Dec. 25, 1956 J. BAXTER, JR 2,775,168

PAPER MACHINERY

Filed Oct. 20, 1953 2 Sheets-Sheet 1

FIG-1

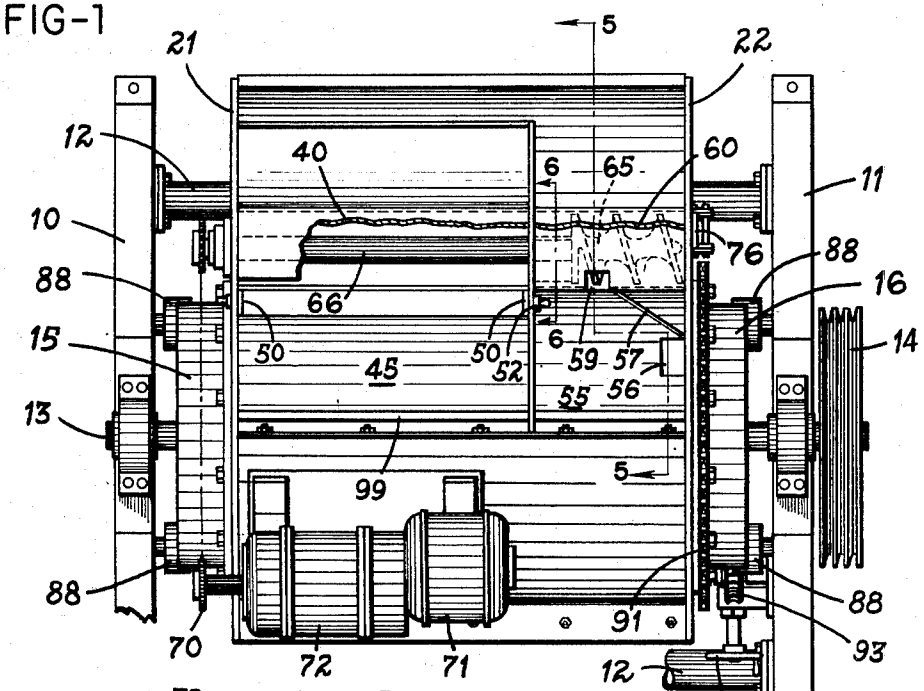
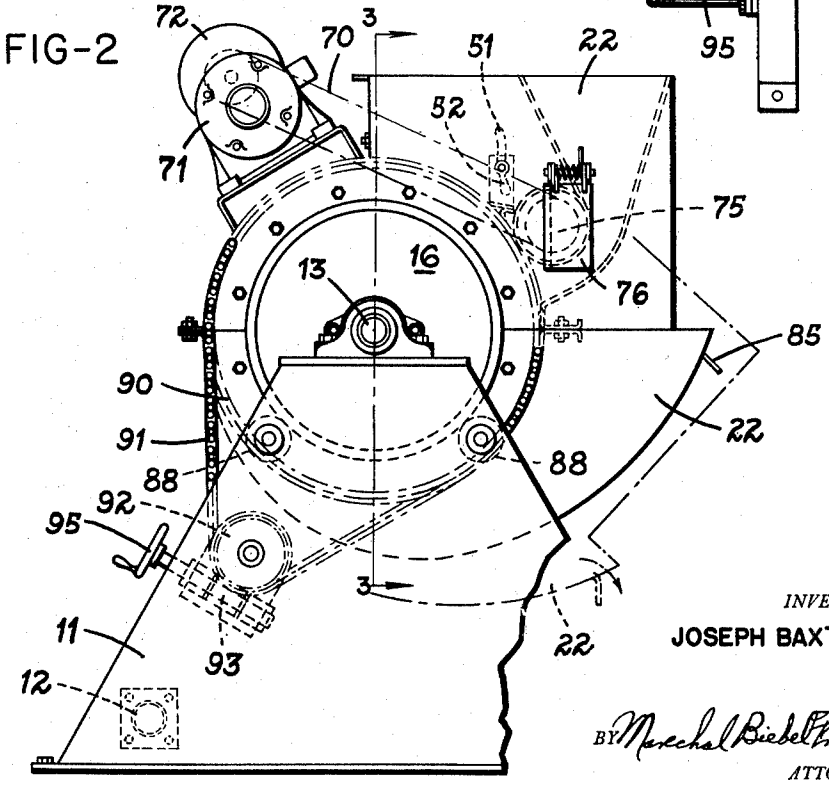


