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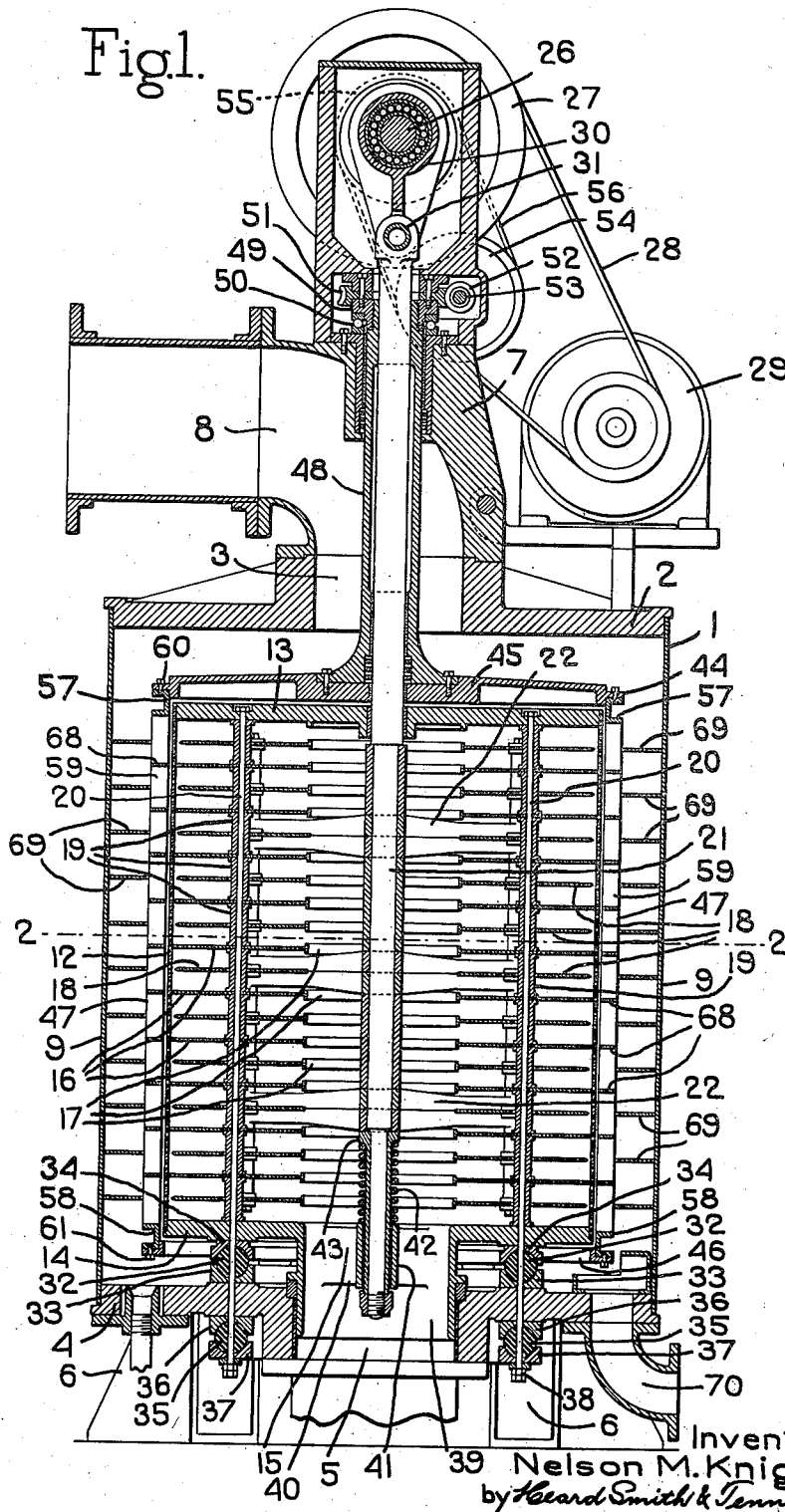
N. M. KNIGHT

