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# APPARATUS FOR TREATING SOLIDS, SUCH AS ORES, LIQUIDS, OR GASES.

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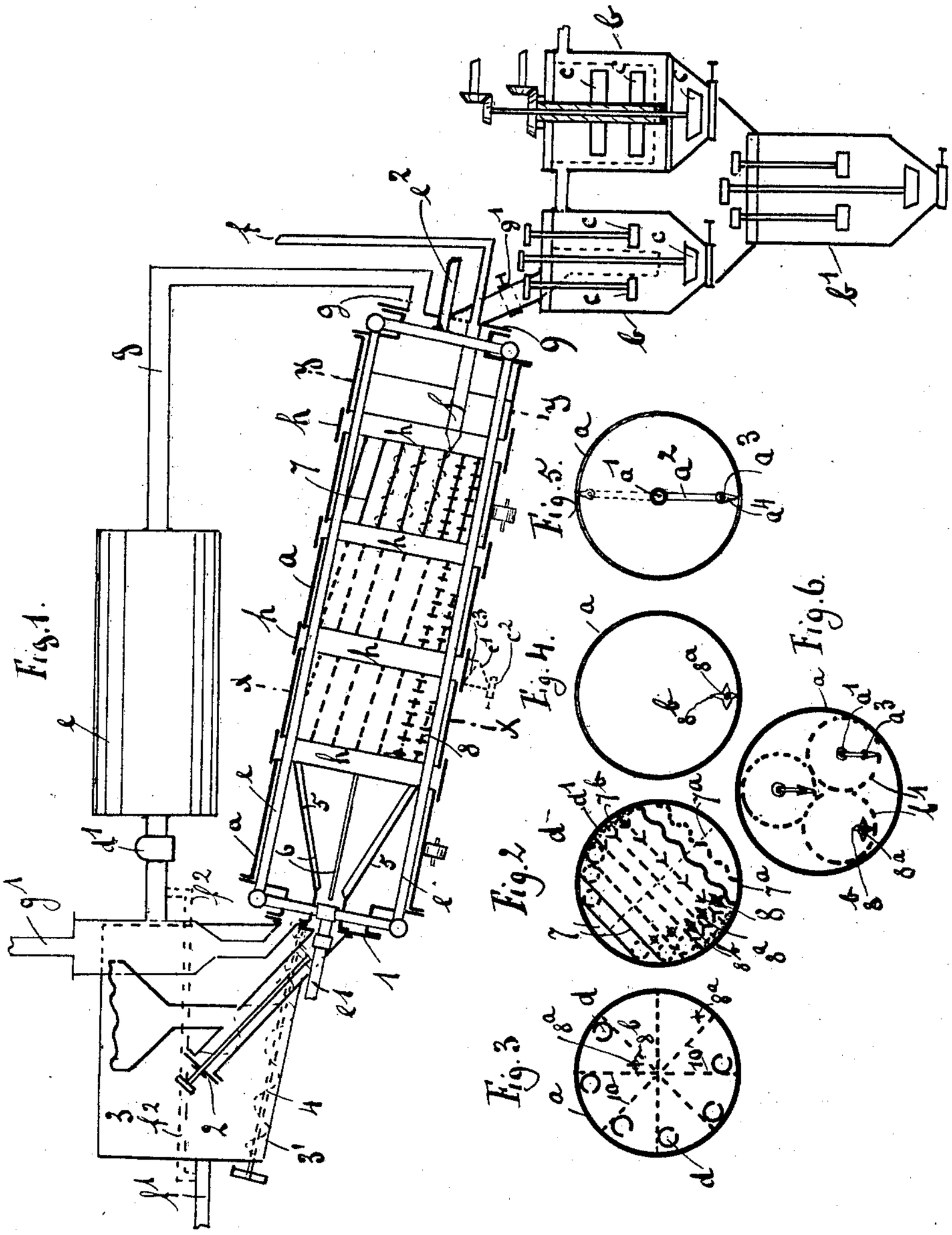
NO MODEL.

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR TREATING SOLIDS, SUCH AS ORES, LIQUIDS, OR GASES.

SPECIFICATION forming part of Letters Patent No. 756,271, dated April 5, 1904.

Application filed April 18, 1901. Serial No. 56,378. (No model.)

