Sept. 1, 1925.

1,551,953

A. J. HAUG

PULP SCREENING MACHINE

Filed Oct. 11, 1924

5 Sheets-Sheet 1

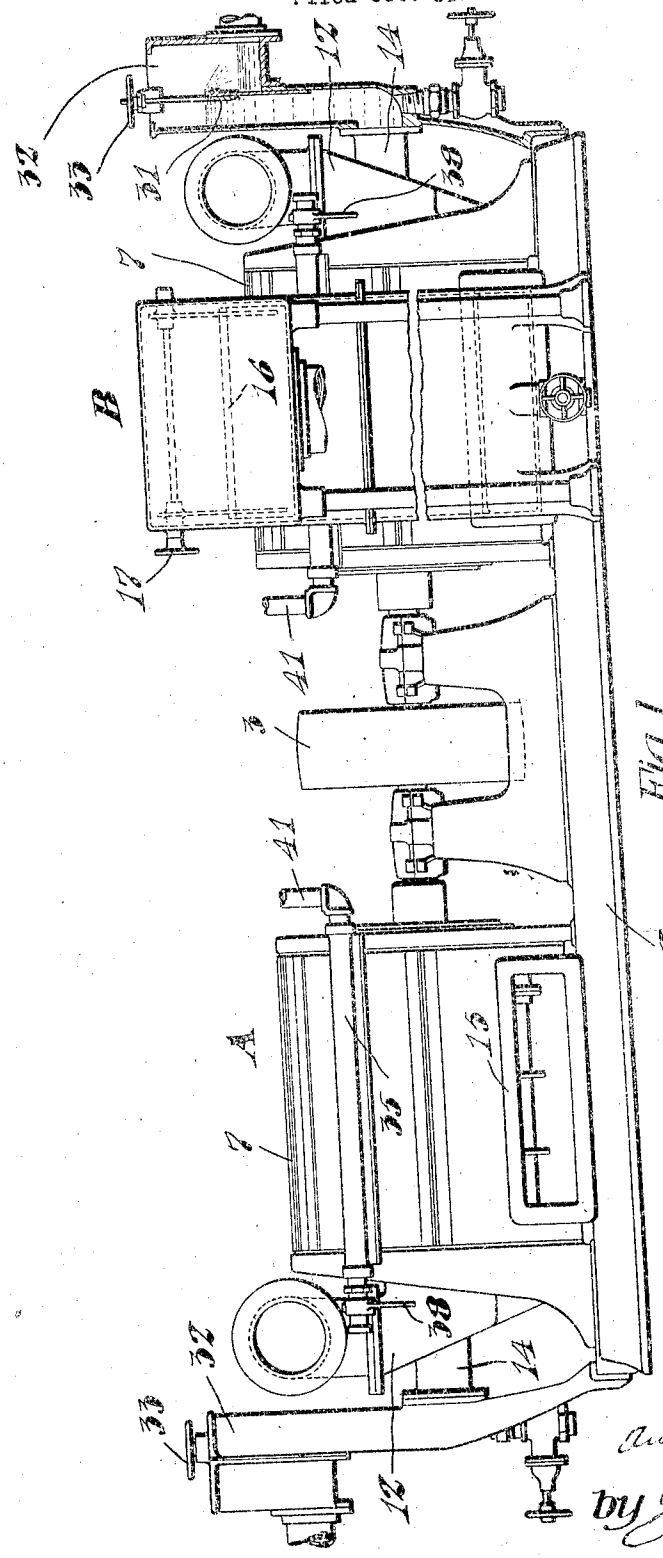


Fig. 1.

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PULP SCREENING MACHINE

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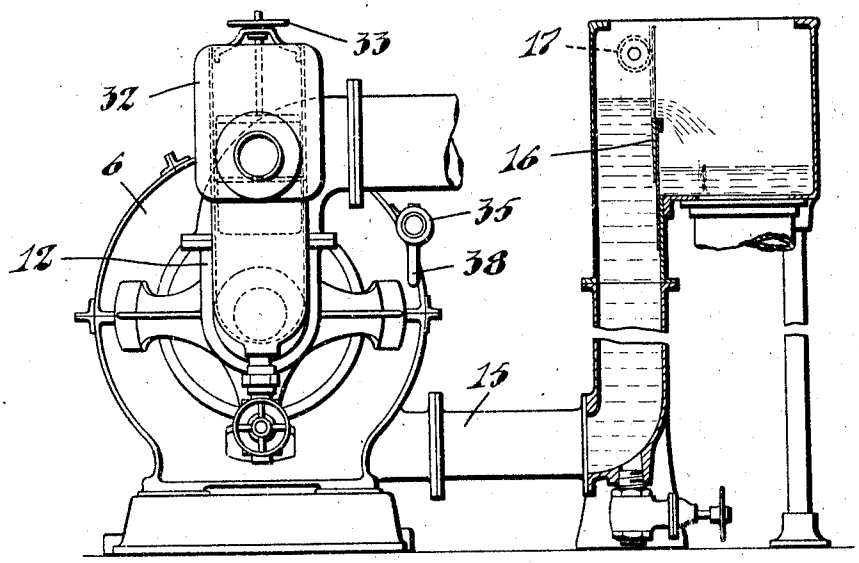