2,230,647

PULP SCREENING MACHINE

Filed July 9, 1938

4 Sheets-Sheet 1



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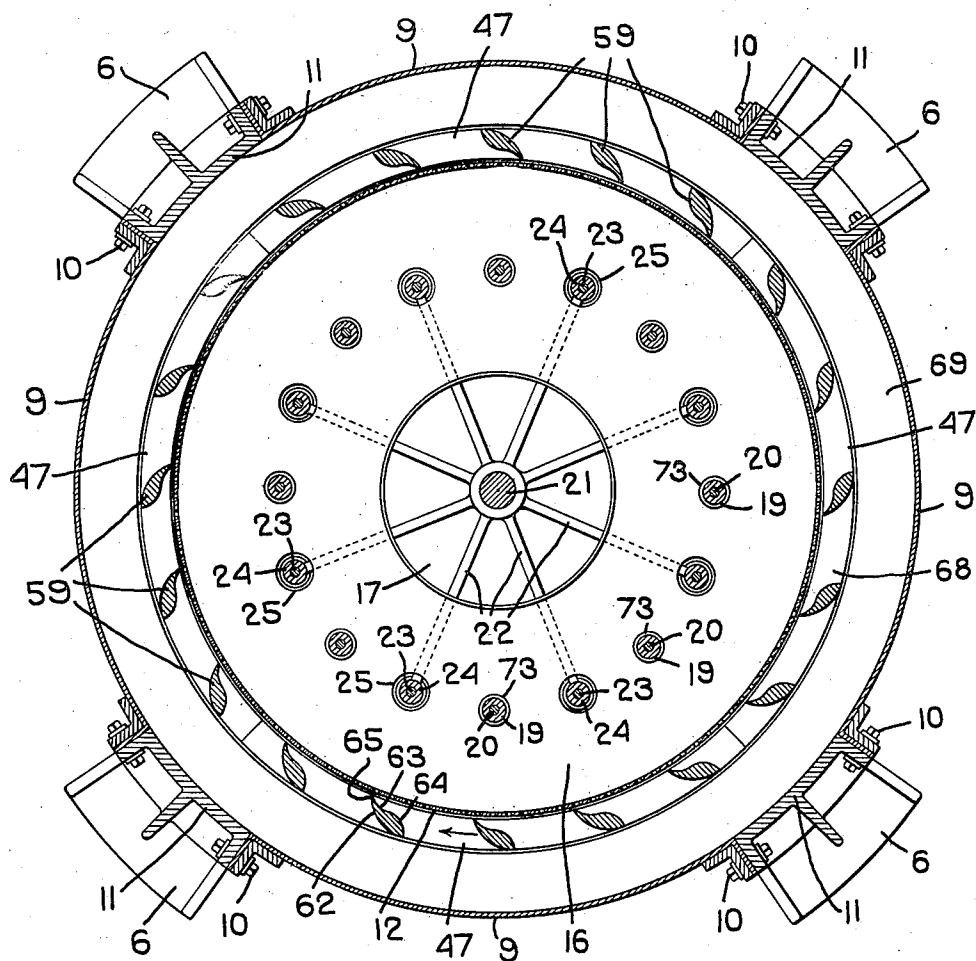
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Fig.2.



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Fig.3.

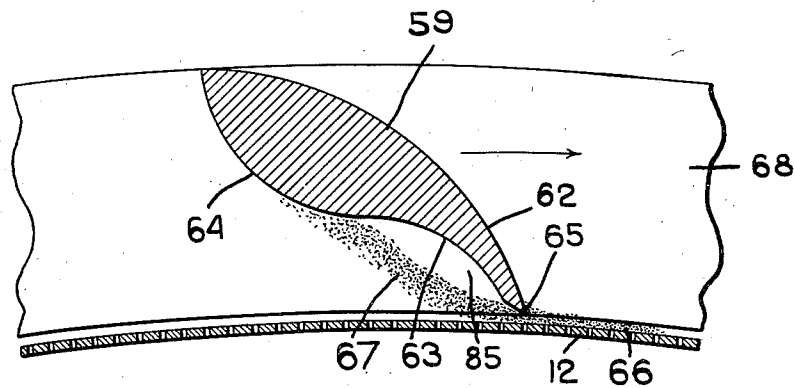
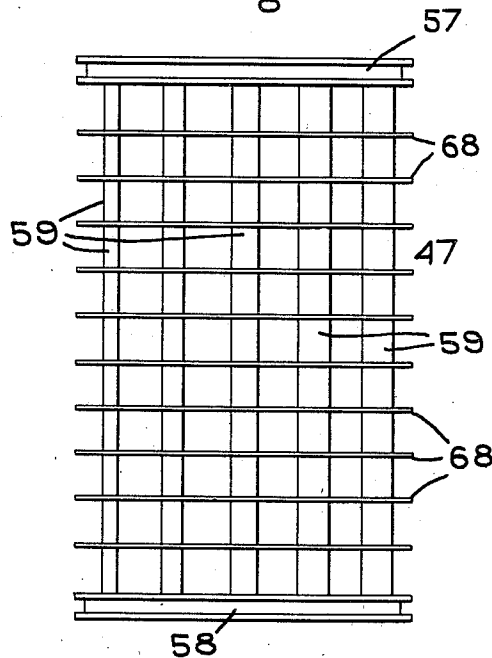


Fig.4.



