Jan. 3, 1950 A. J. WEINIG 2,493,049

ORE SCRUBBING APPARATUS

Filed July 2, 1945 3 Sheets-Sheet 1

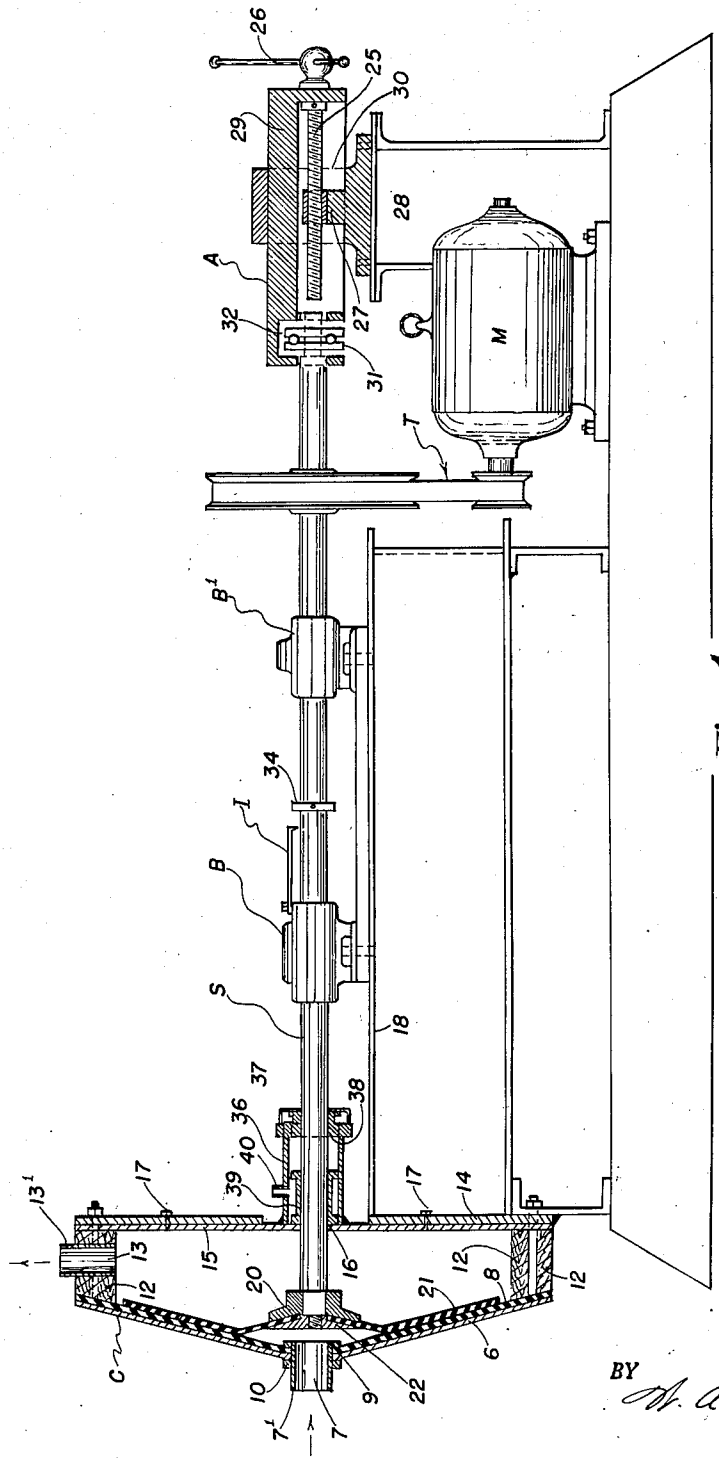



Fig. 1

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ORE SCRUBBING APPARATUS

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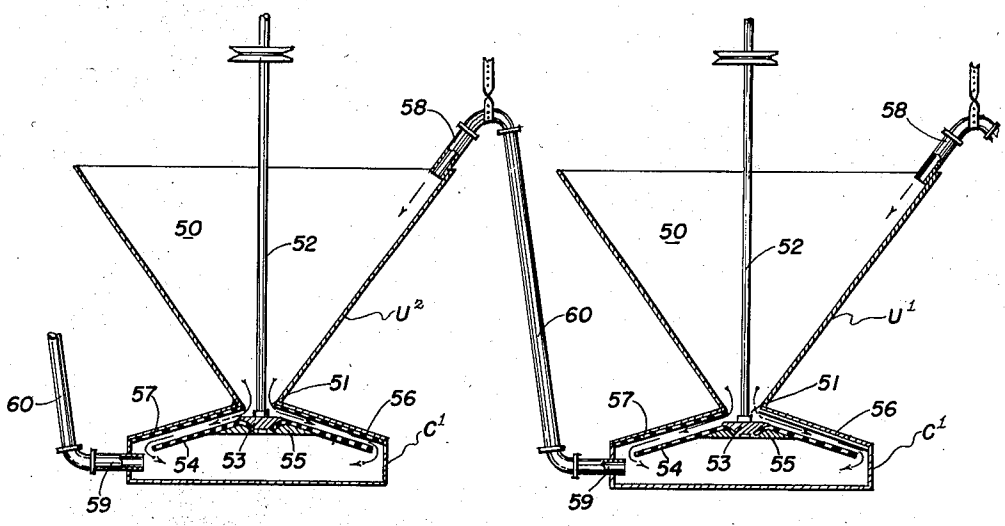