Fig. 2.

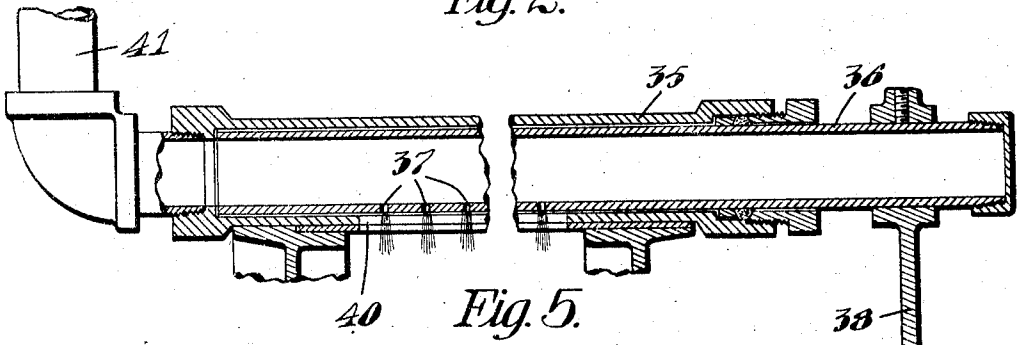


Fig. 5.

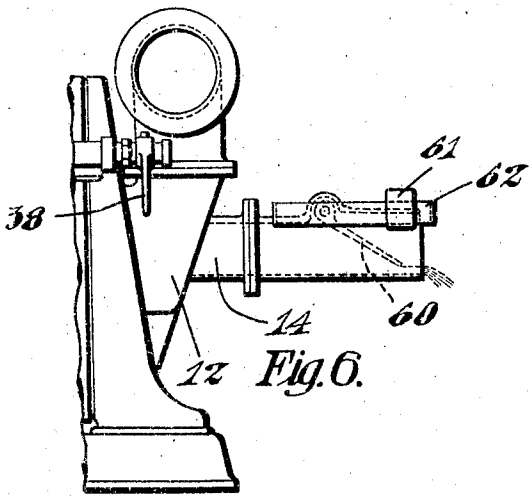


Fig. 6.

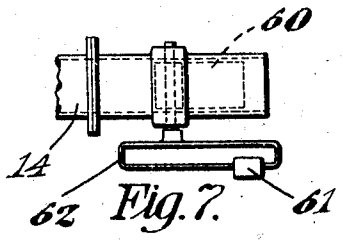


Fig. 7.

