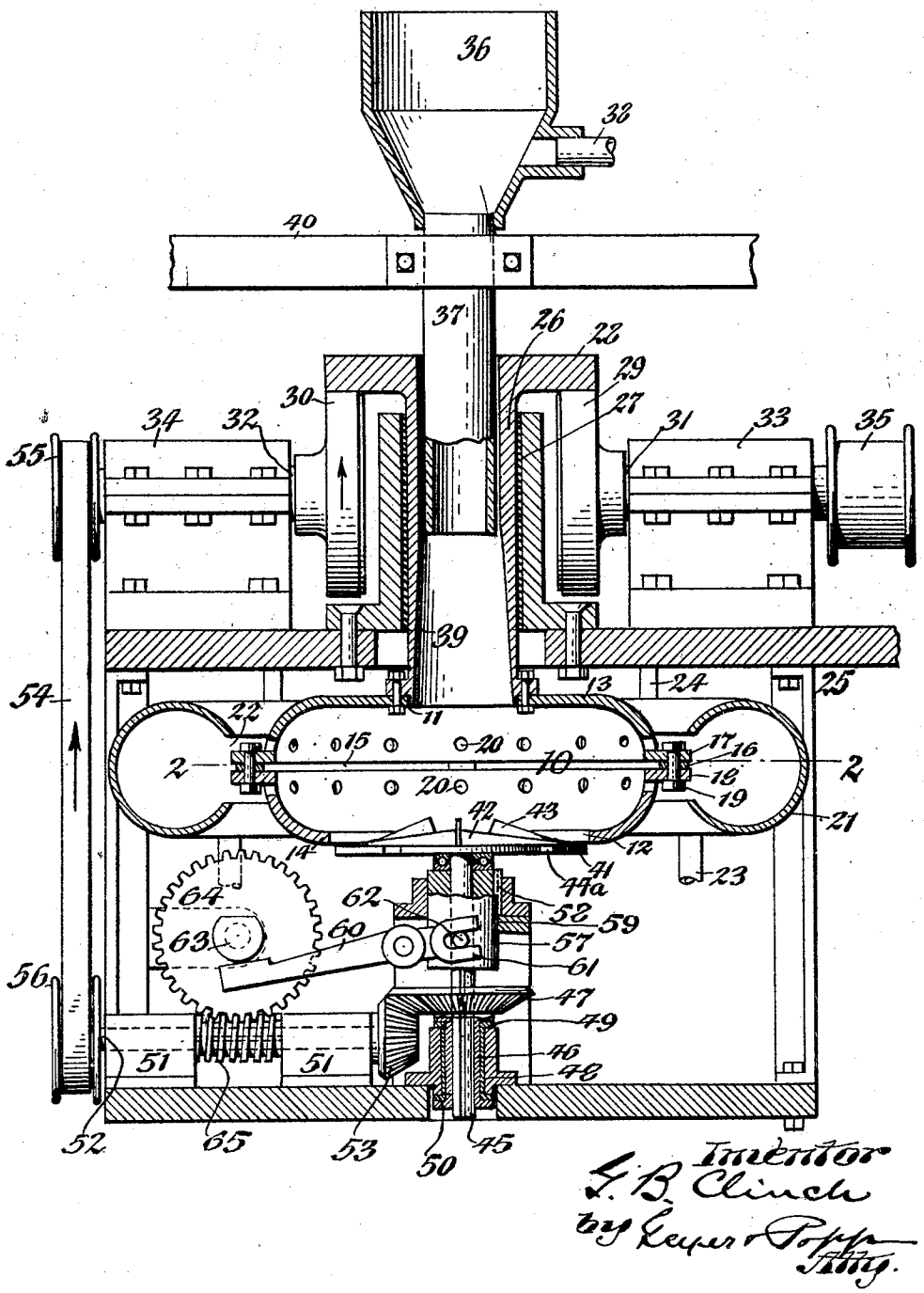
June 30, 1925. 1,543,986

G. B. CLINCH

CENTRIFUGAL WASHING AND DRYING APPARATUS

Filed April 10, 1923 3 Sheets-Sheet 1

Fig. 1.