Fig. 2

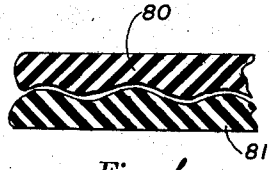



Fig. 4

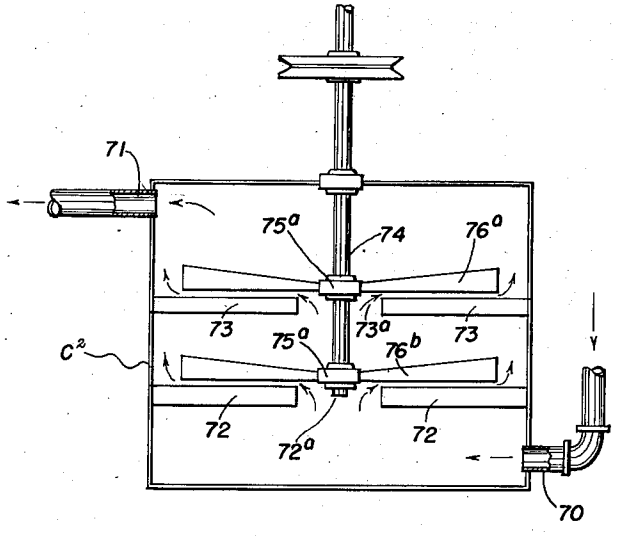



Fig. 3

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ORE SCRUBBING APPARATUS

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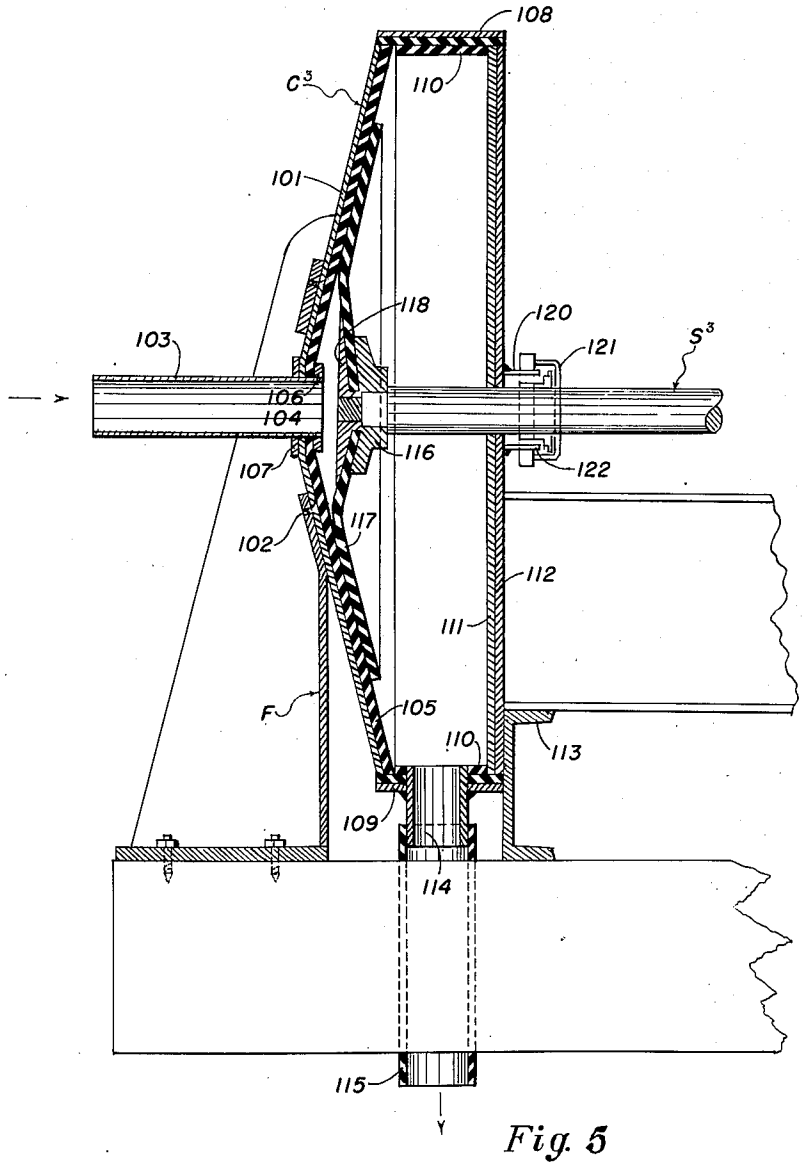



