June 20, 1950 G. J. LIPSCOMB 2,512,253

CENTRIFUGAL SEPARATOR

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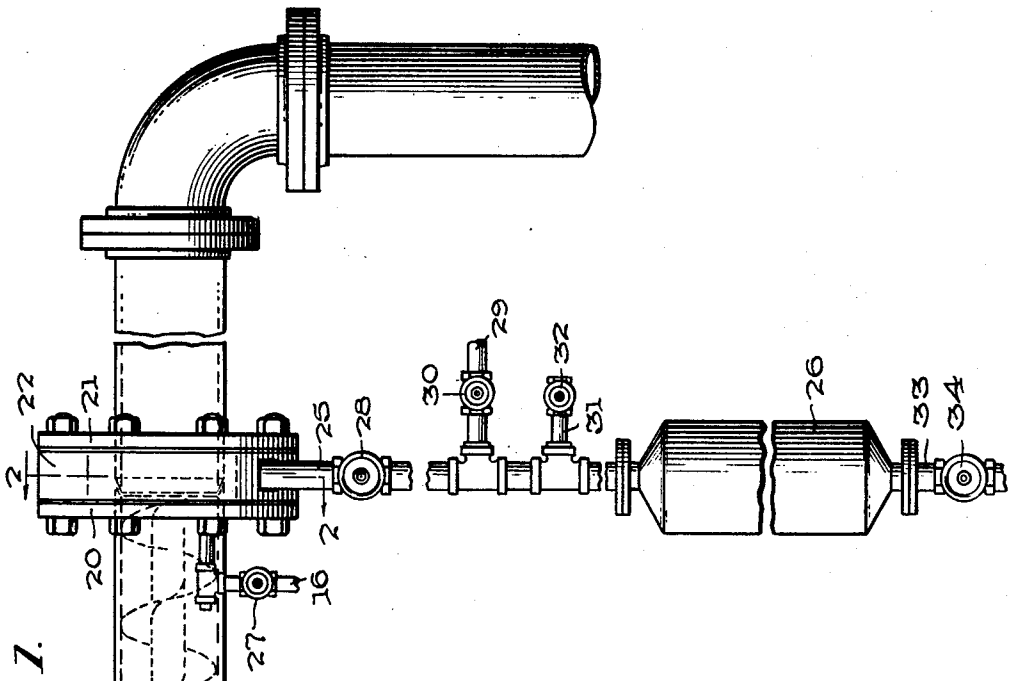

Fig. 1.

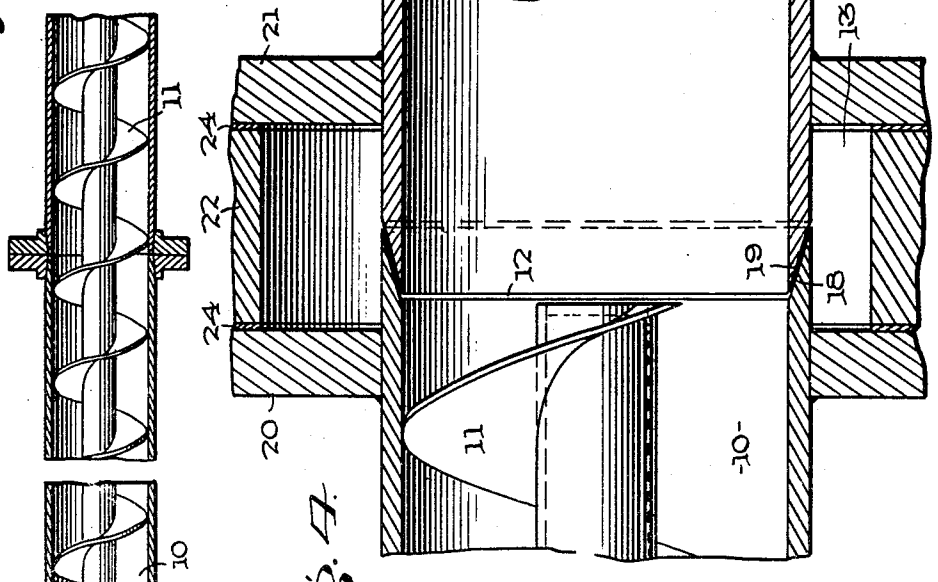

Fig. 4.