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PULP SCREENING MACHINE

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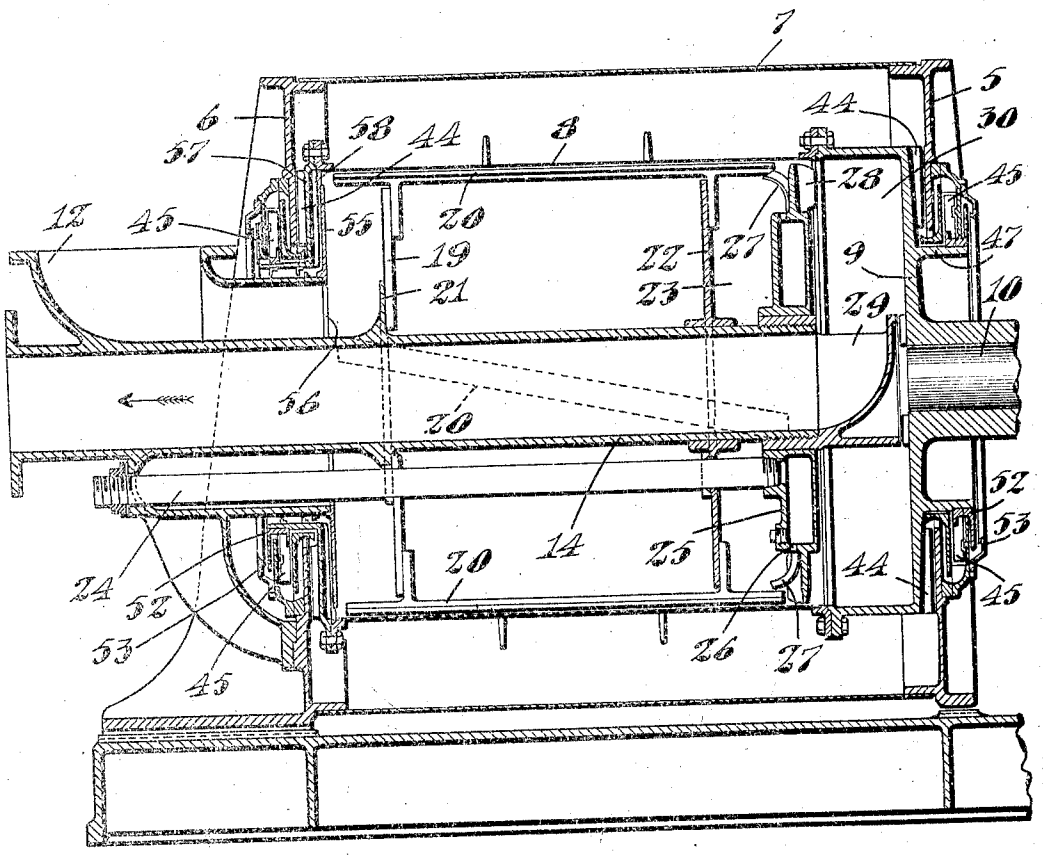


Fig. 3.