Fig. 5

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Patented Jan. 3, 1950

2,493,049

# UNITED STATES PATENT OFFICE

2,493,049

## ORE SCRUBBING APPARATUS

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Application July 2, 1945, Serial No. 602,897

15 Claims. (Cl. 241—102)

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This invention relates to ore scrubbing apparatus and more particularly relates to apparatus for scrubbing ores which can be adapted to pump the material under treatment in a circulatory movement in conjunction with its scrubbing function.

In the treatment of certain minerals it is necessary to scrub the surfaces of the individual grains or particles in order to properly condition the material for treatment at various stages of an ore milling operation. As an example, in preparing certain ores for froth flotation it is advantageous to subject altered or unclean surfaces of the mineral or minerals to be recovered to a scrubbing or cleaning action in advance of the flotation stage.

Also in some ores valuable constituents may exist as relatively soft stains or coatings on harder grains of waste material and/or soft discrete grains of valuable constituents associated with harder grains of waste matter.

For example, "carnotite ores" of Colorado, Utah, New Mexico and Arizona have the yellow soft mineral "carnotite" existing as stains and coatings on the quartz grains of the sandstones which constitute vanadium and uranium ores. Carnotite also exists as discrete grains associated with quartz sand. There also exists soft discrete grains of chloritic minerals within which grains vanadium minerals occur as inclusions. When the chloritic minerals predominate the ores are frequently called "roscoelite ores" in local parlance.

It has been discovered that by the use of suitable scrubbing apparatus the valuable constituents of such ores are freed and disintegrated into slimes and simple desliming of the ores so treated yields at once an effective separation between the valuable minerals and the waste matter of the ore.

It is an object of the present invention to provide simple, durable and efficient apparatus for scrubbing ores.

Another object of the invention is to provide simple and efficient apparatus for pumping and/or scrubbing ores in which the moving parts and associated wear-surfaces of the apparatus have a high degree of resistance to abrasion.

A further object of the invention is to provide ore scrubbing apparatus in which particles in a variety of sizes are subjected to a rolling movement in conjunction with a scrubbing action to subject all surfaces of the individual particles to repetitions of the scrubbing action in a single treatment.

Other objects reside in novel details of construction and novel combinations and arrangements of parts, all of which will be described in the course of the following description.

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Briefly described, the ore scrubbing apparatus of the present invention comprises a closed chamber or container into which a free-flowing pulp is fed through a suitable opening, and caused to pass between contiguous and preferably yieldable surfaces of two cooperative members, at least one of which is rotary and so constructed as to tend to change shape or otherwise move and press against the other said member under the centrifugal influence of the rotation, thereby inducing a strong suction influence on the intake opening and rolling the particles continuously in their passage between the contiguous surfaces until they pass from between said surfaces, whereupon the pulp is discharged from the container. It should be understood that the container may be enclosed when advantage is to be taken of the inherent pumping action of the apparatus, or the container may be open when the pumping action is not desired.

By having the two cooperative members located in partitioning relation between the inlet and outlet of the container, the rotary member also functions as a valve to prevent recirculation of material within the container and this serves to enhance the pumping effect in the scrubbing action. Consequently, the entering material is given only one pass through the container, but in its movement between the contiguous surfaces, the particles are given a thorough and intensive scrubbing, and subjected to sufficient compressive influences to effectively extract soft embedded constituents in the solids.

With this understanding of the general arrangement and function of the apparatus, reference will now be made to the accompanying drawings, which illustrate typical embodiments of the invention. However, I do not desire my invention to be limited to the particular construction and arrangement shown and described, as I intend by the appended claims to cover all embodiments within the spirit and scope of my invention.

In the drawings in the several views of which like parts have been designated similarly.

Fig. 1 is a side elevation, partially in section, showing the arrangement of parts in one form of scrubbing apparatus embodying features of the present invention;

Fig. 2 is a more or less diagrammatic, vertical section through another form of apparatus embodying features of my invention and showing

an arrangement for a series or battery type operation;

Fig. 3 is another diagrammatic vertical section through still another form of apparatus embodying features of this invention and showing an arrangement for a multiple-stage treatment in a single treatment unit;

Fig. 4 is a fragmentary section illustrating a modified arrangement of the cooperative members that produce the scrubbing action in the several structural forms illustrated herein; and

Fig. 5 is a vertical central section through another modified form of ore scrubbing apparatus embodying features of the present invention.

