C. ALLEN.

SLIME SEPARATOR AND CLASSIFIER.

APPLICATION FILED SEPT. 7, 1909.

949,560.

Patented Feb. 15, 1910.

3 SHEETS—SHEET 1.

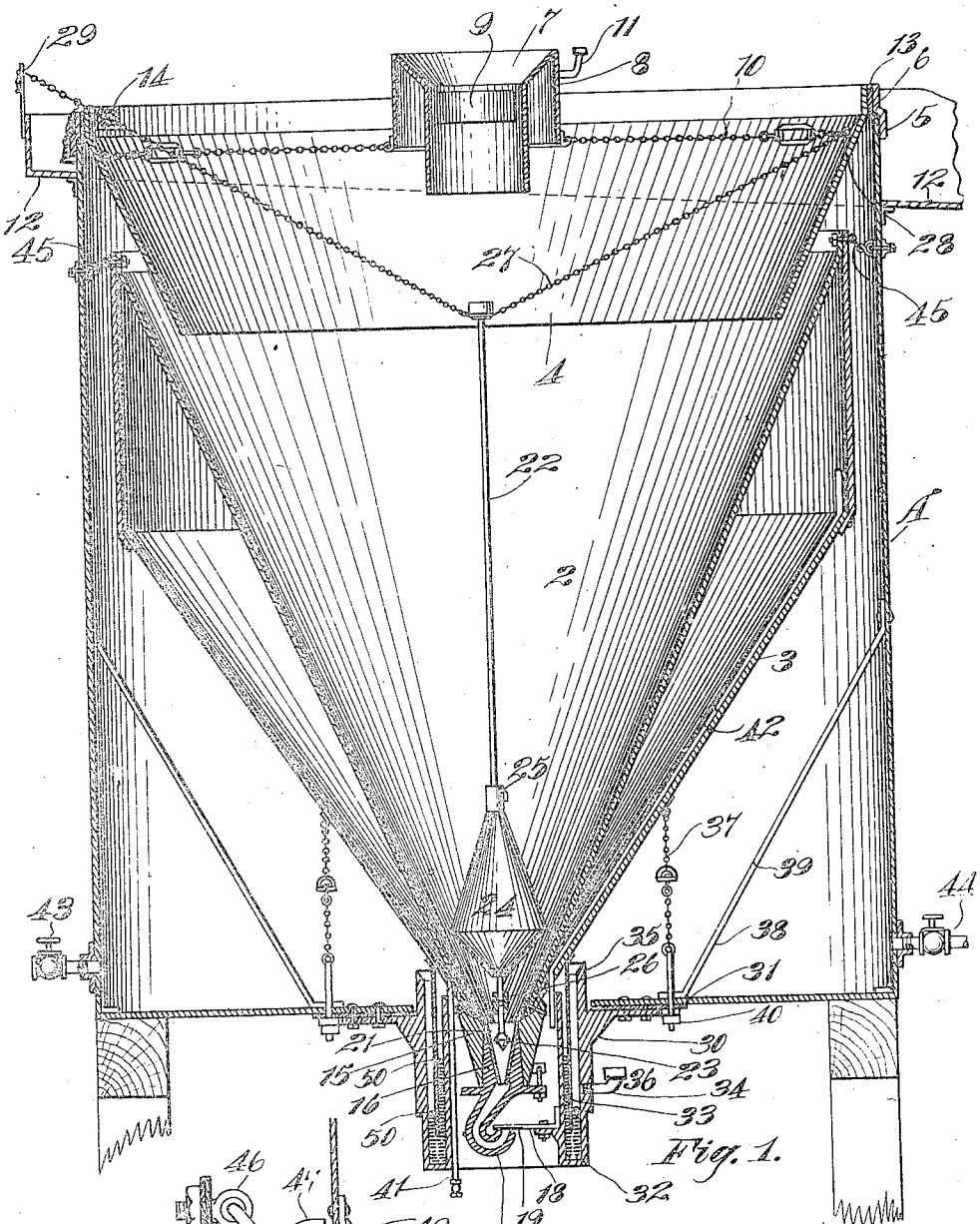

Fig. 1.

Fig. 4.