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CENTRIFUGAL WASHING AND DRYING APPARATUS

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Fig. 3.

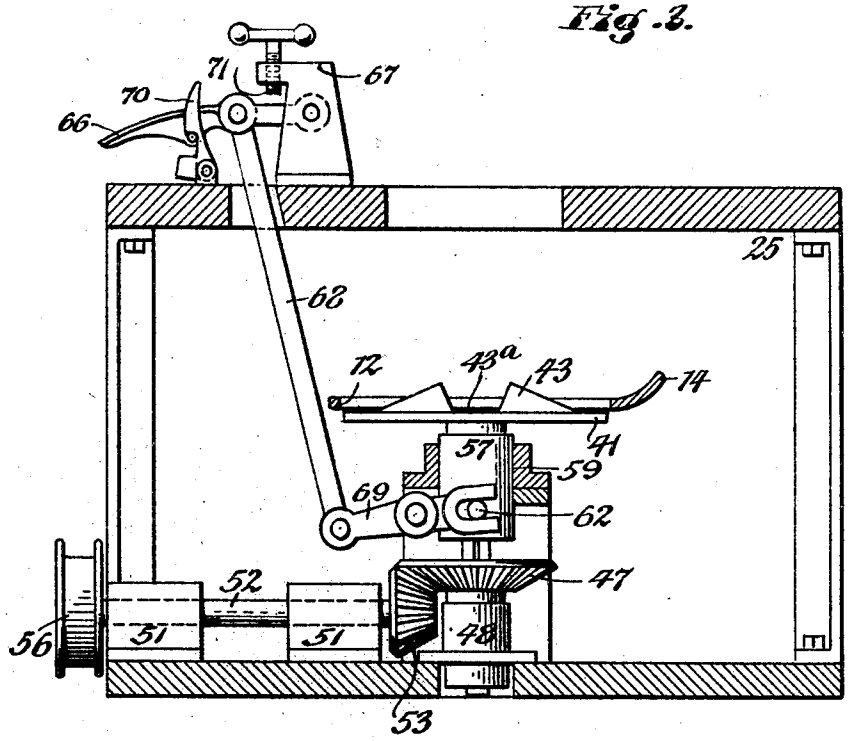


Fig. 2.

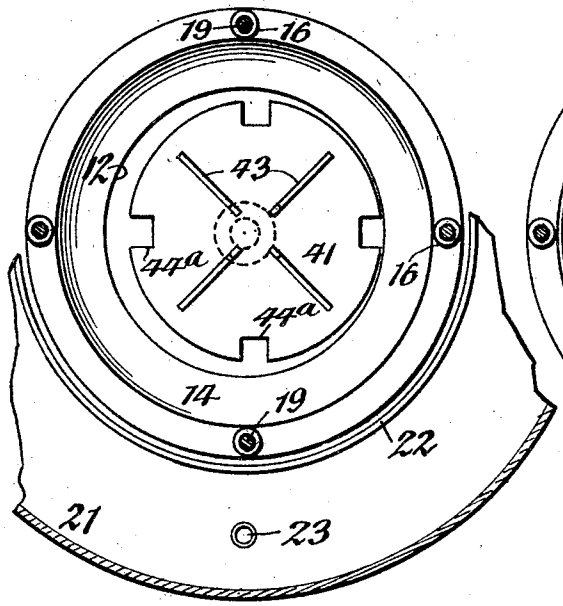
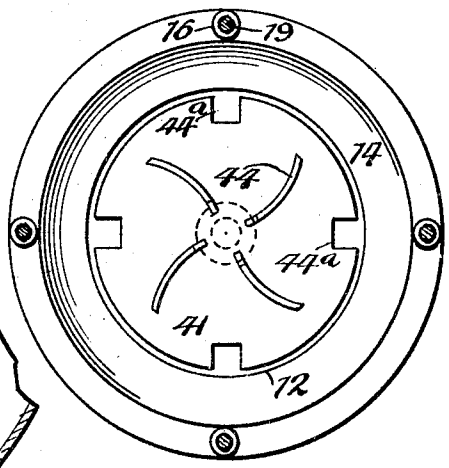


Fig. 4.