Referring first to the form of the invention illustrated in Fig. 1, a container or casing C is mounted to admit one end of a horizontally disposed shaft S, journalled in bearings B and B', and driven by a motor M through the intermediary of V-belt or other suitable transmission T. Provision is made for lengthwise adjustment of shaft S by an adjusting mechanism A located at the free end of said shaft. An indicating element I shows or measures the extent of such adjustment.

As shown in Fig. 1, container C comprises a hollow body having a frustro-conical surface 6 at one end, which is provided with a central inlet opening 7 preferably in the form of a nipple 7'. An abrasion-resistant cover or lining member 8 is seated on the inner conical surface and preferably is formed of rubber or similar yieldable material. The lining is fitted within a groove 9 on a hub member 10 seated on nipple 7' and is held at its periphery by a clamping ring 12, which also forms the side wall of casing C.

An outlet opening 13 is provided by another nipple 13' extending through the side wall 12 of casing C. An end plate or disc 15 covers the opposite end of the casing and is apertured as shown at 16 to admit shaft S. This plate is supported on a face plate 14 by bolts or other suitable fastening means 17 and the face plate in turn is attached to and supported from a suitable base 18, which also provides the support for bearings B and B'.

Shaft S extends substantially through the interior of casing C and carries at its end a hub 20 against which a flexible disc member 21, preferably rubber, is held by a nut 22. The adjoining surfaces of hub 20 and nut 22 position the central portion of member 21 in one direction while the lining member 8 bends the peripheral portion of member 21 in an opposite direction and thus member 21 when at rest is maintained in unbalanced relation to a plane perpendicular to the lengthwise axis of shaft S.

However, due to the elastic or flexible character of member 21, rotation of shaft S will cause said member to change shape or distort as it tends to approach a position perpendicular to the axis of rotation under the centrifugal influence of its rotation. Since the cooperative flexible member 8 prevents member 21 from assuming the aforesaid perpendicular position, the adjoining surfaces are brought in contact with considerable pressure being exerted by member 21 during its rotation.

This action produces a substantial suction effect for feeding the apparatus through inlet 7. However, gravity or pressure feed may be employed additionally. When the inlet 7 is receiving a liquid such as an ore pulp feeding through a conduit connected with a suitable source of supply, the pulp is drawn between members 21 and 8, with the particles rolled and scrubbed repeatedly in their travel through the restricted passage. Due to the yieldable properties of the material of the two cooperative members, the individual particles are substantially enclosed, and the pressure exerted thereon is sufficient to disintegrate and free the soft constitutents held within the solids of the pulp.



The member 21 in addition to producing the scouring and pumping action aforesaid, also acts as a valve to prevent recirculation, between the outlet portion of the casing interior and the inlet portion thereof, as the only escape for the pulp passing from between the members is through the outlet 13.

It has been found by experimentation that proper spacing of member 21 from member 8 in the inactive position will produce optimum scrubbing for a given pulp. For this reason, I prefer to use a shaft mounting which permits selective longitudinal movement and the adjusting mechanism A is a convenient means for so changing the position of shaft S for adjusting the required power input.

To this end a screw 25, actuated by a suitable handle member 26 is threaded through an extension 27 on a stationary base 28 and drives a control member 29 mounted for sliding movement through a recess 30 of base 28. A double thrust bearing 31 at the end of shaft S is fitted within and slightly spaced from a recess 32 at the end of slidable control member 29. Through this arrangement, movement of the screw will cause the end surfaces of said recess portion of member to bear against the thrust bearing 31 in either a forward or rearward direction, according to the direction of rotation of the screw. As soon as one of said surfaces engages the thrust bearing, the shaft is moved in a longitudinal direction and thereby changes the relative positions of members 21 and 8.

In order to provide an accurate visible measurement of the extent of any such movement, I place a ring 34 on shaft S in proximity to bearing B and then locate an indicatory element I on bearing B which overhangs the shaft and terminates in a pointer located in spaced but proximate relation to ring 34. When the screw is actuated it is possible for the operator to observe graduations in the spacing between indicatory element I and ring 34 which assists the operator in making power input adjustments in conjunction with power indicating meters or devices (not shown).

In order to prevent leakage of the pulp through opening 16, I provide a stuffing box 36 about the exterior of said opening, which may be of any suitable type. As illustrated, the stuffing box may include a cylindrical housing welded to or otherwise mounted on plate 15 in fluid-tight connection therewith. The end of the housing is threaded for attachment of a cap member 37 which bears against a gland 38. Adjacent opening 16 a lantern ring 39 is mounted on shaft S and has suitable apertures (not shown) for admission of a lubricant to the shaft. A nipple or fitting 40 is provided for the supply of pressure gland water or lubricant and the space within the housing will be filled with packing material (not shown) in a manner well known in the art.