FIG-2



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FIG-3

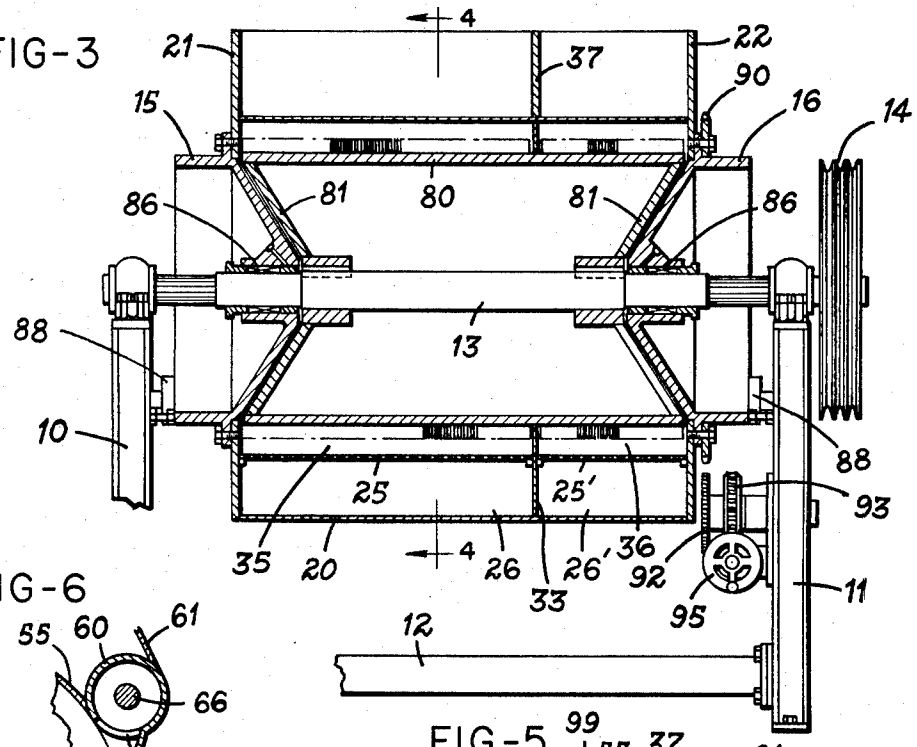


FIG-6

FIG-5

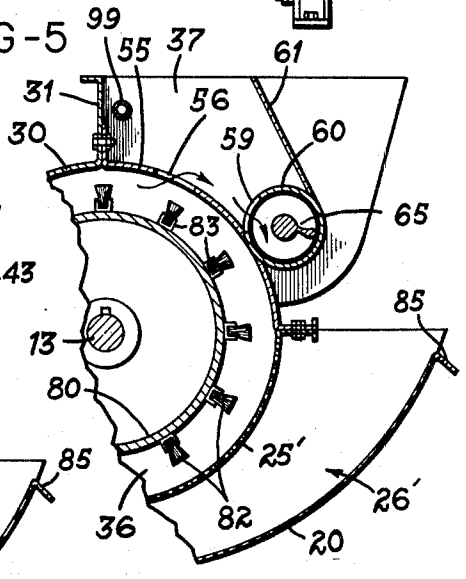
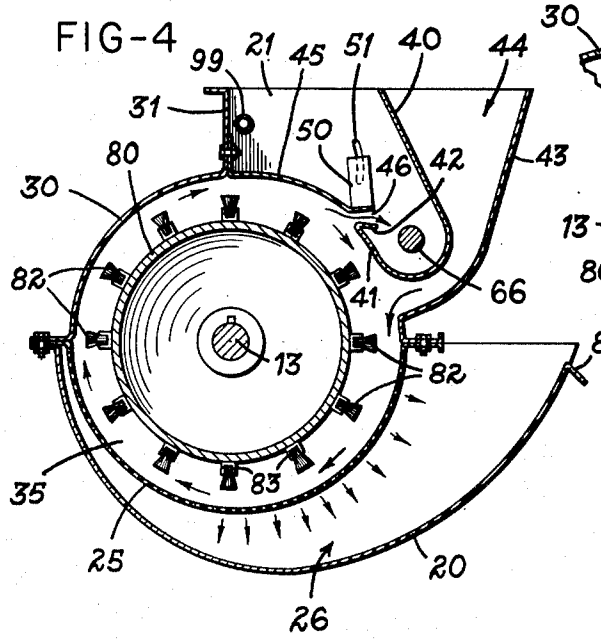