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Fig.5.

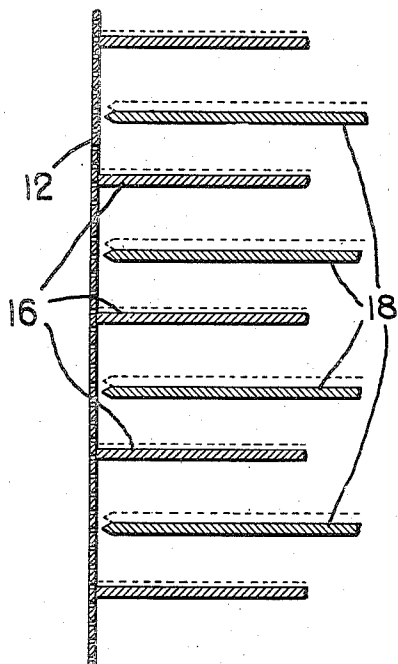


Fig.6.

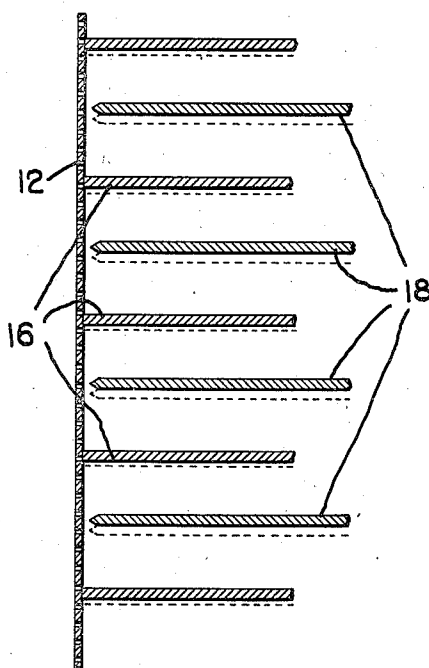
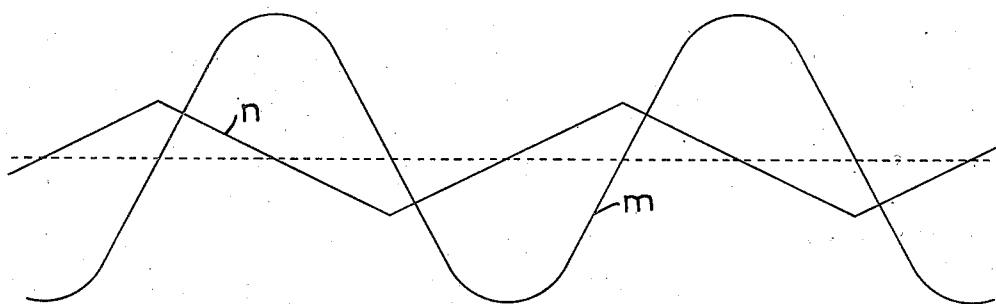


Fig.7.



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UNITED STATES PATENT OFFICE

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PULP SCREENING MACHINE

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4 Claims. (Cl. 92—29)

This invention relates to pulp screening machines which have a casing provided with a pulp inlet and a screened pulp outlet, and a screen within the casing between the inlet and the outlet for the purpose of screening the pulp.

In the operation of pulp screens, the coarse material and tailings which cannot pass through the screen gradually accumulate on the inlet side thereof, and if allowed to remain would seriously interfere with the screening operation.

It is customary to provide pulp screening machines with some form of screen-cleaning device having for its purpose to remove the coarse or waste material from the screen as it accumulates thereon, and it is one of the objects of my present invention to provide an improved form of screen-cleaning device which is movable over the screen and which is so constructed that as it moves over the screen, sufficient suction is produced by its movement at its trailing side to withdraw by suction all coarse or waste material from the screen.