WITNESSES:

G. E. Maynard.

C. A. Penfield

INVENTOR:

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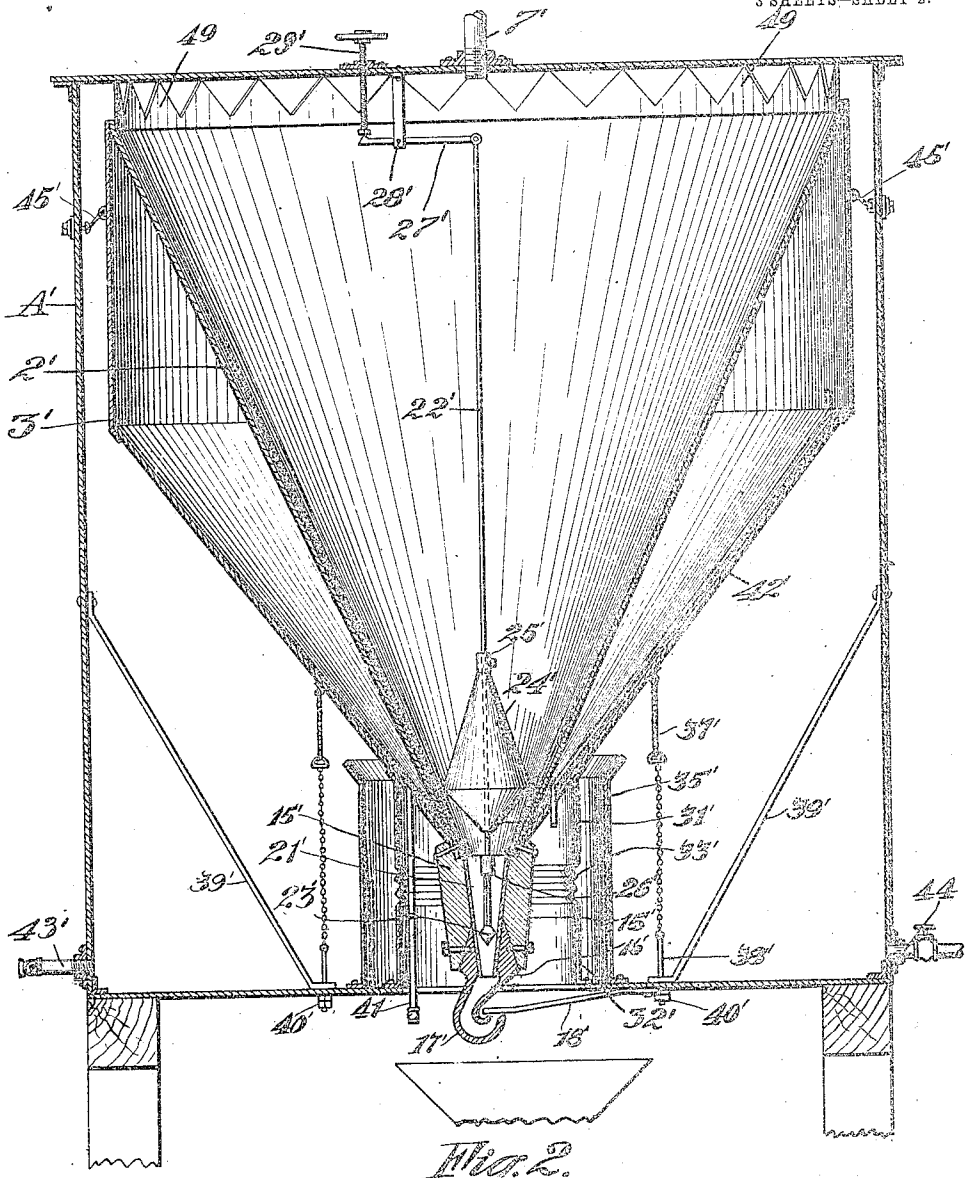

Fig. 2.

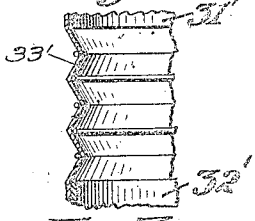

Fig. 3.

WITNESSES

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3 SHEETS—SHEET 3.