FIG-4



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2,775,168

PAPER MACHINERY

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Application October 20, 1953, Serial No. 387,151

9 Claims. (Cl. 92—23)

This invention relates to apparatus for effecting combined screening and pulping operations on a liquid slurry stock such particularly as paper making stock, and the invention has special relation to improved and simplified apparatus of the general characteristics disclosed in my copending application Serial No. 238,001, filed July 21, 1951 and assigned to the same assignee as this application, now Patent No. 2,661,664, issued December 8, 1953.

The invention is especially directed to the provision of apparatus capable of both reducing large particles of fiber to a suitable small size for refining and also of screening the reduced particles to separate therefrom undesirably large particles such as floating trash and the like. A major object of the invention is to provide such apparatus in the form of a single self-contained unit of simplified construction and low operating cost which will operate in such manner as first to subject all the incoming stock to agitation under conditions effecting separation of the major portion of usable fiber, then to screen off the separated fibers and to transfer the large unreduced particles to a second agitation station at decreased consistency for further defibering and screening of the good fiber, and finally to discharge the remaining reject material in semi-dry condition.

It is especially an object of the invention to provide apparatus as outlined above which is of simplified construction for initial fabrication and assembly and also for ease of maintenance and especially of servicing for purposes such as general cleaning, replacement of screen plates and the like in a minimum of time.

It is also an object of the invention to provide apparatus of the above general characteristics wherein all the operating parts are carried by a main shell which includes a sump portion for receiving the screened stock and which is mounted for rotation on the base of the unit in such manner as to dump the entire contents thereof by simple rotation to a dumping position for maximum ease of cleaning as well as facilitating access to all parts of the unit which may require servicing.

Additional objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

Fig. 1 is a plan view, partly broken away, showing a pulping and screening apparatus constructed in accordance with the invention;

Fig. 2 is an end elevation looking from left to right in Fig. 1 and with the driving pulley removed;

Fig. 3 is a vertical section on the line 3—3 of Fig. 2;

Fig. 4 is a vertical section on the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary section on the line 5—5 of Fig. 1; and

Fig. 6 is a fragmentary section on the line 6—6 of Fig. 1.

Referring to the drawings, which illustrate a preferred embodiment of the invention, the base of the unit is formed by a pair of end stands 10 and 11 connected by cross braces 12 and supporting the main drive shaft 13,

which is shown as provided with a driving sheave 14. The main shell of the unit includes a pair of heads 15 and 16 journaled on the shaft 13. The bottom wall of the shell is formed by a semi-cylindrical wall 20 which forms a trough and is welded between end plates 21 and 22 bolted to the heads 15 and 16 respectively, and assembly and maintenance are facilitated if the end plates 21 and 22 are in separate upper and lower sections for more convenient handling. Within the trough 20 is a semi-cylindrical screen plate 25 which is of smaller radius than the trough 20 and is radially offset within trough 20 to leave a sump 26, and satisfactory results are obtained with the holes in this screen plate of circular form and approximately ⅛ inch in diameter.