*To all whom it may concern:*

Be it known that I, PAUL NAEF, Ph. D., chemical engineer, a citizen of Switzerland, and a resident of 132 Woody Crest avenue and One Hundred and Sixty-fifth street, New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Treating Solids, such as Ores, Liquids, or Gaseous Fluids, of which the following is a specification.

This invention relates to improved apparatus for treating ores and other solids with liquids and gases or vapors for extracting or recovering certain of their constituent elements.

The apparatus is especially intended for the extraction of gold by cyanid or chlorin; but it is also applicable for the treatment of other materials, as for the extraction of glue from bones and the manufacture of bicarbonate of soda, &c.

The object of the invention is to provide means for moving the solid material through a liquid while the latter passes in the opposite direction to that of the solid and to bring the solid and the liquid into intimate contact with each other and with a gas or vapor.

With this object in view the invention consists in certain novel features of construction and combinations and arrangements of parts, as hereinafter set forth, and pointed out in the claims.

The drawings show a revolving cylinder *a*, supported on rollers and connected by means of a stuffing-box with a stationary cover 1 on the charging end. Solid material is fed into the cylinder *a*—for instance, by a conveyer 2. Liquor enters from the cylinder *a* into a chamber 3, having an inclined bottom 3′, on which solid material settles, and is brought back into the cylinder by a conveyer 4. In some cases I use no conveyer and incline the bottom sufficiently so that the solid flows back into the cylinder by gravitation. For the purpose of preventing overflow of materials from the charge end the conveyer 2 empties the fresh material into a funnel 5, which may have ribs 6 arranged in helicoid lines to assist the forward movement of the material. The cylinder, which is fitted with agitating devices in other parts, has no such devices in the charging end to prevent carrying over of solid with the liquor. Partitions 7 are arranged in sections and are made perforated, corrugated, or of wire-gauze. They are so arranged that they lift the material through the liquid and expose it also to the vapors or gases which may be circulating through the cylinder. The partitions also are so arranged that they move the material through the cylinder and may to further assist this be arranged in inclined position, as shown in Figure 1.

Radial partitions may be employed, as shown in Fig. 3, in which case the said partitions do not run in the direction of the axis of the cylinder on the periphery, but are bent so as to move the material.

If partitions are arranged in parallel position and longitudinal sections, each section is not arranged running in the direction of the axis, but as shown in Fig. 1. After each section the material is lifted and then passes downward over the partitions and at the same time is moved forward to be lifted and showered again by the next set of partitions. The arrangement can be applied in cylinders used for the treatment of solid material without the presence of liquids. At the lower end the cylinder is closed by a plate *g*, usually also connected to the cylinder by a stuffing-box. The liquor is with advantage conducted some distance into the cylinder—for instance, by inserting an inlet-pipe *f*, reaching into the cylinder.

The way of removing the material from the cylinder and treating it is varied according to the nature of the material. In many cases the material runs out as a sludge into a settling-tank *b*, which is fitted with a conical bottom and has stirrers *c* for preventing solidification in the lower part. Several of these tanks can be arranged side by side. The product of one or more cylinders is run into one of the tanks until it is filled. Then settling takes place as far as allowable without solidification of the solid and the clear liquor is drawn off. Afterward washing of the material takes place by addition of weak liquor or water and

afterward settling and withdrawing of liquor. Stirring appliances are arranged in the upper and lower part of the vessels, which can be independently operated. Only the lower stirring devices are operated during settling, but both after wash-water has been added.

With the arrangement described the liquor from the cylinder has to be alternately run into and through different settling-tanks. In place of this arrangement liquor can be continuously run through one or more settling-tanks, as shown in the drawings. Clear liquor leaves the last tank continuously. The solids settle in the conical bottom and solidification is prevented by running the stirrers in the conical part, which in this case are alone required. The sludge is withdrawn from the bottom of the tanks $b$ to tanks of similar construction on a lower level $b'$, where it is washed, or it is conducted to a filter-press or centrifugal machine.

Hot or cold gaseous fluids can be conducted through the apparatus by suitable inlets $g$ and outlets $g'$. Often it is of advantage to conduct the same gaseous fluid through the cylinder by a fan $d'$. A temperature-adjuster $l$, consisting of a vessel containing a pipe system, can be arranged in the pipe $g$, which returns the gas leaving the cylinder back to the same, so as to keep the temperature of the cylinder at a constant point. Ores can in this way be leached by cyanid in the presence of oxygen or of other gas. Ores can further be leached in this way by applying chlorin directly to the charge as well as to the liquor in which the leaching takes place.