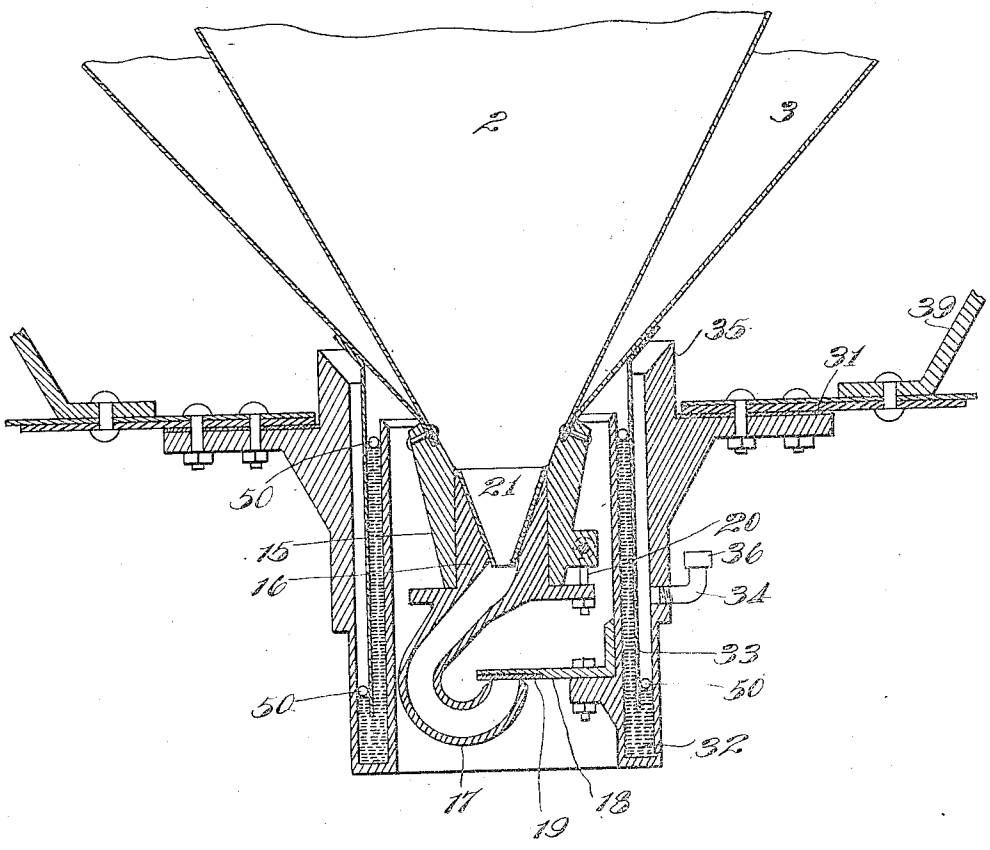

Fig. 5.

WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES ALLEN, OF EL PASO, TEXAS.

SLIME SEPARATOR AND CLASSIFIER.

948,560. Specification of Letters Patent. Patented Feb. 15, 1910.

Application filed September 7, 1909. Serial No. 516,559.

To all whom it may concern:

Be it known that I, CHARLES ALLEN, citizen of the United States, residing at El Paso, in the county of El Paso and State of Texas, have invented new and useful Improvements in Slime Separators and Classifiers, of which the following is a specification.

My invention relates to a pulp supporting and classifying apparatus of the general type shown in my former application, Serial No. 477,188, filed Feb. 10, 1909.

The objects of the invention will more fully appear hereinafter.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a sectional view representing an open top immersed cone machine. Fig. 2 is a modification representing a closed-top machine embodying the invention. Fig. 3 is a detail in section of a form of flexible diaphragm. Fig. 4 is a detail of the means for limiting the side motion of the top of the cone. Fig. 5 is a detail of part of the mechanism of Fig. 1 on an enlarged scale.

Referring to the open type of tank shown in Fig. 1, A represents a tank of any suitable description adapted to contain water or other suitable liquid, and 2 is an immersed cone in floating suspension in the tank, and here shown as provided with the annular buoy 3 attached to the cone.

4 is a shield shown in the form of a truncated cone and provided with a rim or flange 5 at the top adapted to slip over the top edge of the tank A; a piece of blanket, or rubber sheeting, or other suitable gasket, represented at 6, being inserted between the edge of the tank and the under side of the overhanging flange 5 to form a tight joint. This truncated cone 4 projects for a short distance into, but does not touch, the immersed cone 2, nor does it interfere with the vertical movement of the latter; it being understood that the cone or receptacle 2 is essentially free to fall and rise in the liquid-containing tank A, according as the weight in the receptacle is added to, or diminished. The purpose of the conical shield 4 is to employ the full radius or width of the containing tank A as a settling area, by preventing solid particles from settling between the tank and the immersed cone; the loose telescoping action of the cone within the shield providing for this.

The material to be classified is fed into the receptacle by any suitable means and in any suitable manner. As here shown, 7 is a floating hopper by which the pulp stream is conducted into the cone, this hopper being being suitably buoyed up by the air chamber 8 carried by the hopper.

9 is a wooden float or block upon which the entering pulp stream impinges, so as to prevent undesirable currents in the settling receptacle. This floating hopper is held in position by the chains 10. The buoyancy of the hopper may be varied by admitting or discharging air into or from the air chamber 8 through a suitable normally closed air inlet 11.

12 is a launder surrounding the tank to conduct away the clarified water.