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Fig. 2.

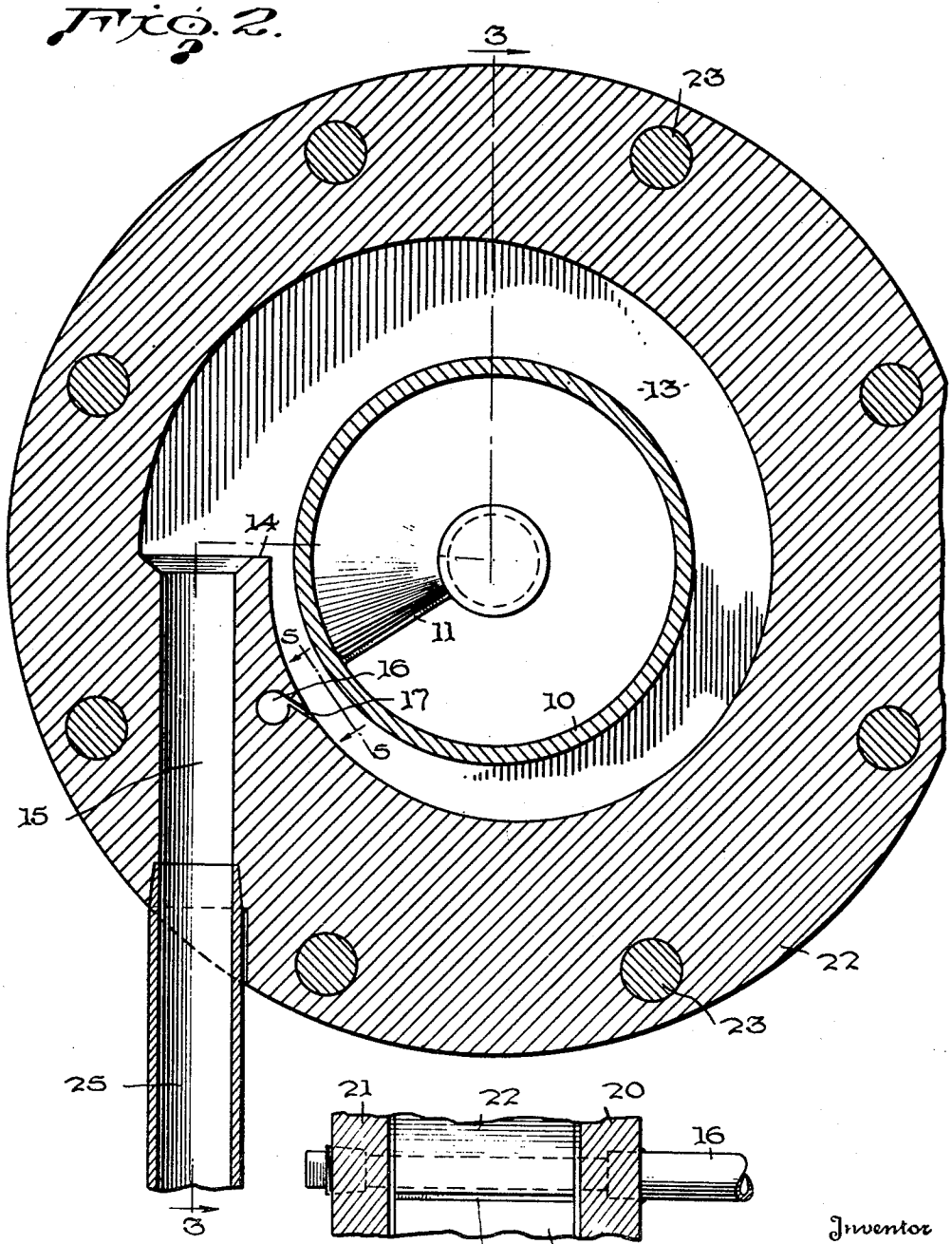

Fig. 5.