The apparatus can be applied for dissolving bicarbonate without decomposing the same by effecting this dissolving in the presence of carbonic acid. The liquor thus obtained can be run continuously from the cylinder through a settling-tank and through a cylinder which may be arranged on a lower level, in which cooling takes place, carbonic acid being also at the same time passed through the apparatus. Pure bicarbonate is thus produced in a continuous and practically automatic manner.

The apparatus described finds with advantage application in the brewing industry for operations where solid materials have to be treated. Most of the operations in this industry can thus be effected in a continuous manner, the liquor flowing from one part of the plant to the other.

The cylinders offer especial advantage for heating and also for cooling beer, as the speed and degree of such operations are absolutely under control. They also offer great advantage for heating and cooling such fluids as beer in presence of a suitable gas. Cooling can, for instance, take place first in the presence of air and afterward in the presence of carbonic acid. By cooling sufficiently low a considerable amount of gas is taken up by the fluid, so that beer, for instance, can be casked in this cool state. The entire operations of the brewing industry are by these means entirely under control to obtain the best results from whatever material is used.

In the drawings, Fig. 1 shows a vertical longitudinal cross-section; Fig. 2, a section of Fig. 1 on line $x\ x$, and Fig. 3 a section on line $y\ y$. Figs. 4, 5, and 6 are modifications.

$d\ d$ are lifters, usually arranged in the form of pipes with suitable perforations for lifting and showering the liquid on the partitions 7.

The pipes $e\ e$, Fig. 1, are arranged for the purpose of heating or cooling the cylinder $a$. $e'$ is the inlet, and $e^2$ the outlet, for cooling fluid. $f$ is the inlet-pipe for liquid to the cylinder, which reaches some distance into the latter, and $f'$ is the outlet-pipe for liquid from the settling-tank. $g$ is the gas-inlet pipe, and $g'$ the gas-outlet pipe. Manholes $h$ may be arranged between the agitating-sections of the cylinder.

Fig. 3 shows the last section of the cylinder near the discharge end with radial partitions to lift and discharge the material.

If operations are to be conducted in the apparatus under pressure, the settling-tanks are fitted with tight covers. Suitable valves are arranged above and below the feed-hopper, the latter being closed while the hopper is being filled and the upper valve being closed all the time, except when filling the hopper. In Fig. 2 it is shown that the partitions can be non-perforated, perforated, corrugated. They may also with advantage consist of wire-gauze $7^a$, which may also be corrugated. In some cases the corrugations run across the cylinder. In others, especially if the material is heavy, they run longitudinally. The partitions are often with advantage fastened to a frame, as indicated by the dotted line $7^b$, in such a manner that whole sections can be pushed bodily into the cylinder. The frames may be filled with suitable rollers facing against the periphery of the cylinder, so that the sections can easily be placed.

To prevent the formation of scale on the partitions and periphery, it is, when treating some materials, of advantage to use special devices. They may consist of rods or pipes $8^a$, placed into the cylinder, which carry teeth $8^b$ to facilitate the removal of crust. These pipes may extend through the entire cylinder or be placed extending through each section of partitions.

Fig. 4 shows an empty cylinder with rod $8^a$ and teeth on the latter, $8^b$. As the shell revolvs the rod also begins to revolve, remaining at the same time in the lower part of the cylinder in a position depending on the speed of the periphery-surface moving under it. In Fig. 3 rods having teeth are shown between the radial partitions. As the cylinder revolves the rods slide on the surfaces, thus keeping par-

titions as well as periphery clean. In Fig. 2 rods $8^a$, having teeth $8^b$, are shown between the parallel partitions, on which they slide when the cylinder gets into a certain position alternately on one side of the surface and afterward on the other. In Fig. 2 it is further shown that the partitions can carry projections 9′, which act as lifters and can eventually replace the lifter *d*.

Instead of placing the rods $8^a$ in cylinder loosely guides can be arranged which allow only movement in certain directions, which may, for instance, be controlled by a slot in which the rods run. It is in this way possible to keep the rods and teeth a short distance from the surfaces and prevent wear and tear. If the surfaces are of round or nearly round cross-section, the arrangement shown in Figs. 5 and 6 can be adopted.