13 is a ring or band of lead, wood, or other suitable material, secured around the lip of the hopper or discharge edge from the top of the tank, and which ring or rim can easily be dressed or rasped down, so that in setting up the tank, or in case the tank settles, the edge can be dressed to a true horizontal, so as to insure a uniform discharge of clarified water at all points. I prefer to use a strip of lead because it is easily worked and neither shrinks nor swells.

If desired, a strip 14 of porous material, such as cloth or the like, may be hung around the discharge edge of the tank, the strip projecting into the water in the cone a short distance, say three or four inches, and overhanging the outside of the tank a distance of six inches, more or less, thus forming a siphon by capillary attraction, to draw off the clarified water.

The discharge of the settled solids in the cone takes place at the bottom thereof, and is controlled by the following means: The apex of the cone has riveted, or otherwise secured to it, a casting 15 which surrounds the outlet, and in this casting is removably secured a plug 16 having a discharge spout 17 through which the discharge of the settled matter in the cone takes place. The spout 17 is of suitable shape and construction, and is preferably here shown as curved, with its mouth portion approximately in the line of the axis of the cone, and this mouth portion is adapted to coact with a fixed plate 18 which carries on its under side a suitable packing 19. The nat-

ural buoyancy of the cone under normal conditions will carry the mouth of the spout 17 up against the packing 19 and close the outlet from the cone. When the cone sinks, the spout 17 moves down with it and away from the valve plate 18, thereby uncovering the outlet from the cone and allowing discharge to take place. Any suitable means may be employed to hold the plug and spout in position. As here shown, I employ the eye-bolts 20 carried by casting 15 fitting perforations in a flange on casting 15, with tightening nuts screwing on to the bolts. This forms a firm attaching means, and at the same time it enables the spout and plug to be easily removed and renewed or replaced, as where it is desired to vary the size of the discharge nozzle. The plug where it fits into the casting or seat 15 is preferably cone-shaped to facilitate its removal.

In order to prevent the discharging material from spurting as it issues from the nozzle underneath the plate 18, I employ the following means:

21 represents a funnel suitably seating in the bottom of the cone and having a more or less restricted discharge into the nozzle 17. By changing these cones and using cones with different sized outlets at the bottom, I can vary the rate of discharge from the cone, without any need for changing either the nozzle 17 or any of its parts or attachments. The funnel 21 may or may not be fastened in position, since ordinarily it will be held in position by its own weight and the downward force of the overlying material. Coacting with the outlet of the funnel 21 is a rod 22 having a conical projection or head 23. This rod may be supported in any suitable way, so that normally with the nozzle close up against plate 18 the head 23 will touch the sides of the funnel 21 and form a supplemental closure to the discharge from the cone. When the immersed cone sinks, the head 23 will remain stationary, and an annular opening will be formed around it and between it and the inside of the funnel 21, through which the settled material may pass into the nozzle 17 and thence be discharged into any suitable receptacle outside the apparatus. The area of the contracted discharge opening of the funnel 21 into the nozzle is less than the area of the discharge passage in the nozzle 17; thereby operating to remove the hydrostatic pressure from the outlet, and thus preventing spurting of the discharging material. This is important, especially where the material is very fluent.

Where working with heavy slimes, and especially sticky material, the rod 22 adjacent to the anti-spurting device 23 may be provided with an adjustable double-ended cone or block 24 which will coact with the contracted lower end of the cone to cause the solids to draw off from all parts of the settled mass, instead of drawing from the center only, as would occur if this spreader 24 was omitted. Suitable means, as the clamp collar and set screw 25, may be employed to adjust the height of the conical spreader 24 on the rod, and similarly, the anti-spurting head 23 may be made adjustable by suitable means, as the turn-buckle 26. Any suitable means may be provided for suspending the rod 22 and its spreading and anti-spurting connections. As here shown, in the open-topped type of machine, Fig. 1, it is carried on the chain 27, one end of the chain being secured at 28, and the other end extending over the outside of the tank and being adjustably engaged in its links by a pin 29. This method of freely suspending the rod 22 is preferred, since it permits it to move freely horizontally in all directions, thereby allowing it to swing to one side and double the average width of the space between either the spreader 24 or the anti-spurting device 23, and the side of the cone, should it be necessary to permit coarser particles to pass.