I have herein shown my invention as embodied in a pulp-screening machine of the type shown in my Patents No. 2,003,150 dated May 23, 1935, and No. 2,122,475, dated July 5, 1938. This type of pulp screen has a cylindrical screening element situated within the casing and the screen-cleaning member encircles the screen and rotates thereabout and is provided with blades or runners that move over the outer surface of the screen. In adapting my invention to this type of pulp-screening machine, I make the blades of the screen-cleaning element of such cross-sectional shape that during rotation around the screen, a vacuum condition will be established at the trailing side of the blade and close to the screen, the result of which will be that the suction thus produced pulls all the waste or coarse material from the face of the screen, leaving the screen clean for further screening operation.

Another feature of my invention relates to a novel construction involving a series of baffle plates secured to the casing and between the latter and the screen-cleaning member and which have for their purpose to compel the pulp to be forced back and forth through the screen a plurality of times during its passage from the inlet to the outlet and to prevent establishment of a flow of unscreened pulp along the inner wall of the casing from the inlet to the tailings outlet.

In order to give an understanding of my invention I have illustrated in the drawings a selected embodiment thereof which will now be

described after which the novel features will be pointed out in the appended claims.

In the drawings:

Fig. 1 is a vertical sectional view through a pulp-screening machine embodying my invention;

Fig. 2 is an enlarged horizontal section on the line 2—2, Fig. 1;

Fig. 3 is a fragmentary sectional view showing one of the blades of the screen cleaning element and illustrating the manner in which it operates to clean the screen by suction;

Fig. 4 is a side view of one section of the screen-cleaning element.

Figs. 5 and 6 are fragmentary sectional views illustrating the relative movement of the pulsating plates and the baffle plates;

Fig. 7 is a graph illustrating the relative movements of the pulsating plates and baffle plates.

In the drawings, 1 indicates generally the casing of the pulp-screening machine, this being shown as a vertical cylindrical casing having an upper head 2 provided with an inlet 3 for the pulp to be screened and also having a lower head 4 provided with a central outlet 5 for the discharge of screened pulp. The casing is shown as supported on suitable legs or supports 6, and the upper head 2 has attached thereto a fitting or bearing member 7 having an inlet passage 8 through which the unscreened pulp is delivered to the inlet 3.

The casing 1 herein illustrated is constructed similarly to that shown in my Patent No. 2,122,475, and it comprises a plurality of curved plates 9 which are connected by bolts 10 to vertically extending posts 11.

The screen which is situated within the casing 1 is indicated at 12 and is shown as a cylindrical screen. Said screen is connected at its upper end to a screen head 13 and at its lower end to another screen head 14, the head 14 being provided with the central outlet opening 15 which communicates with the discharge opening 5 and through which the screened pulp flows.

The unscreened pulp thus flows into the casing 1 at the top and then flows through the screening wall 12 and is discharged through the central openings 15 and 5.

The screen 12 has a plurality of horizontally extending baffle plates 16 rigid therewith, each baffle plate being provided with a central opening 17. Situated between the baffle plates are pulsating plates 18 which are moved toward and from the baffle plates thereby causing the pulp to be pulsated or forced back and forth through

the screen 12 as it flows from the inlet to the outlet. The general construction of these baffle plates and pulsating plates is the same as that disclosed in my above mentioned patents. The baffle plates are held spaced relative to each other by suitable spacers 19 which are tied together by the tie rods 20, and which extend through openings 73 in the pulsating plates 18. The pulsating plates 18 are carried by a spindle 21 situated axially of the screen and which is vibrated in the direction of its axis. This spindle 21 is provided with a plurality of radially extending arms 22 to which certain of the pulsating plates are secured and the other pulsating plates are tied to those pulsating plates which are secured to the radiating arms 22 by means of tie rods 23. The pulsating plates are held spaced from each other by spacers 24 which pass through openings 25 in the baffle plates in the manner described in my above mentioned Patent 2,122,475.

The vertical vibration of the spindle 21 is derived from an eccentric portion 26 of a drive shaft which has a driving pulley 27 fast thereon, the latter being driven by a belt 28 from a suitable motor 29. The eccentric 26 has an eccentric strap 30 which is connected to the upper end of the spindle 21 as shown at 31, so that rotation of the driving shaft causes an up-and-down vibratory movement of the spindle.