The upper part of the shell includes a cylindrically curved wall section 30 which is bolted along its lower edge to flanges on the trough 20 and screen 25 and which includes along its upper edge a vertical wall section 31 welded at opposite ends to the end plates 21 and 22. The screen 25 and wall section 30 thus cooperate to define approximately three-fourths of a cylinder, and a radial partition 33 separates the interior of this cylinder into a relatively large primary chamber 35 and a smaller secondary chamber 36, which may advantageously be approximately one-half the size of the primary chamber. A vertical wall 37 is mounted on the top of the unit in line with the partition 33. The screen 25 may be the length of both of chambers 35 and 36, but for convenience of assembly it is shown as in two parts 25 and 25', and the partition 33 similarly forms a sump chamber 26' below screen section 25' in trough 20.

A J-shaped wall section 40 is welded between the end wall 21 and the wall 37, and it includes a trough section 41 which forms a part of the upper wall of the chamber section 35 and terminates in a flanged lip 42. An additional wall 43 is welded between the end wall 21 and the vertical wall 37 for cooperation with the wall 40 to form a funnel-shaped hopper 44 for receiving the stock to be pulped and screened, and this hopper opens at its lower end directly into the primary chamber 35 in such manner as to deliver the incoming stock substantially horizontally into chamber 35. The remaining wall section for the primary chamber 35 is formed by a flexible segment 45 bolted at its upper end to the wall section 31 and adapted at its lower end to seat on the flanged lip 42 of the wall 40.

The segment 45 is flexibly adjustable with respect to the lip 42 to vary the size of the discharge passage 46 thus formed therebetween. Adjustment of segment 45 is effected by a pair of vertical plates 50 secured to opposite ends of segment 45 and abutting the adjacent wall 21 or 37. Each of these walls has a slot 51 therein to receive a bolt projecting from the adjacent plate 50 and carrying a nut 52 having a handle thereon to lock the plates 50 in the desired adjusted position of the segment 45.

The secondary chamber 36 is provided with a cylindrically curved cover section 55 which is welded between the walls 22 and 37 and is bolted as shown to the trough 20 and wall section 31. This wall 55 is provided with a discharge outlet 56 adjacent the wall 22 and hence at the opposite end of the secondary chamber from the partition 33. A baffle 57 projects upwardly from wall 55 and extends from just below the outlet 56 to an inlet opening 59 in a cylindrical casing 60 leading from the wall 37 through the wall 22. An additional wall 61 extends upwardly from casing 60 in line with the wall section 40 and is welded between the walls 22 and 37.

The cylindrical casing 60 houses a compaction screw 65 at the forward end of a shaft 66 which extends at its rearward end through the wall 21 and is driven through

the sprocket drive **70** by a motor **71** and gear reduction **72** mounted at a convenient location on the casing wall **30**. The casing **60** is entirely open through the wall **37**, but its outer end at the wall **22** is provided with a semi-circular discharge opening **75**, and a counterweighted closure **76** is mounted on wall **22** for normally closing the outlet **75**, this general arrangement of the compaction screw and counterweighted closure being of the type disclosed in my Patent No. 2,622,795, issued December 23, 1952, to the assignee of this application. The casing **60** is also provided with an outlet opening **77** in its lower side adjacent the wall **37** for connecting directly with the secondary chamber **36**.

Within the chambers **35** and **36** is an impeller unit comprising a drum **80** mounted for rotation with shaft **13** by means of end heads **81** keyed to the shaft. The drum **80** is provided on its outer surface with a plurality of axially arranged brushes or bristles **82**, which may be formed of steel wires arranged in axially extending and angularly spaced rows along the drum, with these rows mounted on the drum face by means of V-shaped clips **83**. Satisfactory results are obtained, for example, with bristles approximately 1/64 inch in diameter and two inches in length grouped in twelve rows each one inch in thickness on a drum 20 inches in outer diameter when the inner diameter of the chambers **35** and **36** is approximately twenty-seven inches. The drive to this brush impeller is through the sheave **14** as already described. It will also be noted that shaft **13** is slightly radially offset with respect to the center of curvature of the screen **25** and wall **30** to provide a correspondingly greater radial spacing between drum **80** and the screen adjacent the intake hopper **44** than at the opposite side of the drum.