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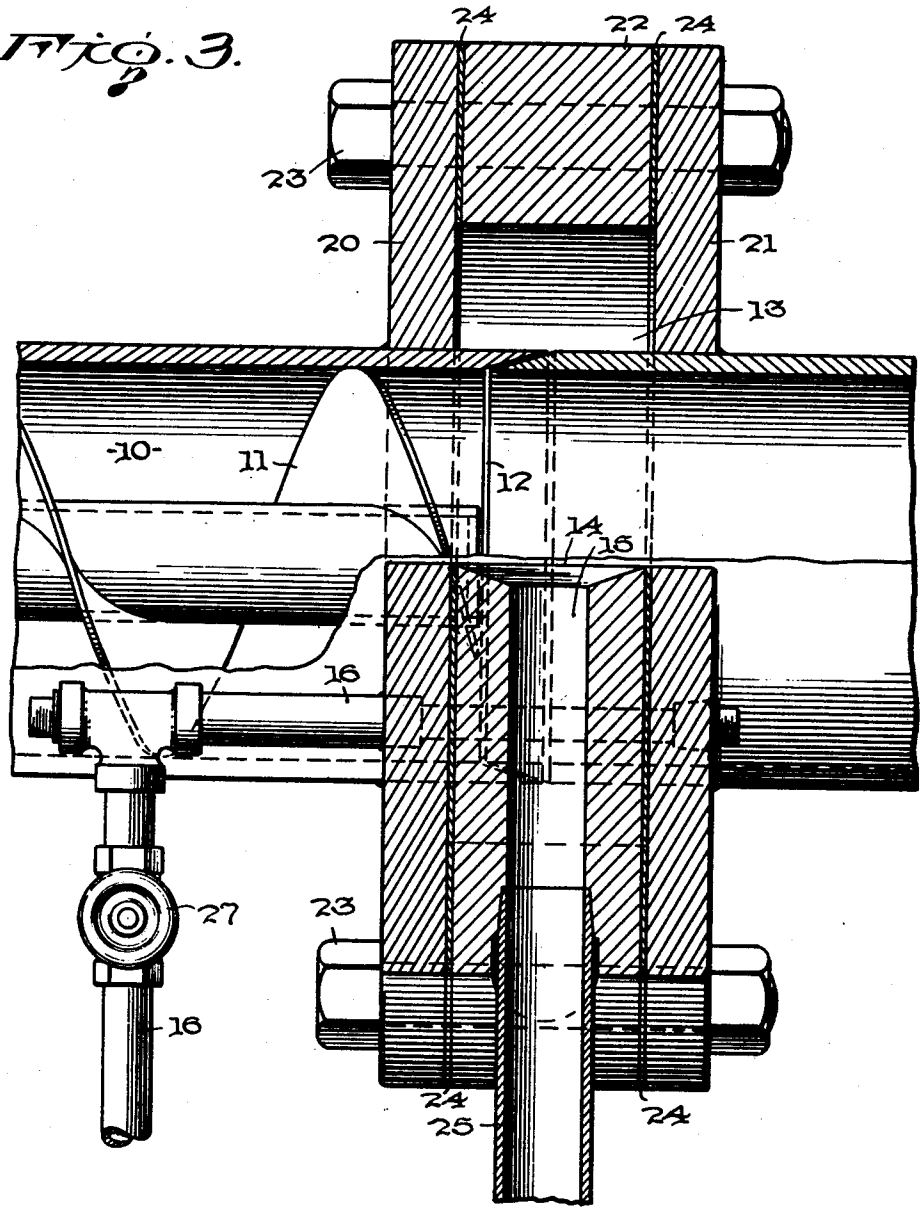
Fig. 3.