As stated above the screen 12 is yieldingly supported. The yielding support therefore is somewhat similar to that illustrated in my said Patent No. 2,122,475, and comprises a plurality of rubber balls 32 which are confined between lower seat members 33 supported by the lower casing head 4 and upper seat members 34 which rest against or are secured to the lower screen head 14.

During the downward movement of the pulsating plates, each pulsating plate moves toward the baffle plate directly beneath it with the result that the pulp between any two plates that are approaching each other will be forced outwardly through the screen and at the same time pulp will flow inwardly through the screen into the enlarging space between each pulsating plate and baffle plate directly above it. This downward movement of the pulsating plate produces a downward pressure on the baffle plates and thus on the screen which causes the yielding balls 32 to be compressed slightly and thus permits a slight downward movement of the screen.

In the device herein illustrated there is provided an additional set of rubber balls 35 which are situated below the lower casing head 4 and are connected to the screen so that during the upward movement of the pulsating plates the upward pressure produced on the baffle plates and screen will serve to compress the balls 35 as the balls 32 were compressed during the downward movement of the pulsating plates.

These rubber balls 35 are confined between upper seat members 36 which rest against the underside of the lower casing head 4 and lower seat members 37. The tie rods 20 extend from the upper screen head 13 through the spacers 19, through the lower screen head 14, the balls 32 and their seats 34, 33, and through the lower casing head 4, the additional set of balls 35 and their seats 36, 37. The tie rods 20 are provided at their lower ends with suitable clamping nuts 38 by which the lower seat members 37 are tied to the screen structure.

With the construction above described including the two sets of rubber balls 32 and 35, the

screen will have an upward and downward movement during each upward movement of the pulsating plates, and will have both a downward and an upward movement during each downward movement of the pulsating plates. This is illustrated in Figs. 5, 6 and 7, Figs. 5 and 6 being somewhat in the nature of diagrammatic views which show a portion of the screen 12 with its baffle plates 16 and also some of the pulsating plates 18.

Since the spindle 21 is operated by an eccentric said spindle will have a simple harmonic motion, and during each half rotation of the eccentric which moves the spindle from one end to the other of its stroke, the velocity of the spindle will increase progressively from zero to its maximum speed during the first quarter of the revolution and will decrease progressively from maximum to zero during the second quarter of the revolution, the spindle being at rest for an instant while the eccentric is passing either its high point or its low point.

Assuming that the spindle 21 is at its low point and that the pulsating plates and baffle plates have the relative position shown in Fig. 5, then during the first quarter revolution, the pulsating plates will be moved upwardly from the full line position, Fig. 5, to the dotted line position, and during this movement, the pressure to which the pulp above the pulsating plates is subjected by the upward movement thereof will partially be transferred to the baffle plates 16 thus causing the baffle plates and screen to be raised slightly as shown by the dotted lines in Fig. 5. The maximum pressure which is generated by the upward movement of the pulsating plates occurs when the pulsating plates have reached their maximum speed in an upward direction, and this occurs at the end of the first 90° movement of the eccentric. This upward movement of the screen will serve to compress the rubber balls 35. During the second 90° movement of the eccentric which carries the spindle to the upper limit of its stroke and which moves the pulsating plates 18 from the dotted line position Figs. 5 and 6 to the full line position, Fig. 6, the speed of movement of the pulsating plates is gradually diminishing from maximum to zero and, therefore, the pressure of the pulsating plates against the pulp directly above them will be gradually diminishing pressure. The rubber balls 35 thus receive their maximum compression at the end of the first 90° movement of the eccentric or when the pulsating plates 18 and baffle plates 16 are in the dotted line position, Fig. 5. During the second 90° movement when the pressure of the pulp against the baffle plates is a decreasing pressure and the pulsating plates are moving from the dotted line position to the full line position, Fig. 6, the balls 35 recover their original shape thus bringing the screen 12 back to its normal position, that is the full line position in Fig. 5. During this time, the baffle plates will have a downward movement from the dotted line position back to the full line position and thus during the first half rotation of the eccentric and during the resultant upward movement of the pulsating plates from their low position to their high position, the baffle plates 16 and the screen 12 will have a slight upward movement and then a slight downward movement, thus practically subjecting the pulp to two pulsations.