In operation, the height of the liquid within the chambers **35** and **36** will be determined by the height of the overflow from the trough **20**, which is provided with an overflow lip **85** to a suitable chest (not shown). Control of the liquid level is accordingly accomplished by mounting the entire unit for rotation on the end stands **10** and **11**. As shown, the heads **15** and **16** are provided with sealed bearings **86** on the shaft **13**, and each head is also supported by a pair of rollers **88** on the adjacent end stand. The head **16** has a large sprocket wheel **90** bolted thereto and connected by a chain **91** with a smaller sprocket **92** mounted on the end stand **11** and driven through the worm and pinion **93** by a handwheel **95**.

In operation, the stock to be pulped and screened enters as stated through the trough **44** and flows into the primary chamber **35** substantially directly against the brush impeller **80—82**, which is rotated in clockwise direction as viewed in Fig. 4. This causes generally circumferential flow of the stock within the chamber **35**, and with the impeller rotating at substantially greater surface speed than the incoming velocity of the stock, for example six times as great, the individual rows of brushes or tufts will effectively comb the stock a corresponding number of times before the individual particles attain the same speed as the bristles. This action in turn causes the ends of the bristles to whip against the inertia of the stock in such manner as to tear apart the bundle of fiber or trash and other particles.

As the particles of fiber are thus reduced to sufficiently small size to pass through the perforations in the screen plate **25**, they flow with the liquid into the sump **26**, and the velocity imparted to them by the impeller tends to drive them through the screen. At the same time, the arrangement of the rows of bristles in angularly spaced relation on the surface of the impeller drum tends to create a pulsating or back flow effect which acts to prevent the screen from felting over by the fibers and especially also to lift pieces of cellophane or like floating trash away from the screen plate. As the operation of the apparatus continues, the floating trash and other particles in chamber **35** which are too large to pass through screen **25** are thrown through the discharge slot **46** into the trough-like portion of the wall **40**, with the rate of this discharge being regulated by adjustment of the lip **42** as described.

This discharged reject material will include a substantial portion of water, and additional water may be readily added thereto by means of a shower pipe **99** mounted along the vertical wall section **31**. The reject particles will accordingly float into the open end of the casing **60** and thence down through the opening **77** into the secondary chamber **36**. In the chamber **36**, the discharged particles will be again subjected to the same treatment as in the primary chamber **35**, and since the concentration of solids in this part of the stock will normally be substantially less than in the primary chamber, such good fibers as remain will be readily separated from the reject and floating trash for passage through the screen plate **25** into the sump **26**. In addition, since the discharge outlet **56** is at the opposite end of chamber **36** from the inlet **77**, the large particles will be forced to travel the full axial length of chamber **36** for maximum pulping action before finally being thrown out by centrifugal force through the outlet **56**. Such discharged particles will be floated down along the wall **55** and baffle **57** to the opening **59** into the casing **60**, this action being aided by the water from the shower pipe **99**.

The reject material ultimately reaching the casing **60** through the opening **58** will be picked up by the screw **65** and carried towards its outlet **75**. This accumulated reject is first compacted into a relatively solid slug between the end of the screen and closure **76**, with the water therein being squeezed out and running back to the opening **77**. When sufficient reject has accumulated to open counterweighted closure **75**, this reject will be gradually extruded, the vertical wall on the opening **75** acting to shear the slug of reject for effective discharge in the form of a damp sludge including relatively little liquid. The semi-circular shape of the outlet **75** aids this continuous discharge by preventing possible rotation of the slug with the compaction screw.