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Fig. 5.

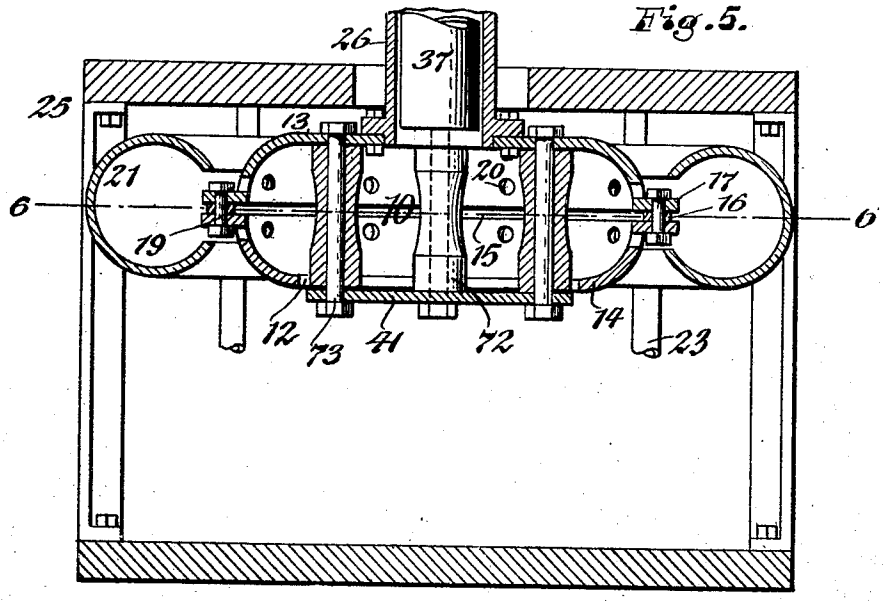
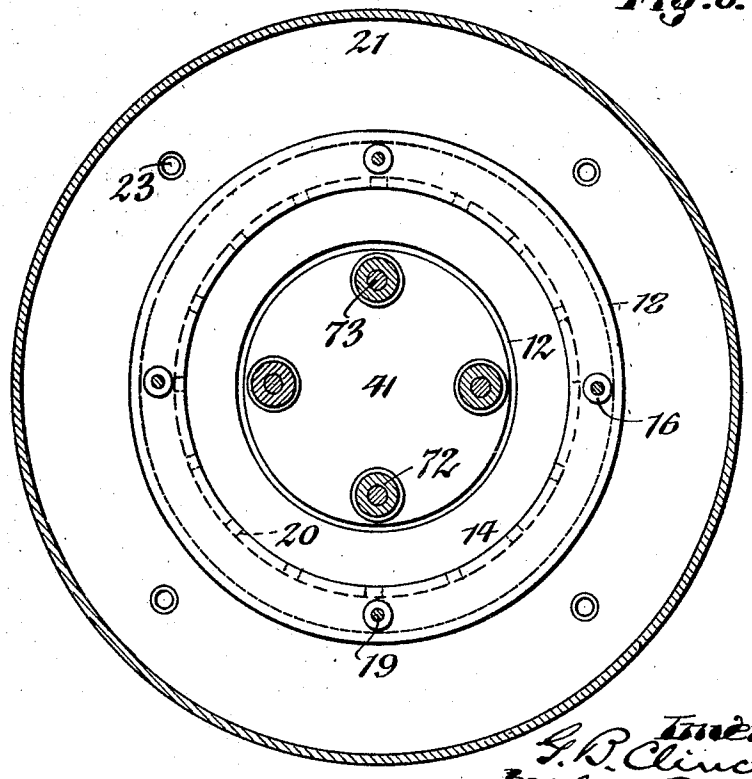


Fig. 6.



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UNITED STATES PATENT OFFICE.

GEORGE BURTON CLINCH, OF MULBERRY, FLORIDA.

CENTRIFUGAL WASHING AND DRYING APPARATUS.

Application filed April 10, 1923. Serial No. 631,232.