The same operation occurs during the downward movement of the spindle 21 from its high point to its low point. During the first quarter

of the downward movement, the pulsating plates 18 will move from the full to the dotted line position Fig. 6, and during this movement the speed or velocity of the pulsating plates is gradually increasing due to the simple harmonic motion. The pressure developed on the pulp beneath the pulsating plates will force the baffle plates downwardly from the full line position Figs. 5 and 6 into the dotted line position Fig. 6. During the second 90° downward movement of the pulsating plates by which they are brought to the full line position, Fig. 5, from the dotted line positions Figs. 5 and 6, the speed of downward movement of the plates is gradually decreasing and the pressure which the plates apply to the pulp beneath them is also a decreasing pressure. When the pulsating plates 18 have reached the dotted line position, Fig. 6, and the baffle plates 16 have been forced downwardly into the dotted line position, Fig. 6, the balls 32 will be compressed to their maximum extent and during the second 90° downward movement of the pulsating plates the balls 32 will recover thus moving the baffle plates and screen upwardly from the dotted line position, Fig. 6, into the normal full line position shown in Figs. 5 and 6.

This relative movement of the screen and the baffle plates is illustrated graphically in Fig. 7 wherein the line *m* indicates the up and down movement of the pulsating plates and the line *n* indicates the up and down movement of the baffle plates and screen. A comparison of the lines *m* and *n* show that the baffle plates and screen have an up and down movement during each up or down movement of the pulsating plates.

The use of the two sets of rubber balls 32 and 35 thus produce a double pulsating action between the pulsating plates and the baffle plates which is extremely effective in forcing the pulp back and forth through the screen and which, therefore, increases the screening effect.

The lower screen head 14 is provided with a depending sleeve portion 39 which extends into the opening 5 of the lower casing head 4, and this sleeve portion 39 is formed with radially extending arms 40 which support a guiding sleeve 41 through which the lower end of the spindle 21 extends. 42 is a spring which encircles the lower end of the spindle 21 and is confined between the guiding sleeve 41 and a collar 43 on the spindle, said spring serving to yieldingly support the weight of the spindle and pulsating plates while permitting the spindle to vibrate relative to the screen.

During the screening operation the coarse material which cannot pass through the screen will tend to accumulate on the outside thereof, and as in my Patent No. 2,003,150, and also in my Patent No. 2,122,475, there is provided a screen-cleaning element which encircles the screen and rotates thereabout. In the present invention, however, this screen-cleaning element is constructed to clean the coarse unscreenable matter from the outside of the screen by suction.

The rotary screen-cleaning element is indicated generally at 44 and it comprises an upper head 45 above the screen and a lower ring member 46 below the screen, said head and ring being connected by screen-cleaning sections indicated at 47 and one of which is illustrated in Fig. 4.

The upper head 45 has a tubular neck 48 rising therefrom through which the spindle 21 extends, said neck extending through the bearing member 7 and having a collar 49 at its upper end which is rotatably supported on a suitable bearing member

50. The rotation is given to the screen-cleaning element 45 through a worm gear 51 which is secured to the head 49 and is driven by a worm 52 on a shaft 53 which has a sprocket wheel 54 thereon that is connected to a sprocket wheel 55 on the main driving shaft by means of a sprocket chain 56.

The screen-cleaning element 44 is thus rotated about the screen during the pulp-screening operations.

Each section 47 of the screen-cleaning element comprises an upper header 57 and a lower header 58 which are connected by vertical bars or runners 59. The upper header 57 is connected to the upper head 45 by suitable bolts 60 and the lower header 58 is connected to the ring 46 by suitable bolts 61.

The cross-sectional shape of the blades or runners 59 is such that as these blades move around the screen 12 a strong suction action is produced on the trailing side of each blade which suction action is sufficient to suck or draw the refuse matter or tailings from the screen, thus leaving the screen clean for further cleaning operations.

While the blades may have various cross-sectional shapes which will accomplish this purpose, I have found the shape illustrated in Figs. 2 and 3 to be eminently satisfactory. Each blade is shaped to provide the convexly curved outer or leading side 62 and a trailing side formed with a concavely curved surface 63 adjacent the inner edge of the blade, that is, adjacent the edge nearest to the screen 12, which concavely curved surface merges into the convex surface 64 at the outer portion of the blade. The blade is preferably made with a relatively sharp inner edge 65 adjacent the screen.

Each blade has a slightly inclined position relative to a radial line as best seen in Figs. 2 and 3 and as the blades move through the pulp relative to the screen 12 in the direction of the arrows in Figs. 2 and 3, the leading side 62 of each blade forms a stream-line surface over which the pulp will flow with relatively small resistance. A greatly reduced pressure or a vacuum condition will be established, however, at the point 85 immediately behind the concave surface 63 and the vacuum thus created at this point is sufficient to suck the refuse matter from the outside of the screen and to leave the latter clean.