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PULP SCREENING MACHINE

Filed Oct. 11, 1924 5 Sheets-Sheet 4

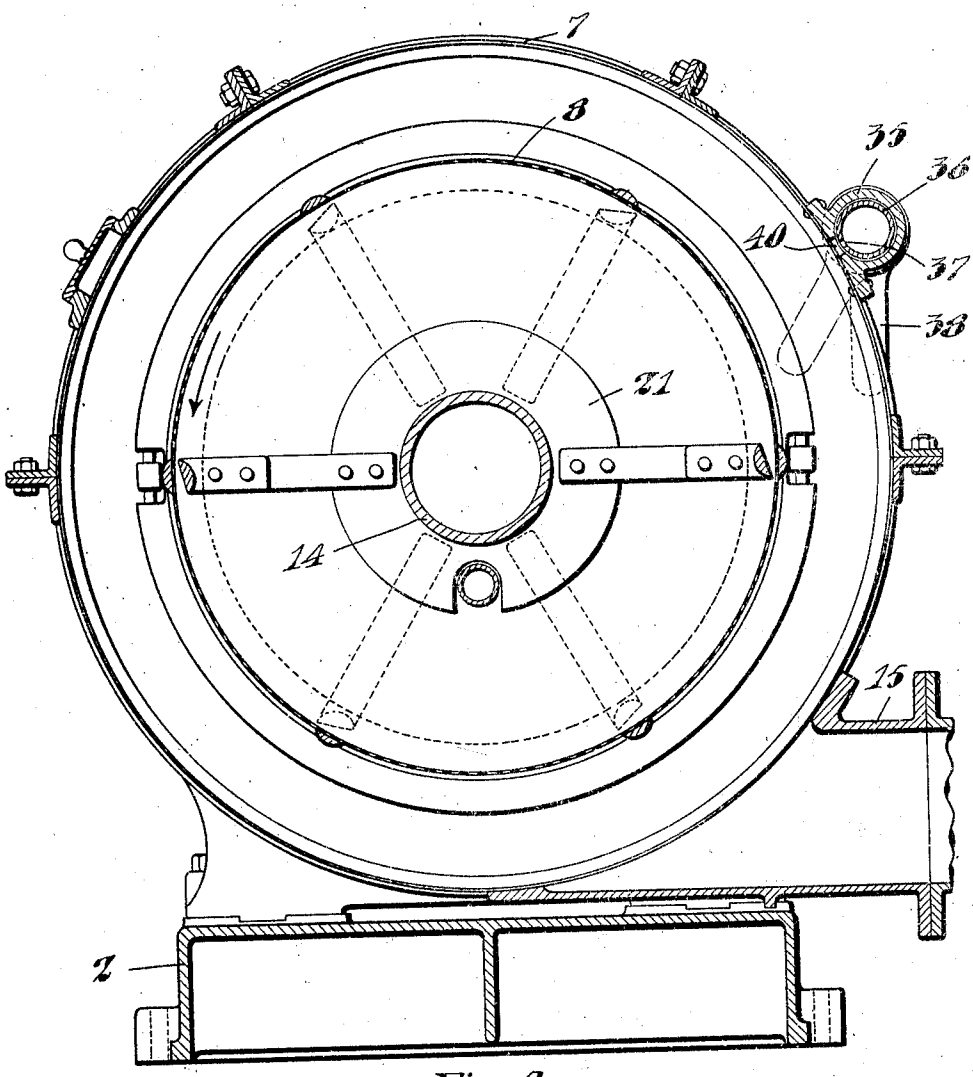


Fig. 4.

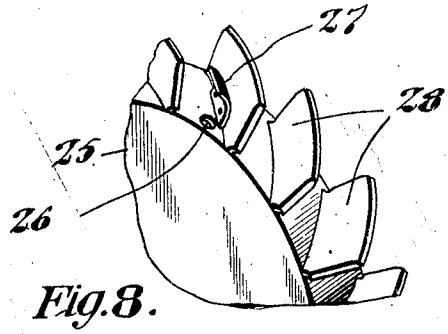


Fig. 8.

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PULP SCREENING MACHINE

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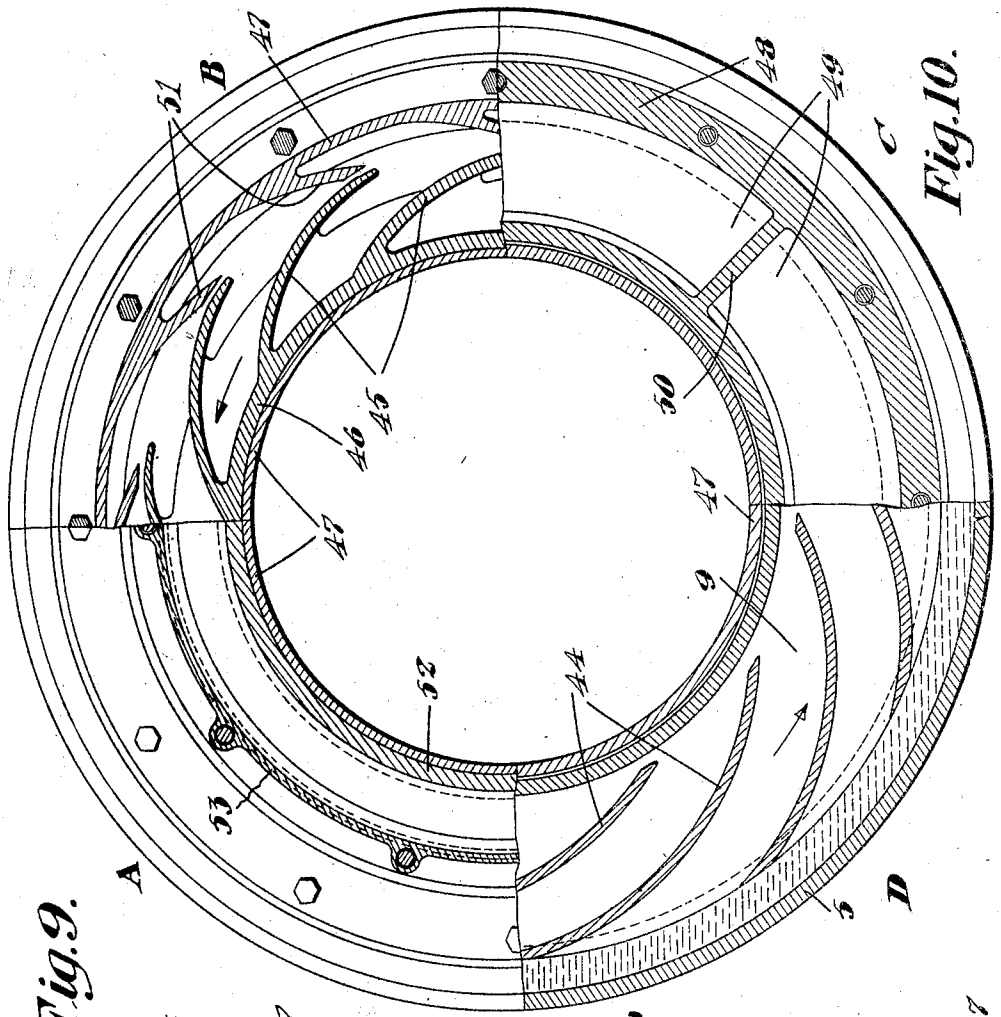


Fig. 10.