To all whom it may concern:

Be it known that I, GEORGE BURTON CLINCH, a subject of Great Britain, residing in Mulberry, in the county of Polk and State of Florida, have invented new and useful Improvements in Centrifugal Washing and Drying Apparatus, of which the following is a specification.

This invention relates to a centrifugal washing and drying machine which is primarily intended for washing and drying phosphate pebble rock, although the same may be used for treating other materials of the same general character, such for instance as building sand and the like, and any other material it may be desired to treat.

It is the main object of this invention to provide a machine for this purpose which is comparatively simple in construction, efficient in operation and free from the wear which would otherwise be produced by the abrasive effect of the material which is being treated.

In the accompanying drawings:

Figure 1 is a vertical section of one form in which my invention may be practically embodied. Figure 2 is a fragmentary horizontal section of the same taken on line 2—2, Fig. 1. Figure 3 is a fragmentary vertical section showing manually operated means for raising and lowering the plate at the solids outlet of the separating vessel or bowl, as distinguished from the automatic means for moving the plate toward and from this outlet, which are shown in Fig. 1. Figure 4 is a horizontal section similar to Fig. 2, but showing a modified construction and arrangement of some of the parts. Figure 5 is a fragmentary vertical section showing an embodiment of my invention in which the solids outlet plate is fixedly mounted on the separating vessel or bowl, but capable of detachment therefrom when required. Figure 6 is a horizontal section taken on line 6—6, Fig. 5.

Similar characters of reference refer to like parts throughout the several views.

In its general organization my improved centrifugal washing and drying machine comprises means whereby the material, such as phosphate pebble rock and the silt or other refuse which is to be removed therefrom, may be supplied either in a wetted condition or mixed with water preparatory to being treated, means for dewatering this rock and removing the silt or similar refuse which may be in the solution therewith, and means for retaining this material within the separating device for a sufficient length of time to effect washing thereof, and then permit the cleansing material to be discharged from the separating device.

The separating device consists essentially of a hollow vessel or bowl 10 which in the preferred construction rotates about a vertical axis and is provided in its upper axial side with an inlet 11 for the material which is to be operated upon and separated, an outlet 12 on the lower axial side of this vessel through which the washed and dried solids are discharged from the machine and an outlet for the liquids and silt or other refuse therein, arranged at the periphery of this vessel.

Although this vessel may be made in a variety of forms, the same in its preferred construction comprises upper and lower sections 13, 14, which are of dish-shaped form and having their concave sides facing each other and the marginal parts of which are curved so that the peripheral part of the interior of this vessel is of rounded form, as shown in Fig. 1, although any other suitable form may be employed, if desired. These two sections of the separating vessel have their opposing peripheral edges separated from each other, so as to form an annular circumferential liquid outlet slot 15 therebetween. These two sections may be held in spaced relation and connected with each other in any suitable manner, but preferably by means of washers 16 interposed between external annular flanges 17, 18 arranged on the peripheral parts of the vessel sections and bolts 19 passing through these flanges and said washers, as shown in Figs. 1 and 2.

This circumferential slot 15 may form the outlet of the vessel for the water which is separated from the rock which is being treated, together with the dirt, silt and the like, which may be in solution with the water. If desired, however, this outlet may be produced by forming an annular row of perforations in the peripheral part of the separating vessel, two rows of such perforations being shown in the peripheral parts of the vessel sections above and below the slot 15 in Fig. 1. In some cases it may be desired to employ both the outlet slots 15 and the outlet openings 20, for the purpose

