotated at a relatively high speed, and it has been usual to provide discharge orifices in the arms which direct the flow vertically downwardly toward the bottom of the tank to avoid disturbance of the blanket and to continuously sweep the bottom free of deposits. In practice it has been found that the rotation of arms with downwardly discharging orifices has a marked tendency of causing the slurry blanket above the arms to rotate in the same direction as the arms and at the same speed. This is undesirable and actually nullifies the improved distribution sought by rotation of the arms.

It is an object of this invention to provide apparatus and process for controlling the speed and direction of rotation of a slurry blanket overlying rotatable distributing arms.

Another object is to provide means for controlling the speed and rotation of a slurry blanket which can be adjusted to provide any desired speed and direction of blanket rotation.

Another object is to provide an improved distributing arm structure for an apparatus of the type mentioned.

Another object of the invention is to provide a rotatable distributing arm discharging downwardly at an angle to the vertical to provide a tangential velocity component opposite to the direction of the arm rotation.

Another object is to provide a distributing arm which is rotatable about a vertical axis and can also be rotated about its own horizontal axis.

Other objects will become apparent upon consideration of the detailed description and of the claim.

It has been the usual opinion of those practicing slurry treatment that rotation of the slurry blanket due to rotation of rotatable members below the blanket should be suppressed, or at least minimized and various kinds of baffling devices have been used therefor, or the rotating members were circulated at a very low speed. However, rotation of the slurry blanket, in and of itself, is not only permissible but often desirable, provided the velocity and direction of blanket rotation are controlled. There should be an appreciable relative velocity between the rotation of the arms and the rotation of the blanket when the slurry blanket is rotated in the same direction as the arms. I have also found that

sometimes it is desirable that the slurry blanket rotate in the opposite direction of the arms. Such reversal has resulted in considerable improvement in the operation of the treating unit, not only with regard to distribution but particularly in avoidance of local boils in the slurry blanket.

I have discovered that the speed of rotation of the slurry blanket can be controlled, and that rotation of the slurry blanket can be entirely stopped or its direction reversed, by discharging the slurry from the arms at an angle to the vertical so that there is a tangential velocity component opposite to the direction of arm rotation. The angle of discharge may vary from about 15° to about 45°, depending on whether it is desired to merely slow down the rotation of the blanket, to stop it, or to reverse its direction.

Whether slowing down of the rotation of a slurry blanket rotating in the direction of the arms, or reversal of the direction of rotation results in the best operating conditions depends largely on the quantity and quality of the solids in the slurry, and particularly their settling characteristics, and must be decided from case to case. Other factors influencing the blanket rotation are the velocity of the jets discharged from the arms, which depends on the speed of rotation of the rotor of the apparatus, and the velocity of rotation of the arms, which is controlled independently of the speed of rotation of the rotor. One difficulty of controlling the slurry blanket rotation is, therefore, that the correct angle of discharge usually can be ascertained only after the apparatus has been put in operation, and that the angle must be changed if the characteristics of the liquid under treatment change considerably. I, therefore, suggest to support the arms in such manner that they can be rotated about their horizontal axis and thus can be readily adjusted to the angle of discharge which is found best in operation.

The invention will be more readily understood by reference to the drawing wherein:

Figure 1 is a vertical cross-sectional view of an apparatus utilizing the invention;

Figure 2 is an enlarged vertical cross-sectional view of a distributing arm taken along line 2—2 of Figure 1; and

Figure 3 is an enlarged vertical sectional view of the adjustable arm mounting of Figure 1.

The apparatus shown in Figure 1 for purposes of illustrating the invention is similar to the apparatus disclosed and claimed in the copending application of Walter J. Hughes, Serial No. 212,761, filed February 26, 1951, now Patent No. 2,673,181, and no claim is made herein to this apparatus per se. The present invention is not limited to use in connection with this specific apparatus, but can be applied to other apparatus of the general type where liquid is discharged through arms rotating below a slurry blanket. The invention corrects objectionable features of such previously known apparatus and provides for better operation.

The liquid treating apparatus shown in Figure 1 comprises a tank 10, which may have any suitable shape but is shown for purposes of exemplification as having a substantially flat bottom 11 and a cylindrical boundary wall 12. Treated liquid overflows into a launder 13 and is withdrawn through an effluent conduit 14. Suitable means for withdrawing excess solids are provided and may take the form of a sludge sump 15 in the bottom 11, and a sludge blow-off line 16 leading from the sump 15.

Axially mounted in the tank 10 is a partition structure 20 comprising an outer partition 21, and an inner partition 22 which may be independently supported or, as

shown, be supported from the outer partition **21** as by brackets **23**. The partitions **21** and **22** may have any suitable configuration, but are shown for purposes of illustration as tubular. The lower edges of partitions **21** and **22** are spaced above the bottom **11** of the tank, and the channel **24** between the partitions is closed at the lower end by a floor **25**. The upper edge of the outer partition **21** is above the overflow into the launder **13**, and the upper edge of the inner partition is at a lower elevation, thus providing an overflow from the space within the inner partition **22** to the channel **24**. The lower part of the outer partition is provided with a plurality of ports **26** symmetrically spaced about the partition **21**.