Apparatus constructed as aforesaid is well suited for performing various scrubbing operations of the type hereinbefore described in continuous operation. While I have described a preferred arrangement of parts, it will be under-

stood that variations may be resorted to within the spirit and scope of the invention. Certain of these variations have been illustrated in the other views of the drawings, which for convenience in illustration have been shown in diagrammatic style.

Thus, Fig. 2 represents an arrangement for a series or battery type operation in which the scrubbing action, in addition to cleaning the surfaces of the mineral particles, may also be utilized to film or surface coat said particles. Two treatment units have been illustrated, but it will be understood that these are intended to designate any plurality of units which may be required in such an operation. As illustrated, the apparatus comprises two treatment units designated U' and $U^2$ respectively, with incoming pulp first treated in unit U' and then passed on to unit $U^2$ for a second treatment. Each said unit comprises an upper tank portion **50**, preferably conical, having a lower central opening **51** through which pulp is fed to a container C' in which the scrubbing operation is performed. A rotary shaft **52** extends downwardly through tank **50** into container C' and carries a hub **53** against which a flexible disk **54** is held by a nut member **55**. The top wall **56** of container C' is conical and has a resilient lining **57** against which disk **54** presses during rotation of shaft **52**.

Feed to unit U' is introduced through an inlet member **58** which is connected with a suitable source of supply (not shown). The pulp feeding into tank **50** is agitated by the rotation of shaft **52** therein and also by the vortex formed by the passage of pulp through opening **51**. Any suitable reagent material, such as dispersing, dissolving, flotation or flocculating agents, may be fed into tank **50** and is there mixed by the aforesaid agitation. Thereafter when the pulp passes into container C' through opening **51**, it is subjected to a scrubbing action of the type hereinbefore described and, in addition, the device serves as a reactor chamber for the reagents above referred to. The pulp passing from between the surfaces **54** and **57** is then pumped through an outlet **59** and is conducted by a suitable conduit **60** to the inlet **58** of the next unit in the series here designated $U^2$, and the action is repeated therein.

The conduit **60** of the final unit in the series may be used to conduct the conditioned pulp to another stage of the treatment, as for example, the feed inlet of a froth flotation machine. It will be apparent that in such a succession of scrubbing stages the desired amount of scrubbing and/or filming may be provided to properly condition the material for the subsequent treatment.

For certain plants it may be desirable to provide a multiple stage treatment in a single unit to conserve floor space or for other reasons. A convenient way of so operating has been illustrated in Fig. 3. In this form of the invention, the tank or container $C^2$ has a bottom feed inlet **70** and a top discharge cutlet **71**. A plurality of spaced partition members **72** and **73** respectively, are disposed within the tank at different levels between the inlet and outlet. A rotary shaft **74** extends into the tank and has a plurality of hub members **75***a* and **75***b* mounted thereon, each of which carries a flexible disk, respectively designated **76***a* and **76***b*, which overhang and are slightly spaced from the coacting partitions **73** and **72** respectively. A central opening **72***a* and **73***a* is provided in said partitions.



In this form, I have used a disk of tapering thickness, which is in unbalanced relation to the adjoining partition surfaces when the shaft is stopped, and subsequent rotation of the shaft causes the members **76***a* and **76***b* to tend to move into a plane perpendicular to the axis of rotation. As a consequence, the members **76***a* and **76***b* bear against said partitions during their rotation and produce a suction effect at the openings **72***a* and **72***b*.

Pulp entering the tank through inlet **70** is thus caused to flow along a circuitous path, first through opening **72***a*, thence between partition **72** and rotary member **76***b* in which it is subjected to a scrubbing action of the type hereinbefore described, thence inwardly through opening **73***a* and between members **73** and **76***a* to finally pass to the discharge outlet **71** under the pumping action of the rotary members. The repetitions of the scrubbing action serve to clean the particle surfaces so that upon final discharge from the tank the pulp constituents are in proper condition for the subsequent treatment.

In all the forms thus far described I have shown smooth surfaces in the contact areas. For some purposes, it may be preferable to have irregular and conforming surfaces to enhance the scrubbing action. Fig. 4 illustrates a suitable arrangement of this type in which two coacting members **80** and **81** are provided with undulating or corrugated surfaces **82** and **83** respectively, which preferably but not necessarily are parallel when in the inactive position. Either or both of such members may be rotary and by having a central opening in one (not shown) which acts as the pulp inlet, an effective scrubbing action may be produced.

For certain purposes it may be desirable to control the pressure exerted in the scrubbing action by varying the spacing between members of constant shape rather than by utilizing deformation or flexure under the centrifugal influence of the rotation as previously described.

In many operations it will be preferable to use the scrubbing apparatus merely as a scrubber and not as a pump. Fig. 6 illustrates an arrangement well suited for such an operation. The container $C^3$ of this form is mounted on a suitable frame F by connecting its conical end wall **101** with supporting surfaces of the frame by means of bolts **102** or other suitable fastenings. The wall **101** has a central opening in which a nipple or inlet member **103** is fitted to provide a feed passage **104** to the unit.