of affording the maximum discharge of the dirt laden water from the vessel, but in most instances it will be sufficient to employ either one or the other of these means for dewatering the rock which is being treated. This solution of wash water and impurities is separated from the rock and discharged through the liquid outlet of the vessel by centrifugal force upon turning the vessel about its vertical axis, while the machine is in operation and this water, as it escapes from the exterior of the vessel, may be disposed of in any suitable manner. For convenience, comfort and sanitary purposes, however, this dirt laden water is caught in a launder or curb 21 which is preferably constructed in the form of a hollow ring which surrounds the separating vessel and is spaced a suitable distance therefrom and is provided on its inner side, which faces the periphery of the vessel, with an annular slot 22 which is arranged horizontally opposite the liquid outlet of the vessel, consisting of a slot 15 and and openings 20, so that the liquid which is thrown off from this vessel at its periphery will pass into the launder through the inlet slot 22 thereof. Thereafter, this wash water, with the dirt in solution therein, may be disposed of in any suitable manner, for instance, the same may be conducted by waste pipes 23 from the underside of the launder to a drain, sewer, or elsewhere, as preferred. This launder may be supported in this relation to the vessel by any approved means, for instance by means of hangers 24 which connect the same with the adjacent part of the main frame 25 in which the various working parts of the machine are mounted.

Although the separating vessel may be rotatably mounted in various ways, the particular means shown in the drawings, as one example of a suitable mounting, comprise an upright hollow shaft 26 which is connected at its lower end with the top of the separating vessel and communicates at its lower end with the latter through the inlet 11 thereof, so that this shaft also serves as part of the means for supplying the materials to be operated upon. This shaft is journaled immediately above the separating vessel in an upright bearing 27 which is mounted on the adjacent part of the main frame which bearing may be of any suitable or approved construction, although the one shown in the drawing is of the plain cylindrical type. The weight of the separating vessel and the hollow shaft in this case is supported by means of a driven wheel 28 arranged horizontally at the upper end of the hollow shaft and resting with diametrically opposite parts of its margin on the upper peripheries of the two supporting wheels 29, 30, which are arranged vertically on opposite sides of the bearing 27. These two vertical wheels are mounted respectively on the inner ends of the two shafts 31, 32, which are journaled respectively in bearings or pillow blocks 33, 34 on the upper parts of the main frame. Obviously, the separating vessel and hollow shaft may be otherwise supported for rotation about a vertical axis, for instance, by means of roller bearings or ball bearings of well known construction, which may be organized to take up the lateral and vertical thrust of the loads. Part of the means for thus rotatably suporting the separating vessel may be utilized as the means for driving the separating vessel, although this is not necessarily so.

In carrying out this purpose, the outer end of the shaft 31 may be provided with a driven pulley 35 around which a driving belt receiving power from any suitable source, may pass, or a motor may be connected thereto, thereby causing the supporting wheel 29 to operate as a driving friction wheel and the horizontal wheel 28 of the hollow shaft to serve as a driven friction wheel, by reason of the frictional engagement between these two wheels in a manner common in friction driving gearing. If desired bevel friction, or tooth spur gearing may be used. The material to be treated and the liquid, such as water, for removing the silt or other refuse therefrom, may be supplied to the hollow shaft by any suitable means, but this may be satisfactorily accomplished by means of a supply hopper 36 arranged above the main frame and adapted to receive the rock to be treated through its upper end while its lower end is connected with the upper end of a spout or a chute 37, which latter extends with its lower end into the hollow shaft 26 an appropriate distance. As shown in Fig. 1, this spout terminates about midway of the length of the shaft while in the construction shown in Fig. 5, this spout extends nearly to the lower end of the same. The rock or other material to be treated may be introduced into the hopper 36 in a previously wetted condition, but if desired, the same may be mixed with water while in the hopper preparatory to being discharged into the separating vessel, for which purpose the lower part of the hopper is provided on one side with a water supply pipe 38 whereby water may be mixed with the material to be treated within the hopper, preparatory to delivering the same to the separating vessel.

As the material passes from the supply spout 37 into the hollow shaft, the same is immediately subjected to centrifugal force, due to the rotation of this shaft and the separating vessel, which causes the material to adhere to the bore of the shaft. Ordinarily, the weight of the material to be operated upon is sufficient to cause the same to flow downwardly through the hollow shaft and

into the separating vessel, but the downward movement of the material is insured by making that part of the bore of the hollow shaft through which the material passes off downwardly of enlarging conical or flaring form, as shown at 39 in Fig. 1. This form of the bore of the hollow shaft operates to continually relieve the adhesion of the material against this surface, in a downward direction, and thus enables the material to release itself therefrom and flow in a steady stream downwardly through the hollow shaft into the separating vessel instead of being retarded in this movement by undue frictional engagement of the material with the bore of this shaft.