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UNITED STATES PATENT OFFICE

2,512,253

CENTRIFUGAL SEPARATOR

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3 Claims. (Cl. 209—211)

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This invention relates to apparatus for centrifugally separating particles of matter from a liquid in which they are carried in suspension.

Some types of pulp, in a raw state, contain sand that is so fine that it is almost impossible to remove the sand pneumatically from the pulp and the primary object of the present invention is to provide apparatus for removing this fine sand from pulp by means of centrifugal force generated in a column of liquid carrying the pulp stock in suspension.

Another feature of the invention consists in the novel arrangement for discharging the sand centrifugally from a flowing column of liquid carrying the pulp stock and collecting the sand so removed.

Still another object of the invention is to provide means for readily regulating or varying the size of the opening through which the separated material is discharged from the body of liquid in which it is carried in suspension.

More specifically, the invention contemplates an apparatus in which the liquid with the particles to be separated in suspension is flowed uni-directionally through a conduit while, at the same time, a whirling or spiral motion is imparted to the liquid so that the particles to be separated move toward the conduit wall in which there is a discharge opening through which the particles escape into an annular chamber or compartment surrounding the conduit and discharge opening, this compartment being of convolute formation with means for delivering water tangentially to the interior of the convolute compartment adjacent the narrow end thereof while adjacent the wider portion of the compartment there is a discharge opening for removal of separated matter accumulating in the compartment. The tangential disposition of the means for delivering the water to the compartment is so disposed as to insure the water and particles of matter suspended therein in the compartment moving circumferentially of the compartment in a direction from the narrow portion toward the portion of greater width where the discharge opening is located.

With these and other objects in view, the invention consists in certain details of construction and combinations and arrangements of parts, all as will hereinafter be more fully described and the novel features thereof particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is a side elevational view of the apparatus with a portion of the conduit broken away;

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Fig. 2 is a sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view on the line 3—3 of Fig. 2;

Fig. 4 is a sectional view taken axially of the conduit and showing a collecting compartment in cross-section; and

Fig. 5 is a detail view on the line 5—5 of Fig. 2.

Generally, the present apparatus may be described as consisting of a conduit 10 composed of a plurality of pipe sections through which the liquid carrying, in suspension, the particles to be separated flows uni-directionally, the liquid having a spiral or whirling motion imparted thereto preferably by a spiral motion imparted within the conduit. The spiral 11 terminates at an annular discharge opening 12 in the conduit and the heavier particles, which, at that time, are traveling along the wall of the conduit due to the whirling action of the liquid, will escape or be discharged into an annular chamber 13 surrounding the conduit and said discharge opening. As shown in Fig. 1, and as previously stated, the body of liquid has a unidirectional flow through the conduit in advance of the discharge opening 12 so that it is the centrifugal force that effects the discharge of the heavier particles as distinguished from an apparatus wherein there is a reversal in the direction of flow for the purpose of assisting in effecting the separation of the heavier particles. After the liquid has passed the discharge opening it is, in a sense, immaterial if the direction of flow thereof is altered because the separation of the heavier particles is accomplished at the discharge opening 12.

The chamber 13 into which the particles are discharged through the outlet 12 is of continuous annual formation but, as best illustrated in Fig. 2, this compartment is of convolute form having a shoulder 14 at its widest portion in which there is formed a discharge opening 15. Adjacent this shoulder but adapted to discharge into the narrower portion of chamber 13 there is a water supply line 16 which communicates with the narrower portion of chamber 13 through an entrance slot 17 that extends the full width of the chamber. This entrance slot 17 is arranged tangentially of the chamber wall so that liquid entering the chamber through said slot will be directed circumferentially of the chamber in the direction in which the chamber widens. In other words, the incoming liquid will be directed from the entrance slot 17 around the gradually widening chamber so that the particles of material entering the chamber through conduit discharge