As stated, the level of liquid within the chambers **35** and **36** is controlled by rotation of the casing as a whole, which will normally be maintained in the position shown in Fig. 4 and in full lines in Fig. 2. The liquid level can be lowered as indicated in dotted lines in Fig. 2, and this is especially advantageous for final dumping of the unit at the end of a run. It will also be apparent that this arrangement greatly facilitates washing out the casing between runs as well as general overhaul of the unit. Thus instead of requiring complete dismantling if, for example, the impeller requires servicing, it is necessary merely to rotate the unit until it is completely upside down, in which position the bottom wall **20** and the screen plates are all available for easy removal from above to expose the impeller, and the same procedure is followed for exchanging screen plates.

The apparatus of the invention is accordingly especially useful for the treatment of waste paper stock and the like, and it not only provides both a pulping and selective screening action in a single unit, but it has further advantages of compactness together with low initial cost and also low operating cost. Thus, for example, a unit constructed as shown and having a capacity of 50 tons of mixed paper stock per day requires only about 25 square feet of floor space. Also, it requires no special plumbing or like attachments with other parts of the stock preparation system, since the incoming stock may be simply dumped into its intake hopper while its screened stock is discharged into any suitable chest or flow trough. Finally, this apparatus is so constructed as to minimize wear on its moving parts while at the same time affording ease of accessibility to all parts thereof for maintenance as required.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be

understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, means defining a discharge passage from said first chamber through said cover, impeller means extending lengthwise of both said chambers for rotation therein causing essentially circumferential travel of said stock and discharge through said passage of large particles too large to pass through said screen into said sump, means for conducting said discharged large particles into said secondary chamber for further reduction and discharge through said screen into said sump, and means forming a discharge outlet in said cover from said secondary chamber for particles too large to pass through said screen, both said discharge outlet and said discharge passage being in portions of said cover located above the rotational axis of said impeller for essentially tangential discharge of said particles therethrough.

2. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, impeller means extending through both said chambers for rotation about an axis arranged lengthwise of said chambers, means defining a discharge passage from said primary chamber extending lengthwise of said primary chamber through said cover and located above the axis of said impeller, means for conducting discharged particles from said passage into said secondary chamber, means forming a discharge outlet in said cover from said secondary chamber and located above the axis of said impeller, means for rotating said impeller means in the direction to cause essentially circumferential travel of said stock in said chamber with resulting reduction of the particles therein and generally tangential discharge through said passage of particles too large to pass through said screen into said sump followed by further reduction of said discharged particles in said secondary chamber and finally by generally tangential discharge through said outlet of particles still too large to pass through said screen into said sump, and means for varying the effective flow area through said discharge passage to regulate the rate of discharge of said particles therethrough.

3. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, impeller means extending through both said chambers for rotation about an axis arranged lengthwise of said chambers, means defining a discharge passage from said primary chamber extending lengthwise thereof through said cover and located above said impeller axis, means for conducting discharged particles from said passage into the adjacent end of said secondary chamber, means forming a discharge outlet from said secondary chamber located in said cover above said impeller axis and at the opposite end of said secondary chamber from said primary chamber, and means for rotating said impeller means in the direction to cause essentially circumferential travel of said stock in said chamber with resulting reduction of the particles therein and generally tangential discharge through said passage of particles too large to pass through said screen into said sump followed by further reduction of said discharged particles in said secondary chamber and finally by generally tangential discharge through said outlet of particles still too large to pass through said screen into said sump.

4. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including a curved upper wall forming a cover and a lower wall forming a sump, a curved perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, impeller means extending through both said chambers for rotation about an axis arranged lengthwise of said chambers, means including a movable portion of said cover defining a discharge passage from said primary chamber extending substantially the full length thereof through said cover, means for moving said movable cover portion to vary the effective flow area through said discharge passage for regulating the rate of discharge therethrough, means for conducting discharged particles from said passage into the adjacent end of said secondary chamber, means forming a discharge outlet from said secondary chamber located in said cover above said impeller axis and at the opposite end of said secondary chamber from said primary chamber, and means for rotating said impeller means in the direction to cause essentially circumferential travel of said stock in said chamber with resulting reduction of the particles therein and generally tangential discharge through said passage of particles too large to pass through said screen into said sump followed by further reduction of said discharged particles in said secondary chamber and finally by generally tangential discharge through said outlet of particles still too large to pass through said screen into said sump.

5. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, means defining a discharge passage from said first chamber through said cover, impeller means extending lengthwise of both said chambers for rotation therein causing essentially circumferential travel of said stock and discharge through said passage of large particles too large to pass through said screen into said sump, means for conducting said discharged large particles into said secondary chamber for further reduction and discharge through said screen into said sump, means forming a discharge outlet in said cover from said secondary chamber for particles too large to pass through said screen, both said discharge outlet and said discharge passage being in portions of said cover located above the rotational axis of said impeller for essentially tangential discharge of said particles therethrough, means forming a reject chamber on said shell, means for conducting said discharged particles from said discharge outlet to said reject chamber, and means in said reject chamber for compacting said particles and for discharging said compacted particles from said casing.

6. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an imperforate upper wall forming a cover and an imperforate lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump

having the lower portion thereof extending into said sump, means on said cover forming an inlet for stock to said chamber, means within said chamber for effecting pulping and screening of said stock through said screen into said sump, means on said lower wall forming a discharge lip for overflow of said screened stock from said sump, and rotary means supporting said shell for rotation on said base to regulate the liquid level within said sump and said chamber by adjusting the level of said lip through a range including a position maintaining said screen substantially submerged in liquid and a position providing for gravity discharge of substantially all the stock in said sump.

7. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump having the lower portion thereof extending into said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, means defining a discharge passage from said first chamber through said cover, impeller means extending lengthwise of both said chambers for rotation therein causing essentially circumferential travel of said stock and discharge through said passage of large particles too large to pass through said screen into said sump, means for conducting said discharged large particles into said secondary chamber for further reduction and discharge through said screen into said sump, means forming a discharge outlet in said cover from said secondary chamber for particles too large to pass through said screen, both said discharge outlet and said discharge passage being in portions of said cover located above the rotational axis of said impeller for essentially tangential discharge of said particles therethrough, means on said lower wall forming a discharge lip from said sump, rotary means supporting said shell for rotation on said base to regulate the liquid level within said sump and the lower portion of said main chamber by adjusting the level of said lip, and said rotary means being constructed to provide sufficient rotation of said shell for gravity discharge of substantially all the stock in said sump.

8. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, means on said shell forming an inlet for stock to said primary chamber, means defining a discharge passage from said first chamber through said cover, an impeller drum extending lengthwise of both said chambers for rotation therein, a plurality of rows of bristles extending axially across the face of said drum for causing essentially circumferential travel of said stock in said chamber upon rotation of said drum with resulting discharge through said passage of large particles too large to pass through said screen, said bristles being arranged in angularly spaced rows on said drum to create a pulsating effect within said chamber upon rotation of said drum for preventing clogging of said screen by the solid particles in said stock, means for conducting said discharged large particles into said secondary chamber for further reduction and discharge through said screen into said sump, and means forming a discharge outlet in said cover from said secondary chamber for particles too large to pass through said screen.

9. Apparatus for screening and pulping a liquid slurry stock comprising a base, a shell mounted on said base and including an upper wall forming a cover and a lower wall forming a sump, a perforate screen mounted within said shell and cooperating with said cover to form a main chamber above said sump, a radial partition forming primary and secondary chambers within said main chamber, a hopper on said chamber forming an inlet for stock to said primary chamber and having the lower end thereof located along the side of said shell, said hopper including a curved upper wall forming a trough extending lengthwise of said primary chamber, means defining a passage through said cover extending lengthwise of said primary chamber above said trough, impeller means extending lengthwise of both said chambers for rotation therein to cause essentially circumferential travel of said stock and generally tangential discharge through said passage into said trough of large particles too large to pass through said screen, means for conducting said discharged particles from said trough into said secondary chamber for further reduction and discharge through said screen into said sump, and means forming a discharge outlet in said cover from said secondary chamber of particles too large to pass through said screen.

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