This hopper and its delivery spout 37 may be supported by means of a stationary beam 40 secured to this spout, as shown in Fig. 1, or on any other stationary part of the plant which is available.

After the material to be treated, together with the wash water, has been delivered to the separating vessel, the same is carried by centrifugal force against the peripheral part of the inner side of this vessel where it is deposited in the form of an annular body, which is built up by the gradually increasing thickness of the continued inflow of material from the hollow shaft. As the material accumulates in this vessel it is prevented from escaping through the solids outlet on the lower axial side of the separating vessel by means of a controlling plate 41 which is preferably constructed in the form of a disk and is movable toward and from the solids outlet of the separating vessel, but is at all times separated more or less at its peripheral edge from the edge of the outlet 12, by means of an annular space through which some of the washed rock or cleaned material may escape, while the controlling plate 41 is in its substantially closed position, but holds back the bulk of the material within the vessel. In the preferred construction, this controlling plate is so constructed, that the same operates to throw the material deposited thereon laterally by centrifugal force and thus aid in causing the material supplied to the vessel to be carried toward the periphery thereof and also aid in discharging the dry material from this vessel. For this purpose the controlling plate, in addition to being capable of moving into and out of a position in which it nearly closes the solids outlet 12 of the vessel, the same also has a rotary movement in the same direction as the separating vessel and its upper side is constructed so as to enable the same to act more effectively upon the material resting thereon.

As shown in Fig. 1, the top 42 of the separating plate is constructed of upwardly tapering conical form and this upper surface is also provided with wings or flights 43, both of which operate to cause the material deposited upon this plate to be thrown laterally by centrifugal force. Instead of making the plate 41 conical on its upper side, as shown in Fig. 1, the same may be flat on this side, as shown at 43^a in Fig. 3. The throw off wings 43 may be of any suitable form, for instance as shown in Fig. 2, they are straight and arranged on radial lines, while the wings 44 shown in Fig. 4, are of volute form. To permit of a more ready discharge of the material through the solids outlet 12 of the vessel and also aid the controlling plate in imparting a rotary action to the material escaping from the vessel through this outlet, the peripheral edge of the controlling plate 41 may be provided with notches or recesses 44^a of suitable number, for instance, four arranged equidistant circumferentially of this plate, as shown in Figs. 2 and 4. If desired, the center line of rotation of the controlling plate may coincide with the hollow shaft and the bowl but its periphery is eccentric relatively to this axis of rotation whereby a crescent shape opening is produced between the outlet 12 of the bowl and the edge of the controlling plate 41 the widest part of which is next to the shortest radius of this plate, as shown in Fig. 2. This opening is continually changing its circumferential position relative to the revolving bowl due to the variation in the speed of the bowl and controlling plate so that the discharge of material from the controlling plate at the periphery thereof occurs successively at different points of the mass of material within the bowl.

Normally, the controlling plate 41 is in its elevated position, so as to close the solids outlet 12 to the maximum extent, as shown in Fig. 1, in which position of the parts the inflow of material into the separating vessel will cause the solids to build in the form of an annular ring against the peripheral part of the inner side of the vessel, while the water and the dirt in solution therein will be driven out of the rock or other material under treatment and pass out through the outlet slot 15 or openings 20.

The constant inflow of this material into the separating vessel will cause the ring of solid material to gradually increase in thickness until the bore of the same assumes the form of a cone, the angle of which extends from the lower edge of the bore of the hollow shaft 26 to the edge 12 of the solids outlet opening of the separating vessel. In this manner, the solid material which first is accumulated on the inner side of the separating vessel lies there against, and moves with the same so that no abrasive action is exerted by this material against the vessel and the same also acts as a screen or filter bed for holding back subsequent layers or

deposits of the material on the inner side of the first deposit while permitting silt and refuse in solution with the water, to pass to the liquid outlet of the vessel. This action continues progressively as the ring of washed solid material increases in thickness inwardly until the inner side of this ring overhangs the edge 12 of the solids outlet opening at which time the further addition of wet material through the inlet of the vessel will cause a corresponding discharge of dried material through the solids outlet of the vessel. When this occurs it is desirable to lower or open the controlling plate 41 for emptying the separating vessel either partly or wholly of the cleansed or washed and dried rock, which is accumulated therein and then the controlling plate is again raised into its raised position, so as to substantially close the solids outlet 12.