The lower end of the cone projects through the bottom of the tank, and the water is retained in the tank by any suitable means which will provide for the proper maintenance of the cone in floating suspension and allow for its proper rising and falling movements, and permit of the operations dependent on such movements. As here shown, I employ a cylindrical casting 30 suitably fixed to the bottom of the tank around the outlet opening therein and suitably packed, as shown at 31. This casting has an annular mercury cup 32 in which a cylindrical member or rigid diaphragm 33 carried by the cone and surrounding the outlet and nozzle is adapted to operate. This cup or pocket 32 is filled to a sufficient depth with mercury through an ordinarily capped inlet 34. The casting has an upwardly extending annular flange or cylinder 35 with its upper edge beveled corresponding to the pitch of the cone, and this beveled cylinder 35 is adapted to form a seat to support the cone when the latter settles to its lowermost position and uncovers its outlet through nozzle 17. When the machine is set up with the cone resting on the beveled cylinder 35, and before the addition of water either to the cone or to the tank, the cap 36 is removed from the inlet 34 and mercury is poured into the pocket 32. Preferably the mouth of this inlet or nipple 34 is placed at such a level that by filling the pocket 32 until the mercury shows at the top of the nipple, the proper quantity of mercury will be used so as to insure a proper seal under all ordinary working conditions for that particular machine.

After adding the mercury and replacing the cap 36, the tank A and cone 2 are simultaneously filled with water. As the water rises in the tank A it will by its pressure force the mercury on the opposite side of the cylinder diaphragm 33 to a higher level, at the same time lowering the surface of the mercury on the side covered by the water; but it is understood that the quantity of mercury in the pocket 32 is always sufficient to maintain a tight water seal in the tank. The mercury forms a trap that retains the water in the tank at all times, while permitting a free vertical movement of the cone and its partition cylinder 33. This construction of partition cylinder 33 and mercury seal permits of a practically frictionless vertical movement of the immersed cone.

Suitable means, as the adjustable chains 37, may be employed to limit the upward movement of the immersed cone, as otherwise damage might occur to the parts controlling discharge from the cone. These chains 37 are attached to the cone and carry eye-bolts 38 which project through the bottom of the cylinder at the feet of the braces 39. By screwing up simultaneously on all of the nuts 40 the cone may be pulled down and made to discharge its contents independent of the load within the cone; and by drawing the cone down far enough so that it is brought in tight contact with and rests on top of the casting 30, the water can be maintained in the tank temporarily independent of the mercury seal, and so allow for the replacement and repair of the valve plate 18 or the parts 21—15—16, or the refilling of the mercury cup. When the repairs or replacements have been made the nuts 40 are slackened, allowing the cone to rise until the mouth of the discharge nozzle contacts with the under side of the valve plate 18.

41 is a pipe for admitting water to the air chamber 3 to vary the buoyancy of the cone, and 42 is an air outlet therefor. 43 is an inlet for water for filling the tank A, and 44 is a draw-off cock therefor.

50 are rows of iron balls floating on the mercury to center the lower end of the cone.

In order to limit the lateral movement of the top of the cone, I may provide the chains or links 45 connected to the cone at suitable intervals around its circumference by the eye-bolts 46. The outer ends of these chains connect with the swivels 47, through each of which passes a screw-headed threaded bolt 48. Each bolt 48 is threaded into a threaded casting 49. By screwing up or loosening more or less on the bolts 48, the movement of the cone within desired limits may be regulated; the connections being sufficiently flexible to permit of the desired action.

In operation, the cone and tank are filled with water. The pulp stream is conducted into the suspended cone through the floating hopper 7 until the desired depth of settled material is over the outlet 17—18. Sufficient water is let into the air chamber 3 through the valved pipe 41, the air escaping through pipe 42 until the cone and its contents are in equilibrium, the pulp stream being again conducted into the cone. The solids settle to the bottom of the receptacle and the water flows over the edges of the cone into the tank A and thence out at 12. The motive force that actuates the machine is the difference in the specific gravity of the substances, such as sand and water, fed to the machine. As the sand or other particles having a specific gravity greater than water settle to the point of the cone they accumulate until they cause the cone to sink; this vertical movement being possible by reason of the mercury seal or equivalent means employed to keep in the water in the tank and at the same time allow for the proper rise and fall of the cone. As the cone sinks under the weight of the accumulating solids, the discharge nozzle 17 is moved away from the valve plate 18, allowing the settled solids in the cone to be discharged until the buoyancy of the float 3 overcomes the weight of the cone and its contents, when the cone rises, closing the outlet automatically.

It is to be observed that the settling-cone is freely suspended in the liquid in tank A, and that the movement of the cone is independent of the means by which it is suspended or supported. This liquid balance gives a sensitiveness not possible in machines using a rigid connection or ordinary fulcruming action. The immersed cone adjusts itself until the same quantity of solids is passing out as is being settled in the cone, regardless of the quantity of water and slimes entering the cone. The discharge from the cone through 17 varies with the change in the feed, but with a uniform feed the same depth of settled material will be maintained over the outlet, and the depth of the settled material in the cone determines the quantity of water passing out with it, and this depth is determined by the buoyancy of the air chamber 3. The full hydrostatic pressure assists the discharge from the cone, so that the outlet does not choke, either by a sudden inflow of sand, or standing closed. The discharged material is sufficiently freed from water for direct conveyance to tube mills.