12 at any point around the conduit will be caused to move in that direction until they gradually reach the discharge 15. As previously stated, chamber 13 is of continuous annular formation and, while the space between shoulder 14 and conduit 10 is comparatively narrow, nevertheless the separated particles will be unable to bridge this space and thus obstruct any portion of the discharge opening 12 by reason of the fact that water from supply line 16 may be continuously circulated in the annular chamber. Thus, the continuous whirling of the contents of the volute or chamber 13 and the self-clearing action which is maintained therein cannot be interfered with or prevented by any clogging or choking up of the narrow portion thereof. Also, by having the chamber 13 in the form of a volute there is a gradual slowing down in the velocity of the whirling particles as they move toward the outlet 15.

In the preferred construction the discharge opening 12 is formed in the wall of the conduit by having the juxtaposed ends of two contiguous sections of the conduit beveled to form a slot or opening that is flared in the direction in which the body of liquid moves through the conduit. For instance, as shown in Fig. 4, the end of one section is beveled on its inner surface, as at 18, and the end of the other section is beveled on its outer surface, as shown at 19, and these two beveled surfaces overlap one another but are spaced apart to provide an opening of the desired size. Furthermore, it is preferred that the size of this opening be capable of being adjusted or regulated for different operating conditions, for instance, for the separation of particles of different sizes, depending upon the nature of the material being treated. To simplify this matter of adjusting the width of discharge opening 12, compartment 13 is formed essentially of two side members 20, 21, mounted, for instance, by welding on the respective ends of the two contiguous pipe sections between which the discharge opening 12 is formed and an intermediate member or spacer 22 against which the side members 20, 21, are clamped by bolts 23. By simply utilizing shims 24 between the central or spacer member 22 and the two side members 20, 21, or by using intermediate spacer members 22 of different widths, the two conduit sections between which the entrance slot is formed may readily be adjusted toward or from each other to vary the width of the discharge opening or slot 12.

In the operation of the present apparatus a very dilute mixture of water and pulp in approximately proportions of about 0.5% of pulp and 99.5% of water is pumped through the conduit 10, the speed through the spiral 11 being such as to impart a centrifugal force to the mixture such as will separate the particles of sand, the water and the pulp into three theoretical layers radially of the conduit. The sand being the heavier will cling, so to speak, to the wall of the conduit and, while, in practice, no such concise divisions or separations would occur, nevertheless, the particles of sand will be positively thrown against the wall of the conduit and gain the correct centrifugal force and the correct forward motion in the conduit so that it will be discharged through the discharge opening 12. In the particular design illustrated in the drawings, 500 gallons of liquid is pumped through the conduit per minute with a forward velocity in the spiral of 6 feet per second which is calculated to impart a centrifugal force to the liquid equivalent to 48 times that of gravity, under which circumstances the

sand will advance along the wall of the conduit until it reaches the discharge outlet 12 through which it is discharged into the compartment 13 filled with water from the water supply line 16. This explanation is given because the present apparatus has been designed primarily for removal of fine sand particles from pulp but it will be realized, of course, in dealing with low grade pulp, before the pulp is beaten in the usual pulp beaters, it is entirely possible to separate or classify the pulp itself with the present apparatus. In other words, low grade pulp before it is treated in the beaters contains heavy pieces or particles and these can be separated from the smaller or lighter particles in the same manner as the sand is removed in the already described operation of the device.