A lining member **105** is fitted against the inner surface of conical end wall **101** and preferably is rubber or similar flexible wear-resistant composition. This member is held centrally in a groove or slot **106** by a clamping member **107** and is held at its periphery by a clamping ring member designated generally by the reference numeral **108** and comprising an outer flexible ring or band **109**, preferably metal, and an inner member **110**, preferably comprising molded rubber on a metallic core.

The opposite end wall of casing $C^3$ comprises an inner wear plate or disc **111** and an outer plate **112** supported from frame F by a structural assembly **113**. A nipple **114** extending outwardly through an opening in ring member **108** functions as the discharge outlet of the unit and connects with a conduit **115** which delivers the discharge by gravity to a pump or other impelling means (not shown) by which it is conducted to the next stage of the treatment.

Shaft S³ is mounted for rotation in the manner hereinbefore described and is driven by a suitable prime mover (not shown) with its free end extending through central openings in plates 111 and 112 and carries a hub member 116 against which a flexible, wear-resistant disc 117 is held by a flat headed nut member 118. The outer portion of disc 117 in its inactive position is bent slightly by contact with lining 105 and during rotation is subjected to the distortion effect aforementioned, thus exerting a steady and forceful pressure against said lining. Leakage of pulp solution along shaft S³ is prevented by the provision of a stuffing box 120, of any suitable type, and which may comprise a cap member 121, a gland 122, and suitable packing material (not shown).

From the foregoing description of the various constructions and arrangements which may be utilized in the practice of this invention, it will be apparent that a thorough and intense scrubbing is given the particles of a pulp in a single pass through the apparatus. When the nature of the material requires a succession of such treatments, the series arrangement shown in Fig. 2, or the multiple stage treatment shown in Fig. 3 are examples of equipment arrangements which may be used. While only two treatment stages have been shown in each of these examples, they are intended to indicate the arrangement of any plurality of such stages which may be utilized in this way.

In all these forms, it will be noted that it is preferable to utilize an elastic material in forming the rotary member to the end that such material will flow or stretch to permit the reshaping of said member under the centrifugal influence or otherwise exert sufficient pressure against the other cooperative member from which it is spaced when not operating, to insure a high degree of scrubbing when the solids of the pulp are moved between the contacting surfaces. Since most pulps treated in the apparatus contain abrasive solids it is preferable to have the cooperative surfaces formed of some abrasion-resistant composition.

For this reason, I prefer to use natural or synthetic rubber compositions in forming the rotary member and the wear surface of the other cooperative member, although for some purposes it may be advantageous to use other materials, such as felt, leather, soft plastics or similar elastic or yieldable compositions. All of such compositions are what may be termed elastoplast materials as defined in Hackh's Chemical Dictionary, second edition, page 330, namely, "a substance having both elastic and plastic properties." Where the yieldable property is not required as in the treatment of some relatively soft materials, a flexible or other suitable metal may be used in forming the rotary member.

The feature of providing for lengthwise adjustment of the shaft supporting the rotary member to selectively vary the spacing between the cooperative members is advantageous in adapting a given apparatus for the treatment of a variety of pulps or to accommodate variations in a given pulp and thus insure substantially optimum scrubbing at all times during continuous operation. While the structural arrangement has been illustrated only in the forms shown in Fig. 1, it will be apparent that the same adjustment may be included in the various other forms shown in the drawings.

Another feature of the action of the present apparatus is that it may be used in filming as well as scrubbing particle surface, when conditioning pulps for froth flotation, for example. In such operations, the various reagent compositions may be introduced into the pulp before it is fed into the scrubbing apparatus and in the subsequent treatment, the scrubber apparatus functions additionally as a reactor chamber for mixing such reagents with the particles of the pulp to condition them for subsequent treatments.

From the foregoing description it will be apparent that many of the component parts are interchangeable in the various forms illustrated and the adjustments and controls disclosed are adapted for use with all the forms, although illustrated as applied to only certain of the forms. The various arrangements of cooperative members are suited for installation in the various scrubber assemblies illustrated and changes and variations in composition of materials may be availed of as pointed out herein.

Through the use of scrubber apparatus of the type disclosed herein, a rapid and intense scrubbing action can be obtained with low cost, efficient operation and with only a minimum of wear on operating parts. Features of the operation described but not claimed herein have been made the subject matter of claims in my copending application Serial No. 623,665.

In the preceding description, reference has been made to a distortable cooperative member and to its distortion in operation to accomplish the desired pressure of one surface against the other. It will be understood that the distortion referred to is not a permanent distortion or deformation of the material, but is only a temporary condition utilized in obtaining the desired scrubbing action. Consequently, as used throughout the specification, such terms should be interpreted as applying to the temporary or existing condition rather than implying that the condition or arrangement is permanent.