The capacity of the machine is the clarifying capacity of the radius of the tank A. Regardless of size, the immersed parts are never far removed from equilibrium. For this reason, inertia is almost absent. The only movement being a short, slow rising or

sinking of the immersed cone, the friction is exceedingly slight. As there are no fulcrumed parts the machine is very sensitive, a few pounds actuating it, although the actuating force of a large machine may exceed 2000 pounds, and the buoyancy of the air chamber exceeds 5000 pounds. Once adjusted, the machine is automatic in operation.

In Fig. 3, I have shown a modification of the invention as applied to a closed top machine. In this case the tank A′ is closed at the top, and the upward movement of the suspended cone 2′ is limited by contact of the points 49 with the under side of the closed top. In this case the rod 22′, having the head 23′ and spreader 24′, is suspended from a lever 27′, which latter is fulcrumed on a fixed bracket 28′. 29′ is an adjusting screw acting on lever 27′ for regulating the size of the discharge outlet for the settled material. In this case instead of using the mercury seal 32 and partition member 33, of Fig. 1, to retain the water, I employ an equivalent construction in the form of a flexible diaphragm 33′ connected at its ends to the upper and lower flanges 31′—32′ carried, respectively, on the under side of the cone, and the upper side of the bottom of the tank. This flexible diaphragm 33′ is of any suitable impervious material capable of keeping the water in the tank, at the same time allowing the immersed cone to rise and fall under its variations of load. Preferably this diaphragm has a length but slightly in excess of the maximum movement of the immersed cone. This diaphragm or flexible ring may, if necessary, have rigid hoops embedded in the woven flexible material to prevent the ring collapsing under a great pressure in the tank.

In order to limit the downward movement of the cone, and also form a means of supporting the cone to permit of replacement or repair of the diaphragm without having to empty the tank, I may employ a cylinder 35′ supported on the bottom of the tank A′, with the upper edge of the cylinder 35′ beveled to form a seat for the cone when the latter sinks to a certain level. By tightening the nuts on the eye-bolts 38′, the cone can be lowered until it seats tight on the end of the cylinder 35′, and keep in the water while repairs or replacements are made. This closed type of machine is principally used and was principally designed to classify the solid particles into finer and coarser separated particles. A stream of water conveying the solid particles is admitted through 7′ where it meets an upwardly flowing current of water that enters the tank A′ at 43′; cock 44′ ordinarily being closed. The quantity of water admitted at 43′ determines the velocity of the rising current through 7′, and this velocity through 7′ determines the size of the solid particles which by their own weight can sink through this ascending current in 7′ into the immersed cone beneath, being discharged automatically from the latter by the rise and fall of the cone, as previously described. The solid particles which do not have sufficient weight to sink through the upward current of water in 7′ flow on over the inlet of 7′ and are separately collected by means not necessary here to be shown. Thus the pipe 7′ classifies out the coarser particles, and similar mechanism may be employed farther down to classify out the finer particles. Where all the settling is to be done in the one apparatus, the upward counter-current through 7′ may be dispensed with, in which case no water is let in through 43′. In that case the only water passing through 7′ into the tank is that to replace the water discharging with the settled material through 17.

In order to obviate spurting during discharge, I employ the funnel 21′ or an equivalent construction whereby there is a restricted discharge provided from the tank into the discharge passage of the nozzle 17′. In actual practice I have found that the restricted discharge opening at the lower end of the cone should, with very fluid matter, be approximately one-fifth the area of the discharge nozzle, in order to prevent spurting. While I have shown the nozzles in both cases here as curved, coöperating with the valve plate 18 or 18′, it is manifest that this nozzle could be of any other shape, straight, for instance, in which case the head 23′ may perform the ordinary functions of a valve. In all cases, however, I prefer to use the funnel 21 or 21′, or an equivalent, for the purpose of providing a restricted passage between the outlet end of the nozzle and the receptacle.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant receptacle adapted to rise and fall in the liquid in said tank, flexible means for suspending the receptacle in the tank while permitting it to rise and fall, said receptacle having a restricted outlet, and a conical member disposed in the outlet and forming between its outside and the wall of the discharge outlet a restricted passage adapted to prevent spurting, a valve carried by the receptacle and a seat against which the valve closes when the receptacle rises.

2. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant receptacle adapted to rise and fall in the liquid in the tank, each receptacle having a discharge outlet at its bottom,

means for suspending the receptacle to permit it to rise and fall, said outlet having a restricted passage between its outlet end and the receptacle to prevent spurting, a spout having an upturned delivery end forming a valve, and a fixed valve plate closing the end of the spout when the receptacle rises.

3. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant freely suspended receptacle adapted to rise and fall in the liquid in the tank, said receptacle having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, said outlet having means to provide a restricted passage between its outlet end and the receptacle to prevent spurting, a spout forming a continuation of the outlet of the receptacle having its outer end upturned, and means for closing the outer end of the spout as the receptacle rises in the tank.

4. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant receptacle adapted to rise and fall in the liquid in the tank having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, said outlet having means to provide a restricted passage between its outlet end and the receptacle, a closure for said outlet, and means independent of said closure coöperating with said restricted passage to prevent spurting when discharge takes place through the outlet, said last-named means including a conical plug arranged in said outlet and maintained stationary relatively to the receptacle.

5. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant receptacle adapted to rise and fall in the liquid in the tank having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, said outlet having means to prevent spurting, said outlet curved laterally, and a fixed valve plate coöperating with the end of the outlet to close the latter when the receptacle moves upwardly.

6. In a separator for liquids and solids, the combination of a rising and falling receptacle having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, said outlet having a restricted passage between its outlet end and the receptacle, said outlet curved laterally, a fixed valve plate coöperating with the end of the outlet to close the latter when the receptacle moves upwardly, and a head or plug member within the receptacle closable over said outlet when the outlet is closed by said valve plate.

7. In a separator for liquids and solids, the combination of a rising and falling receptacle having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, a closure for the outlet, a rod suspended in and supported independent of the receptacle and having a head member coöperating with said outlet to prevent spurting when discharge takes place through the outlet, and said closure for the outlet independent of said head member.

8. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant receptacle of conical form adapted to rise and fall in the liquid in the tank, said receptacle having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, a rod suspended inside of and supported independent of the receptacle and having a head member coöperating with said outlet as a closure, said rod supported to swing horizontally, and means for adjusting said head member vertically on the rod.

9. In a separator for liquids and solids, the combination of a liquid containing tank, a buoyant receptacle of conical form adapted to rise and fall in the liquid in the tank, said receptacle having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, a rod flexibly suspended in and supported independent of the receptacle and having a head member coöperating with said outlet as a closure, and an adjustable spreader carried by the rod above said head.

10. In a separator for liquids and solids, the combination of a rising and falling receptacle having a discharge outlet at its bottom, means for suspending the receptacle to permit it to rise and fall, a closure for the outlet, a rod suspended in and supported independent of the receptacle and having a head member coöperating with said outlet as a closure and an adjustable conical spreader on the rod above said head.

11. A separator for liquids and solids comprising a liquid-containing tank, a buoyant separating vessel in floating suspension in the liquid contents of the tank and having a discharge outlet for the solids outside the tank, a removable funnel member coacting with said outlet to prevent spurting, and a closure for the outlet.

12. A separator for liquids and solids comprising a liquid-containing tank, a separating vessel in floating suspension in the tank and having a discharge outlet for the solids outside the tank, said discharge outlet comprising a curved conduit, a member coacting with said passage to prevent spurting, and a closure for the outlet, said closure comprising a fixed plate, toward and from which said curved conduit is movable on the rise and fall of the receptacle.

13. A separator for liquids and solids comprising a liquid-containing tank, a separating vessel in floating suspension in the

tank and having a discharge outlet for the solids outside the tank, said discharge outlet comprising a curved conduit having intermediate of its length a restricted passage to prevent spurting, a headed member in the receptacle and supported independent thereof and closable over the outlet, a rod supporting said headed member, and means for supporting the rod at different levels.

14. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone suspended in the liquid in the tank, said cone having an outlet for the solids, a closure for the outlet operative automatically on the rise and fall of the cone, said outlet extending through the bottom of the tank, an extendible diaphragm connecting the cone and tank and surrounding said outlet to keep the water in the tank and allowing the cone to rise and fall, and a cylindrical member within the tank limiting the downward movement of the cone and operative to form a coffer-dam to retain the water in the tank when the cone is supported on said cylindrical member.

15. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling said outlet, means for operating the valve on the rise and fall of the cone, an extendible diaphragm connecting the cone and tank and surrounding the outlet, and an inflexible impermeable wall inside the tank and around the diaphragm and operative to support the cone on its limited downward movement and to keep the water in the tank independent of said diaphragm.