Fig. 5 shows a shaft or rod $a'$ arranged in the center. On the shaft are hangers $a^2$, which carry another rod, $a^3$. On the latter numerous teeth $a^4$ are fastened in suitable manner, usually in such a way that they revolve freely on the rod $a^3$. The hangers $a^2$ are usually also loose, and their weight causes them to hang nearly perpendicular, the teeth being stationary and the cylinder moving. The rods $a^3$ are usually arranged in short sections. In smaller cylinders they can be avoided, teeth being placed on shaft $a'$. The arrangement can be so changed that the pieces $a^2$ are fastened tightly on the shaft $a'$. The latter is then revolved, preferably, in a direction opposite to the one of the cylinder. A good agitation is thus effected and the surfaces are kept clean. The pieces $a^2$ can reach right across the cylinder, as indicated by dotted lines. They can be arranged alternately at right angles to each other.

Fig. 6 shows a cylinder in which round surfaces, such as pipes $b'$, are arranged, which are preferably perforated. In these pipes are arranged agitating and cleaning devices. They may consist of a loose rod $8^a$ with spikes $8^b$, as shown, or of an arrangement similar to the one shown in Fig. 5. $a'$ is a stationary or revolving shaft to which are fastened suitable scraping devices. The latter are fastened usually direct on $a'$ and hang perpendicularly if the shaft is stationary, or they are fastened to a rod $a^3$, as described.

The sets of parallel partitions are with advantage radially offset, each set being in a different position than the adjoining set.

The apparatus can with advantage be adapted for the separation of materials of different specific gravity. Such separation can be effected before the material enters the cylinder as it passes through it and also after it has left it. Separation before the entrance is effected by arranging tanks of the same construction as *b*. Material is charged into one of these tanks, and agitation is kept up sufficiently to settle only heavy material which has to be separated and which can be drawn off from the bottom.

If several tanks are used successively, materials of various specific gravity can be separated in the different tanks. If gold ore has to be treated, a material can be separated in these tanks holding most of the coarse gold in concentrated condition. By discharging the same into a tank, as $b'$, much of the coarse gold can be separated as such. Only material of great fineness enters the cylinder, whereby leaching is greatly accelerated.

By running the product from the cylinder through the tanks *b* and suitably adjusting the agitation again a most accurate sorting of material can take place according to specific gravity. The last traces of gold or concentrates can here be collected in one or more tanks sufficiently agitated to allow only them to settle. They are removed as already described.

In regard to separation of material of various specific gravity in the cylinder it can be effected by placing pockets on the circumference. Such pockets can encircle the cylinder. They may consist of a casing $c'$ with doors or valves $c^2$ for withdrawing the material. Plate $c^3$ with suitable openings allows the heavy material to enter the pocket $c'$, from which it is flushed from time to time through the valves $c^2$. A number of these pockets can be arranged.

In washing material such as coal and clay sufficient liquor is often circulated to carry the good material into the tank 3, which is then arranged in the same manner as tanks *b* or which leads to suitable screens. The heavy material passes in this case from the lower end of the cylinder, which can often be made shorter. The same liquid is used over again. It can, for instance, be returned by pipe $f^2$ to pipe *g*, no vessel *e* being required. By adapting the speed of the cylinder and the agitating devices, also the speed of the liquor, large quantities are cheaply separated, the heavy materials passing from the lower end and the light material from the upper end. Pyrites, concentrates of various ores, metals such as copper, gold are in this manner separated from rocks.

It is not always necessary to incline the cylinder from the charging to the discharging end. It can be sometimes with advantage horizontal, and sometimes it is better to charge the solid at the lower end in the same manner as shown, the funnel being then placed at the lower end. If gaseous fluid is conducted through the cylinder by a suitable blower, the agitation is improved and less liquid is required for the separation.

If especially good leaching is required, I arrange several cylinders in such a manner that liquid and material passes successively

through them, preferably in opposite direction. If concentrates are to be separated, I place a settling-tank, as described, between each cylinder.

The cylinders can be operated discontinuously. They are constantly rotated, filled with liquor and solid, as shown, and afterward emptied by opening valve $g'$. A gaseous fluid can be passed through the cylinder at the same time.

As shown in Fig. 2, the partitions 7 can carry projections $7^b$, which act as lifter. These projections can be arranged all over the surface. They lift more liquor than the ribs.

I do not confine myself to any particular kind of interior arrangement, as this is varied according to the material treated. In some cases suitable cross-partitions are arranged between the sections of perforated partitions, with suitable openings to guide the flow of solid and liquid in a zigzag way.