Various means may be employed for rotating the controlling plate and also raising and lowering the same, those shown in Fig. 1 being constructed as follows:

45 represents an upright spindle or shaft on the upper end of which the controlling plate 41 is mounted so as to turn therewith. The lower part of this shaft is splined on a hub 46 of a bevel gear wheel 47, so that this shaft is compelled to turn with the gear wheel, but is free to move vertically therein. The hub 46 of the gear wheel 47 is journaled in a bearing 48 but is incapable of moving lengthwise by means of floaters 49, 50, formed on this hub and engaging with the upper and lower ends of this bearing. Journaled horizontally in bearings 51 on the lower part of the main frame is an intermediate shaft 52 which is provided on its inner end with a beveled gear or friction pinion 53 which meshes with the beveled gear or friction wheel 47. Motion is transmitted to this intermediate shaft by means of a belt 54 passing around driving and driven pulleys 55, 56, secured respectively to the outer ends of the upper supporting shaft 32 and the outer end of the intermediate shaft 52, as shown in Fig. 1, or by a belt from a separate motor, or by direct connection of motor thereto.

By this means the controlling plate 41 may derive its source of power from the same means which drive the separating vessel, but this plate is rotated at a slightly different speed than the separating disk, whereby an agitating effect is produced by the separating plate and its wings 43 which operate on the material deposited therein and serves to discharge the same more readily and operates to throw the same more readily either into the outermost part of the separating chamber during the initial part of the washing and drying operation and to more effectively discharge the dry material from this vessel, after the same becomes fully loaded.

The raising and lowering of the controlling plate into and out of its closed position may be effected periodically and automatically by various means, those shown in Fig. 1, for this purpose comprising a bearing 57 in which the upper part of the spindle 45 is journaled and which is mounted by means of a spline 58 in a guideway 59 in the adjacent part of the main frame, so that this bearing is held against turning. A rock lever 60 is pivoted on the adjacent part of the main frame, so as to be capable of swinging vertically and its inner arm is provided with a fork 61 which embraces a coupling pin 62 on the sliding bearing 57. The outer arm of this lever is engaged by a rotary cam 63 which latter is turned by means of a worm wheel 64 carrying the cam 63 and meshing with the worm 65 on the intermediate shaft 52. Due to this construction a slow motion is imparted to the controlling plate 41 whereby the same is maintained in a closed position for a predetermined length of time and then is lowered momentarily in its open position for discharging the load of washed and dried rock from the separating vessel and then this plate is again raised and maintained in its closed position for a definite length of time, this cycle of operations being continued so long as the machine is in operation.

Instead of opening and closing the controlling plate 41 automatically and periodically, this same effect can be produced at will by manually operated means, shown in Fig. 3. In this construction, the foot lever 66 is employed which is pivoted on a bracket 67 to swing vertically and connected by means of a link 68 to the outer arm of the lever 69, which is coupled with the sliding bearing 57, a ratchet 70 is employed for holding the pedal 66 in its depressed position and the controlling plate 41 in its elevated or closed position and a screw 71 is mounted on the bracket 67 in position to limit the upward motion of the pedal 66 and the downward or opening movement of the controlling plate.

Instead of operating the controlling plate 41 either automatically or manually by the means shown in Figs. 1 and 3, the same, as shown in Fig. 5, may be fixedly secured by a plurality of spacing sleeves 72 interposed between the upper part of the separating vessel and the controlling plate, and a plurality of fastening bolts 73 passing through these sleeves connecting the plate 41 rigidly with the separating vessel, in such a position vertically with reference to the lower edge of the solids outlet of the separating vessel, and in such a position axially as to maintain a fixed outlet or annular opening suitable to discharge the treated material at a desirable constant rate, somewhat retarding the material sufficiently for same to receive proper

centrifugal treatment before emerging through the more or less throttled outlet.