Preferably, sand or other particles discharged in compartment 13 is delivered through a discharge pipe 25 to a collecting chamber 26. However, the supply line 16 is provided with a valve 27 and line 26 with a valve 28 and by closing these two valves it is possible to maintain a static condition in compartment 13, if desired. Discharge line 25 may also be provided with a water supply connection 29 having a control valve 30 therein and a vent line 31, having a control valve 32 therein, and collector chamber 26 is also provided with a discharge line 33 having a control valve 34 therein, so that by opening valve 34 and the valve 30 in water supply line 29, the collector chamber may be flushed out with a positive water supply. On the other hand, by opening valve 34 and valve 32 in vent line 31 the collector chamber 26 may be emptied by gravity. It will be understood that when thus cleaning out collector chamber 26, valve 28 should be closed. Collector chamber 26 might be provided with one or more sight openings (not shown) in order to permit inspection of the interior thereof to determine the amount of material collected therein, although, in practice, the operators of the apparatus will soon learn how often the collector chamber 26 has to be emptied, depending upon the type of pulp being treated.

While the apparatus can be operated with valve 27 in the supply line 16 and valve 28 in the discharge line 25 closed, leaving a static condition in said compartment 13, it is believed preferable to have these two valves and valve 34 cracked open, thus allowing a small flow of water into and out of separating compartment 13 and the collector compartment 26, it being understood that the amount of flow is adjusted so that the amount of water discharged from compartment 13 is compensated for water entering the same from pipe 16, with the result that no liquid is taken from the main conduit 10.

What is claimed is:

1. In an apparatus for centrifugally separating particles of matter from a liquid carrying said particles in suspension, a conduit through which the liquid is flowed unidirectionally, means for imparting a whirling motion to said liquid flowing through said conduit whereby the heavier particles will be forced toward the wall of said conduit, said conduit wall having an annular opening through which particles adjacent said wall are discharged, an annular compartment surrounding said discharge opening, said compartment being of convolute formation circumferentially of the conduit, a valve controlled discharge line for said compartment at the wider portion thereof, said compartment having an outer wall formed with a tangential passage en-

tering the narrow portion of the convolute compartment, a water supply line connected to said passage and a valve for controlling the flow of water through said supply line.

2. In an apparatus for centrifugally separating particles of matter from a liquid carrying said particles in suspension, a conduit through which the liquid is flowed unidirectionally, means for imparting a whirling motion to liquid flowing through said conduit whereby the heavier particles will be forced toward the wall of the conduit, said conduit wall having an annular opening therein through which particles adjacent the wall are discharged, an annular compartment surrounding said discharge opening, said compartment being of convolute formation circumferentially of the conduit with a shoulder formed in the compartment at the point of maximum width radially of the conduit, a discharge opening in said shoulder, and an entrance passage formed in the wall of said compartment through which water is communicated from a supply line into said compartment, said entrance passage extending substantially the entire width of the compartment.

3. In an apparatus for centrifugally separating particles of matter from a liquid carrying said particles in suspension, a conduit through which the liquid is flowed unidirectionally, means for imparting a whirling motion to liquid flowing through said conduit whereby the heavier particles will be forced toward the wall of the conduit, said conduit wall having an annular opening therein through which particles adjacent the wall are discharged, an annular compartment surrounding said discharge opening, said compartment being of convolute formation circumferentially of the conduit with a shoulder formed in the compartment at the point of maximum width radially of the conduit, a discharge opening in said shoulder, a water supply line for said compartment, an entrance passage through which water is delivered from said supply line to said compartment, said passage being in the form of a slot extending transversely of the compartment and arrangeed tangentially thereof adjacent the narrow portion thereof.

GASTON J. LIPSCOMB.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
767,721	Swartwout	Aug. 16, 1904
1,525,249	Mastenbrook	Feb. 3, 1925
1,845,567	Stebbins	Feb. 16, 1932
1,866,663	Morris	July 12, 1932
1,931,193	Hawley	Oct. 17, 1933
2,044,915	Mosley	June 23, 1936
2,192,214	Weir	Mar. 5, 1940
2,346,005	Bryson	Apr. 4, 1944
2,364,405	Trimbey	Dec. 5, 1944
2,377,721	Scott	June 5, 1945
2,425,110	McCurdy	Aug. 5, 1947