What I claim and desire to secure by Letters Patent is:

1. In ore scrubbing apparatus of the type in which an ore pulp is continuously moved in and out of a container and subjected to a scrubbing action therein, the improvement which comprises a container having an interior conical pulp-contacting surface, a rotary disc formed of an elastoplast material so as to be capable of deforming movement and supported adjacent its center and with its remaining peripheral portion freely suspended and positioned in proximate and substantially parallel relation to said pulp-contacting surface of the container, said pulp-contacting surface being inclined at a distinct angle to the plane of rotation of said disc and positioned for contact with said rotary disc during rotation of the disc, there being a feed-delivery opening through one of said contacting surfaces adjacent its center for the introduction of an ore pulp between said surfaces, and mechanism arranged to drive said rotary disc so as to cause it to distort and tend to shift its adjoining surface to approach contact with said pulp-contacting surface and thereby encompass a major portion of the surface of each particle passing between said material-contacting surfaces.

2. Ore scrubbing apparatus comprising a cylindrical container for fluent pulps having a central feed inlet at one of its ends and a laterally-directed discharge outlet distant from said inlet, and cooperative members dividing the interior of the container into an intake portion and a

discharge portion with a restricted passage therebetween for the movement of material between said inlet and said outlet, said passage being formed by substantially parallel surfaces of said members, one stationary and one rotary, the stationary surface bounding a conical zone, the sides of which inclined at an angle less than 90° to the axis of rotation and said rotary surface being located inside the conical bounds and formed of a sheet of elastoplast material so as to be capable of deforming movement, said material being supported for rotation adjacent its center and with its remaining peripheral portion freely suspended and tending to assume a perpendicular relation to the axis of rotation under the centrifugal forces of rotation and thereby bear against the stationary member, and mechanism for driving the rotary member to thereby cause the particles of the feed to assume a progressive rolling movement through said passage.

3. Ore scrubbing apparatus comprising a hollow casing having a central opening at one of its ends and a discharge outlet distant therefrom, a horizontal shaft journalled for rotation and extending into said casing through its end opposite the inlet end, a rotary member spaced from and parallel to a contiguous surface of the container and dividing its interior into an intake portion and a discharge portion and providing a passage for movement of material from the central opening to the discharge portion, the contiguous surface bounding a conical zone, the sides of which incline at an angle less than 90° to the axis of rotation and said rotary surface being located inside the conical bounds and formed of a sheet of elastoplast material so as to be capable of deforming movement with its central portion mounted on the shaft and its remaining peripheral portion freely suspended and positioned at an angle less than 90° to the shaft thereby enabling a distorting movement toward the contiguous surface under the centrifugal force of rotation so as to bear against particles in the passage and conform to the contour of said particles, and means for rotating said shaft.

4. Apparatus as defined in claim 3, inclusive of mechanism, including a screw, mounted at an end of the shaft for varying the spacing between said rotary member and the contiguous surface.

5. Ore scrubbing apparatus comprising a container having a feed inlet and a discharge outlet, a series of spaced partition members located within said container and dividing the space between the inlet and the outlet into a plurality of treatment zones, there being a central opening through each said partition member, a rotary shaft extending through at least one of said openings and carrying a series of rotary members in proximate and substantially parallel and contiguous relation to the respective partitions to provide a pulp passage between adjoining zones in the respective passages, each rotary member being formed of a sheet of elastoplast material having its peripheral portion freely suspended so as to be capable of deforming movement in various directions and positioned on the shaft with its peripheral portion offset from its path of rotation so as to induce a distorting movement toward the contiguous partition surface under the centrifugal force of rotation and thereby bear against and conform to the contour of particles in the respective passages.

6. Ore scrubbing apparatus comprising a plurality of treatment units arranged in series, each such unit comprising a pulp receptacle having a



feed inlet and a discharge outlet, and cooperative members dividing the interior of each receptacle into an intake portion and a discharge portion and providing a restricted passage therebetween for the movement of material between said inlet and said outlet, said passage being formed by substantially parallel surfaces of said members one stationary and one rotary, the stationary surface bounding a conical zone, the sides of which incline at an angle less than 90° to the axis of said rotation and said rotary surface being located inside the conical bounds and formed of a sheet of elastoplast material so as to be capable of deforming movement and supported for rotation adjacent its center and with its remaining peripheral portion freely suspended and positioned during rotation in direct contact relation with the other said member throughout substantially its entire contact area, except as such surfaces are separated by pulp constituents passing between the inlet and outlet, conductive means disposed between said receptacles for the passage of material from the discharge portion of one receptacle into the intake portion of the next receptacle in the series, and mechanism for driving the rotary members to thereby cause the particles of the feed to assume a progressive rolling movement through said passage.