For the purpose of strengthening the perforated surfaces they may be fastened to carrying-rods, which form part of a frame which carries each set of partitions and may be movable, as described. In some cases the carrying-rods to which the partitions are fastened are held by suitable brackets on the periphery of the revolving cylinders.

For the purpose of strengthening the surfaces and also for the purpose of making the apparatus more efficient I sometimes arrange partitions which intersect the parallel partitions at a right angle, as indicated by dotted lines $7^b$ in Fig. 2. Instead of partitions rods may be run in the same direction, which form part of the frame carrying the surfaces.

The apparatus can be adapted to the purification of gaseous fluids or vapors by bringing them in contact with a liquid-purifying agent or a liquid-holding solid in suspension. The amount of liquid in the apparatus is varied according to the material treated. Pipe $f$ is arranged in central position if radial partitions are used.

Having described the nature of my invention, what I claim is—

1. In combination with an apparatus for treating liquids and solids, a settling-tank, an inclined bottom on said tank and means to run sludge from said tank, back to the apparatus.

2. In combination with a revolving cylinder, means for passing liquid through the same, means to separate solids from the product leaving the cylinder and automatically returning the same to the cylinder.

3. The combination with a rotary apparatus, of a funnel located within one end thereof and rotatable therewith, means for feeding solid material to be treated, into the rotary apparatus through said funnel, and means for introducing fluid into said rotary apparatus.

4. In combination with a revolving cylinder, a funnel in the same near one end thereof, means for feeding solids into the funnel from the end of the cylinder and means to conduct liquor from said end.

5. The combination of a funnel-shaped pipe reaching into an apparatus, means for feeding solids into the same and means on said funnel, such as suitable ribs to insure the forward passage of the solids.

6. In combination with a revolving cylinder sets of parallel partitions and open spaces between said sets.

7. In combination with a revolving cylinder, means for passing a liquid and a solid into the same and perforated partitions arranged in such position as to effect a forward movement of the solid independently of the position in which the cylinder is disposed.

8. In combination with a revolving cylinder, perforated partitions arranged at an angle to the longitudinal and transverse axes of the cylinder, so as to effect a forward movement of solid material.

9. In combination with a revolving cylinder, perforated plates arranged diagonally with respect to the longitudinal axis of the cylinder in separate sets.

10. In combination with a revolving cylinder, a liquor-pipe and a gas-pipe communicating with one end of the cylinder and a discharge for solids at the same end thereof.

11. In combination with a revolving cylinder longitudinal bars carrying cleaning devices, such as spikes in the interior thereof.

12. In combination with a revolving cylinder surfaces in the interior and longitudinal bars carrying cleaning devices moving on said surfaces.

13. The combination of a revolving cylinder, perforated partitions dividing the cylinder into compartments and devices for cleaning the surfaces in each compartment.

14. The combination of a revolving cylinder divided into compartments in the interior and a bar carrying cleaning devices in each compartment.

15. In combination with a rotary apparatus bent surfaces in the interior and a loose bar carrying cleaning devices moving on said surfaces.

16. The combination of a revolving cylinder, parallel partitions and devices between the latter to clean the surfaces.

17. The combination of a revolving cylinder, longitudinal parallel perforated surfaces and means to keep said surfaces clean.

18. The combination of a revolving cylinder parallel surfaces in the interior and loose rods carrying cleaning devices between said surfaces.

19. The combination of an apparatus, means to pass a solid and a liquid through the same and means to circulate gaseous fluid through the apparatus and a temperature-adjuster the same fluid circulating several times.

20. The combination of an apparatus, means to pass a solid and a liquid through the same, means to circulate liquid through the apparatus and a temperature-adjuster.

21. The combination of a rotary apparatus, perforated surfaces and projections on said surfaces, which act as lifters.

22. In combination with a rotary apparatus means to separate material according to specific gravity.

23. In combination with a rotary apparatus, means to conduct liquid and solid through the same, means to separate solids from the liquid at each end means to return the liquid.

24. In combination with a rotary apparatus, means to pass solid and liquid through the same, means to pass gaseous fluid through the same and means to separate solid from the liquid at each end of the apparatus.

25. The combination of a series of apparatus, means to pass solid and liquid successively through the same and means to separate heavy material from the lighter material as the mixture passes from one apparatus to the other.

Signed at New York, in the county of New York and State of New York, this 17th day of April, A. D. 1901.

PAUL NAEF.

Witnesses:
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