16. A separator for liquids and solids comprising a liquid-containing tank, a buoyant inverted separating cone in floating suspension in the liquid contents of tank, said cone having an outlet for the solids, a valve for controlling the outlet, means whereby said valve is opened and closed by the rise and fall of the cone in the liquid in the tank, and means independent of the valve for varying the discharge through the outlet.

17. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, a buoy floating in the tank and suspending the cone, said cone having an outlet for the solids, a valve for controlling said outlet, said valve supported independent of the cone, and a removable funnel member arranged in said outlet.

18. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids at its apex extending outside the tank, the apex portion of the cone surrounded by a casting, a removable plug fitting into said casting, said plug having means to provide a restricted aperture opening into the tank, an enlarged portion in continuation of said restricted aperture, and a member supported within and independent of the cone coacting with said restricted aperture to prevent spurting when the cone is discharging.

19. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling the outlet, means whereby said valve is opened and closed by the rise and fall of the cone, and a conoidal shield supported on the edge of the tank and loosely telescoping with the inside of the cone.

20. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling the outlet, means whereby said valve is opened and closed by the rise and fall of the cone, and means for feeding material to be separated into the cone, said tank having an overflow around its periphery, and the lip of said tank over which overflow takes place comprising a strip of lead or like easily workable material.

21. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling the outlet, means whereby said valve is opened and closed by the rise and fall of the cone, and a conoidal shield supported on the edge of the tank and loosely telescoping with the inside of the cone, said shield having a lead rim around its upper edge and over which overflow from the tank takes place.

22. In a separator for liquids and solids, the combination with a liquid-containing tank and separating means therein, of a floating hopper in floating suspension in the tank, and means for discharging air into or from the hopper for varying the buoyancy of said hopper.

23. In a separator for liquids and solids, the combination with a liquid-containing tank and separating means therein, of a floating hopper in floating suspension in the tank, means for varying the buoyancy of the hopper, and a floating splash block in the hopper.

24. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling the outlet, means for operating the valve on the rise and fall of the cone, means connecting

the cone and tank and surrounding the outlet to retain the water in the tank and allow the cone to rise and fall, and independent water-retaining means for retaining the water in the tank when the cone sinks below a predetermined level.

25. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling the outlet, means for operating the valve on the rise and fall of the cone, means connecting the cone and tank and surrounding the outlet to retain the water in the tank, a cylinder in the tank surrounding said water-retaining means and operative to support the cone when the latter sinks below a predetermined level, and means acting against the buoyancy of the cone to depress and hold the latter on the cylinder.

26. A separator for liquids and solids comprising a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids, a valve for controlling the outlet, means for operating the valve on the rise and fall of the cone, means connecting the cone and tank and surrounding the outlet to retain the water in the tank, a cylinder in the tank surrounding said water-retaining means and operative to support the cone when the latter sinks below a predetermined level, and flexible connections with the cone extending outside the tank, with means for adjusting the length of said flexible connections from outside the tank.

27. In a separator for liquids and solids, the combination of a liquid-containing tank, an inverted separating cone in floating suspension in the tank, said cone having an outlet for the solids outside the tank, means for controlling the discharge through said outlet on the rise and fall of the cone, and means for retaining the water in the tank independent of the rise and fall of the cone, which last means include a mercury seal carried by the tank and surrounding the outlet, and a diaphragm member on the cone coacting with the mercury seal.

28. A separator for liquids and solids comprising a liquid-containing tank, a receptacle in floating suspension in the tank, said floating receptacle having a discharge outlet for the solids outside the tank, a valve for said outlet, a mercury seal carried by the tank and surrounding the outlet, and a diaphragm member on the cone coacting with the mercury seal to retain the water in the tank independent of the rise and fall of the cone.

29. A separator for liquids and solids comprising a liquid-containing tank, a receptacle in floating suspension in the tank, said floating receptacle having a discharge outlet for the solids outside the tank, a valve for said outlet, a mercury seal carried by the tank and surrounding the outlet, a diaphragm member on the cone coacting with the mercury seal to retain the water in the tank independent of the rise and fall of the cone, and means floating on the mercury and cooperating with said diaphragm member to center the cone.

30. A separator for liquids and solids comprising a liquid-containing tank, a receptacle in floating suspension in the tank, said floating receptacle having a discharge outlet for the solids outside the tank, a valve for said outlet, a mercury seal carried by the tank and surrounding the outlet, a diaphragm member on the cone coacting with the mercury seal to retain the water in the tank independent of the rise and fall of the cone, and metal balls of less specific gravity than the mercury floating on the latter and cooperating with said diaphragm member to center the cone.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES ALLEN.

Witnesses:
CHARLES A. PENFIELD,
CHAS. E. TOWNSEND.