7. Ore scrubbing apparatus comprising a hollow casing having a central opening at one of its ends and a discharge outlet distant therefrom, a horizontal shaft journalled for rotation and extending into said casing through its end opposite the inlet end, a rotary member spaced from a contiguous surface of the container and dividing its interior into an intake portion and a discharge portion and providing a passage for movement of material from the central opening to said discharge portion, said passage being formed by substantially parallel surfaces of said members, one stationary and one rotary, the stationary surface bounding a conical zone, the sides of which incline at an angle less than 90° to the axis of said rotation and said rotary surface being located inside the conical bounds and formed of a sheet of elastoplast material so as to be capable of deforming movement with its peripheral portion freely suspended and positioned at an angle less than 90° to the shaft thereby enabling a distorting movement toward the contiguous surface under the centrifugal force of rotation so as to bear against ore particles in the passage and conform to the contour of said particles, means for rotating said shaft, and mechanism including a screw mounted at an end of the shaft and a spring interposed between said shaft and said screw for moving said shaft lengthwise to thereby vary the spacing between the rotary member and the contiguous surface.

8. Ore scrubbing apparatus comprising a container for fluent pulps having a feed intake and a discharge outlet, and cooperative substantially parallel dished-shaped members dividing the interior of the container into an intake portion and a discharge portion with a restricted passage therebetween for the movement of material between said inlet and said outlet, the inner of said members being formed of a sheet of elastoplast material so as to be capable of deforming movement supported for rotation adjacent its center and with its conical portion freely suspended and positioned by centrifugal force during rotation in direct contact relation with the other of said member throughout substantially the entire conical portion of said dished-shaped surface

area of said member, except as such surfaces are separated by pulp constituents passing between the inlet and the outlet, and mechanism for driving the rotary member to thereby cause the particles of the feed to assume a progressive rolling movement through said passage.

9. Apparatus as defined in claim 8, inclusive of mechanism arranged to act on at least one of said cooperative members to vary the spacing between said members.

10. Apparatus as defined in claim 8, inclusive of mechanism arranged to act on at least one of said cooperative members to vary the spacing between said members, and indicatory means arranged to measure said variation.

11. Ore scrubbing apparatus comprising a container for fluent pulps having a feed inlet and a discharge outlet, and cooperative substantially parallel dished-shaped members dividing the interior of the container into an intake portion and a discharge portion with a restricted passage therebetween for the movement of material between said inlet and said outlet, the inner of said members being formed of rubber so as to be capable of deforming movement and supported for rotation adjacent its center and with its conical portion freely suspended and positioned by centrifugal force during rotation in direct contact relation with the other said member throughout substantially the entire conical surface area of said member, except as such surfaces are separated by pulp constituents passing between the inlet and the outlet, and mechanism for driving the rotary member to thereby cause the particles of the feed to assume a progressive rolling movement through said passage.

12. Ore scrubbing apparatus comprising a container for fluent pulps having a feed inlet and a discharge outlet, and cooperative substantially parallel dished-shaped members dividing the interior of the container into an intake portion and a discharge portion and providing a restricted passage therebetween for the movement of material between said inlet and said outlet, the inner of said members being formed of a sheet of elastoplast material so as to be capable of deforming movement and supported for rotation adjacent its center and with its conical portion freely suspended and arranged in partially acute-angular relation to its axis of rotation when inactive and adapted to distort in a movement toward a true perpendicular relation to its axis of rotation and in the direction of the other cooperative member under centrifugal force of rotation, thereby conforming to the contour of the particles passing through said restricted passage, and mechanism for driving the rotary member to thereby cause the particles of the feed to assume a progressive rolling movement through said passage.



13. Apparatus as defined in claim 8 in which the elastoplast material is a rubber composition.

14. Ore scrubbing apparatus comprising a cylindrical container having a conical end portion provided with an intake opening and a discharge opening in another surface of the container for the discharge of ore pulp from the container, a shaft extending into the container through its end opposite said conical end, a rotary member spaced from the inner surface of the conical end wall and dividing the interior of the container into an intake portion and a discharge portion, said member being formed of a sheet of elastoplast material so as to be capable of deforming movement in various directions and with its central portion mounted on said shaft and its remaining peripheral portion freely suspended and positioned in converging relation to said conical end portion and tending to assume a perpendicular relation to the axis of rotation under the centrifugal force of rotation and thereby bear against said conical end portion, and mechanism for driving the shaft and said rotary member to thereby cause particles of the feed to assume a progressive rolling movement through said passage.

15. Ore scrubbing apparatus as defined in claim 14, in which the inner conical end surface is formed of a rubber composition.

ARTHUR J. WEINIG.


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| 237,839 | Eichelberger | Feb. 15, 1881 |
| 255,862 | Hoyt | Apr. 4, 1882 |
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