This action is illustrated somewhat diagrammatically in Fig. 3 wherein the coarse matter which accumulates on the outside of the screen is shown at 66. The screen blades 59 are supported with their inner edges 65 slightly spaced from the screen and if the layer of waste matter 66 on the screen in front of any blade is of considerable thickness, then the edge 65 will act as a plow to scrape off the outside portion of the layer 66. A considerable portion of the refuse matter, however, will pass between the edge 65 of the screen blade and the screen 12 and any refuse which passes beneath the blade is drawn away from the screen by the suction created at 85 as shown by the shaded portion 67 in Fig. 3. By means of this suction the screen immediately back of each blade will be thoroughly cleaned and freed from any matter which cannot pass through the screen, and such coarse matter will flow over the stream-line portion 64 of the blade.

Each section 47 of the screen-cleaning member may have a plurality of these blades 59 and as each blade passes over any portion of the screen 12, it leaves such portion of the screen perfectly free from refuse matter.

The shape and configuration of the blades 59 are such to produce a maximum suction effect with a minimum resistance of the pulp to the movement therethrough of the blades.

5 I have shown the screen-cleaning element as provided with a plurality of horizontal plates or partitions 68 which connect the blades 59, and I have also shown the walls of the casing 1 as having rigid therewith annular baffle plates or rings 69 which extend inwardly from the wall to the screen-cleaning element and encircle the latter as shown in Fig. 1. These baffle plates 69 have a staggered relation with the plates or rings 68. The purpose of these rings 68 and baffle plates 69 is to compel all the pulp to be forced back and forth through the screen a plurality of times during its passage from the inlet 3 to the outlet 15, 5, and to prevent the possibility that any of the pulp will flow downwardly along the inner face of the wall of the casing to the tailings outlet 70 without passing through the screen.

I claim:

1. A pulp screen comprising a casing having a pulp inlet and a screened pulp outlet, a screen between the inlet and outlet, a screen-cleaning member formed with a plurality of blades situated on the inlet side of the screen closely adjacent thereto, and means to move the blades relative to the screen in a path parallel thereto, each blade having its width dimension inclined backwardly relative to the screen and having the portion of its trailing side adjacent the screen concavely curved whereby the movement of the blade relative to the screen produces a waste-removing suction at the concavely curved portion of the trailing side which removes from the screen any waste matter accumulating thereon.

2. A pulp-screening machine comprising a casing having an intake and a screened pulp outlet, a cylindrical screen within the casing, means within the screen to pulsate the pulp back and forth through the screen as it flows from the intake to the outlet, a screen-cleaning member encircling the screen, means to rotate said mem-

ber about the screen, baffle plates carried by the rotating screen-cleaning member and extending circumferentially thereof, and other baffle plates carried by the wall of the casing and extending radially inwardly therefrom and cooperating with the baffle plates on the screen cleaning element to cause the pulp flowing between the screen and the casing to have a sinuous course.

3. A pulp-screening machine comprising a casing having an intake and a screened pulp outlet, a cylindrical screen within the casing, means to pulsate the pulp back and forth through the screen as it flows from the intake to the outlet, a screen-cleaning member encircling the screen and provided with baffle plates, and other baffle plates exterior to the screen-cleaning member and carried by the wall of the casing, said other baffle plates extending inwardly from said wall and having their inner edges situated closely adjacent the screen-cleaning element, the baffle plates on the screen-cleaning element and those on the casing having a staggered arrangement.

4. A pulp screen comprising a casing having a pulp inlet and a screened pulp outlet, a screen between the inlet and the outlet, a screen-cleaning member having a plurality of blades on the inlet side of the screen closely adjacent thereto, and means to move the blades relative to the screen in a path parallel thereto, each blade having its width dimension inclined backwardly relative to the screen and the direction of movement of the blades, the outer or leading side of each blade being convexly curved from one edge to the other and the trailing side of each blade being concavely curved at the inner portion thereof which is nearest the screen and convexly curved at the outer portion thereof, whereby the flow of pulp over the blade as the latter is moved relative to the screen produces a waste-removing suction between the concavely curved portion of the trailing side of the blade and the screen sufficient to withdraw from the screen any waste matter that has accumulated thereon.

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