A rotor **30** is mounted within the partition structure **20**, preferably just above the upper end of the inner partition **22**, as shown, and can be rotated by means of a suitable motor-reducer **31**. To afford mixing of the liquid to be treated with the reagent in the presence of slurry pumped upwardly through the partition **22** by the rotor **30**, the liquid to be treated and the reagent are introduced into the space within the partition structure **20** at opposite sides of the rotor **30**, as through conduits **32** and **33**, respectively, or the liquid to be treated can be introduced into the space within the partition **22** below the rotor, as through a conduit **32***a*. The latter construction is preferred when the rate of raw water supply varies considerably, as it permits to maintain a constant volume of discharge through the arms **50**, and therefore a constant speed of rotation of the slurry blanket, regardless of the rate of raw water flow.

A plate **35** may be mounted in any suitable manner between the open lower end of the inner partition **22** and the sump **15** and shelters the sump from the turbulence set up by the return flow of slurry to the inner partition **22**.

The outer partition **21** is rotatably supported by any suitable means, such as a channel structure **36** surrounding its upper end and riding on rollers **37** journaled in bearings **38**. The bearings **38** are supported from a walkway or beam **39** spanning the tank **10**. To prevent sideslipping of the channel structure **36** as it travels over the rollers **37**, a plurality of guide rollers **40** are provided and are journaled in bearings **41**, which also are supported by the beam **39**. Any suitable means can be used to rotate the partition **21**. For purposes of illustration an internal ring gear **42** is shown which meshes with a pinion **43** mounted on the shaft of a speed reducer **44**, driven by a motor **45**. The motor **45** and speed reducer **44** can be mounted on the beam **39**. In Figure 1 it is assumed that the partition **21** rotates clockwise.

A plurality of hollow distributing arms **50** are equally spaced about the partition **21** to register with the ports **26**. The arms **50** extend from the outer partition **21** across the tank **10** and are in hydraulic communication with the channel **24** through the ports **26**. Usually at least four arms are used, but in larger tanks six or more arms should be used for good distribution. The arms **50** are provided with discharge means **51**, which may be in the form of a continuous slot, as shown on the right hand arm in Figure 1, or of orifices suitably spaced along the length of the arm, as shown on the left hand arm of said figure. As best shown in Figure 2, the discharge opening or openings are located in the lower portion of the arm **50** and with their center line C at an angle to the vertical center line C^1 of the arm **50** in the direction opposite the direction of arm rotation indicated by the arrow R.

Since in practice the angle to the vertical may vary considerably, I provide means for adjustably mounting the arms **50** on the partition **21**. The ports **26** are surrounded by couplings **55**, which are welded or otherwise affixed to the partition **21**. Each coupling is machined to provide a shoulder **56** which serves as a stop for the distributing arm which is inserted in the coupling **55**. Each coupling is tapped at two places which are 90° apart to permit the insertion of set screws **57**, which bear against the arm **50** and hold it fixedly in the selected position. By loosening the screws **57** the arm **50** can be rotated about its axis in the coupling **55** until the slots or orifices **51** are in the correct angular position to obtain the speed and direction of rotation of the slurry blanket desired, and then can be fixed in this position by tightening the screws. The angle from the vertical of the center line of the discharge opening should not be less than about 15° and not more than about 45° and will usually be within the range of from 15° to 30°. The choice of the angle depends on the characteristics of the slurry, the speed of the rotor **30** which controls the velocity of the jets discharged from the arms **50**, and the speed of rotation of the arms **50** which is controlled by motor-reducer **45—44**.

I claim:

In a slurry type liquid treating apparatus having a tank which during normal operation contains a slurry blanket and an overlying body of clarified liquid, a central mixing chamber surrounded by a casing separating said mixing chamber from an outer space between said casing and the wall of said tank and conduits having longitudinally aligned discharging distributing openings connected to apertures in the wall of said casing adjacent the bottom of said tank and extending from said casing adjacent to but spaced from the bottom of said tank for approximately the entire distance of the outer space intermediate said tank and said casing, the improvement comprising a collar secured to said casing in registry with each of said apertures and facing the intermediate space between said casing and said tank, each of said collars being dimensioned to surround a conduit, adjustable fastening means carried by each collar for engaging a conduit to maintain it in communication with an associated aperture, each conduit secured in a collar by said adjustable fastening means to position the openings in said conduit at preselected vertical angles whereby slurry mixture conducted to said casing and discharged from said openings for distribution over the bottom of said tank upon rotation of said casing imparts a substantial tangential velocity to the slurry mixture underlying the slurry blanket in said tank and a minimum vertical velocity to slurry solids traveling upward to the slurry blanket while simultaneously controlling the rotational velocity of the slurry blanket relative to the rotational velocity of the conduits.

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