In all of the several forms of my invention shown and described for the proper separation of the materials, the mass must assume the speed of the vessel or bowl or practically so and the apparatus has therefore been so designed that the material is held back in the vessel or retarded in its escape through the solids outlet in the bottom thereof by suitably adjusting the controlling plate so that the rock or other material under treatment will be discharged slowly therefrom only at such a rate as to insure a frictional engagement of the same with the vessel sufficient to cause the rock to assume the velocity of the revolving vessel.

The water and suspended silt, by their fluidity, flow through the mass in an unrestricted manner, and emerge with great force through the annular outlet orifice of this vessel and into the stationary launder, thence by gravity through the waste pipes. The material to be treated therefore can not escape from the vessel until the same has been washed and dried sufficiently for all practical purposes.

In the operation of the apparatus the filter bed formed by the deposit of material against the inner peripheral side of the vessel or bowl is at rest relatively to the latter and this minimizes the abrasion of the material against the surfaces of the vessel and instead causes the inner surface of the relatively stationary body of the material initially deposited in the circumferential portion of the vessel to take the abrasive action of the core or central body of material which latter passes in an oblique path from the upper inlet of the vessel to the lower outlet of the same.

The structures shown in Figs. 1 and 3 are more particularly designed for treating materials which may not be satisfactorily washed and dried while flowing, hence may require "batch" treatment, but the construction shown in Figs. 5 and 6 is better adapted for continuous treatment of materials which are not necessarily difficult to treat and are therefore constantly restrained in their flow while the necessary amount of moisture is being driven off.

Obviously other changes in structure can be made in this machine within the scope of the annexed claims without departing from the essence of this invention.

I claim as my invention:

1. A centrifugal washing and drying machine, comprising a rotatable vessel provided on one of its axial sides with an inlet for the wetted material to be washed and dried and on its opposite axial side with an outlet for the dried solids and at its periphery with an outlet for the liquid separated from the solids, and a plate movable axially toward and from said solids outlet and rotatable in the same direction as said vessel but at a different speed.

2. A centrifugal washing and drying machine, comprising a rotatable vessel provided on one of its axial sides with an inlet for the wetted material to be washed and dried and on its opposite axial side with an outlet for the dried solids and at its periphery with an outlet for the liquid separated from the solids, and a plate movable axially toward and from said solids outlet and rotatable in the same direction as said vessel but at a lower speed.

3. A centrifugal washing and drying machine, comprising a rotatable vessel provided on one of its axial sides with an inlet for the wetted material to be washed and dried and on its opposite axial side with an outlet for the dried solids and at its periphery with an outlet for the liquid separated from the solids, and a rotatable plate arranged in said solids outlet and provided in its periphery with notches.

4. A centrifugal washing and drying machine, comprising a rotatable vessel provided on one of its axial sides with an inlet for the wetted material to be washed and dried and on its opposite axial side with an outlet for the dried solids and at its periphery with an outlet for the liquid separated from the solids, and a plate having its periphery separated from the edges of said solids outlet and turning in the same direction as said vessel and which has its axis of rotation arranged concentrically to the axis of said vessel while its edge is arranged eccentrically thereto.

5. A centrifugal washing and drying machine, comprising a rotatable vessel turning about a vertical axis and having an inlet in its top for the liquids and solids, an outlet in its bottom for the solids and an outlet for the liquids at its periphery, a rotary plate arranged adjacent to the said solids outlet, means for turning said plate including a shaft, and means for moving said shaft vertically periodically and automatically comprising a vertically movable bearing in which said shaft is journaled, a lever having one arm connected with said bearing, a rotary cam engaging the other arm of said lever, a worm wheel connected with said cam, and a rotary worm meshing with said worm wheel, said means for turning the shaft comprising a driven gear wheel splined on the shaft, a driving gear wheel meshing with said driven gear wheel, and a driving shaft carrying said driving gear wheel and said worm.

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