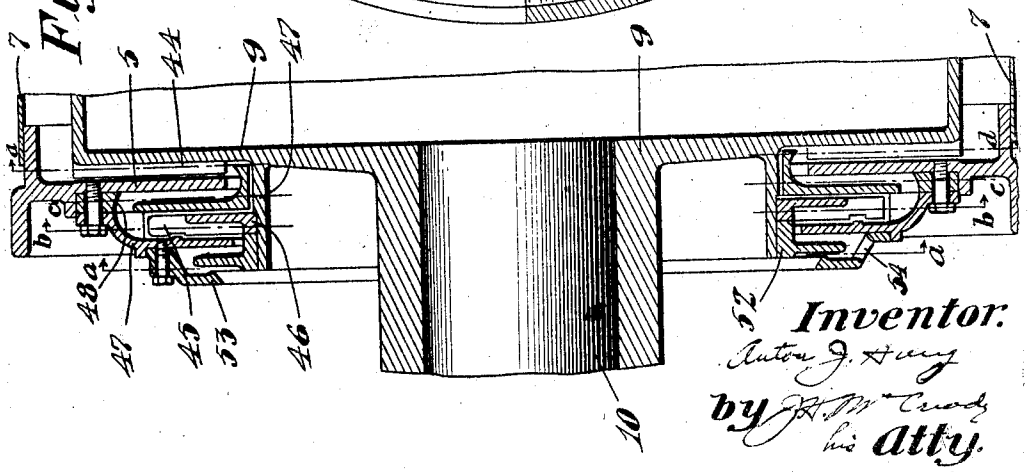


Fig. 9.

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Patented Sept. 1, 1925. 1,551,953

UNITED STATES PATENT OFFICE.

ANTON J. HAUG, OF NASHUA, NEW HAMPSHIRE.

PULP-SCREENING MACHINE.

Application filed October 11, 1924. Serial No. 743,110.

To all whom it may concern:

Be it known that I, ANTON J. HAUG, a citizen of the United States, residing at Nashua, in the county of Hillsborough and State of New Hampshire, have invented certain new and useful Improvements in Pulp-Screening Machines, of which the following is a specification.

This invention relates to processes of screening pulp and to machines for screening pulp through a rapidly rotating screen against a hydraulic head. My invention, however, may be used for screening other materials and some features thereof may be used in machines of other types.

In screening pulp it is important to produce a maximum of suitable screened stock with a minimum expenditure of power and a minimum of good stock in the tailings. A rejection of good stock is serious not only as requiring subsequent screening and refining processes for its recovery, but because the longest and best fibres are likely to be destroyed in such subsequent operations. The present invention is directed to improvements whereby a large volume of pulp can be screened with a low percentage of power expenditure and with a very low percentage of good stock being rejected and passed along with the tailings.

It is a further object of this invention to devise a pulp screening machine which will elevate the screened stock or tailings, or both, to such a height that they can be fed to another machine located on substantially the same level without requiring the use of pumps or other elevating apparatus. Other improvements will appear from the specification.

This invention constitutes in many respects an improvement upon my co-pending application Serial No. 456,374, filed March 28, 1921.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

Referring now to the drawings,

Figure 1 is a side elevation, partly in cross-section, of a pulp screening machine embodying the present invention;

Fig. 2 is an end view, partly in cross-section, of the machine shown in Fig. 1;

Fig. 3 is a vertical, central, cross-sectional view through one of the screening cylinders of the machine shown in Fig. 1 and the parts immediately associated with said screen;

Fig. 4 is a transverse, vertical, cross-sectional view through one of the screening cylinders and its casing;

Fig. 5 is a cross-sectional view showing certain details of a spraying mechanism which forms a part of the apparatus shown in Fig. 4;

Fig. 6 is a side elevation showing an arrangement which may be used to apply back pressure to the tailings or screened stock;

Fig. 7 is a plan view of a part of the mechanism shown in Fig. 6;

Fig. 8 is a perspective view of the blade arrangement which may be used to eject the tailings from the screen;

Fig. 9 is a cross-sectional view on a larger scale of the packing arrangement used at one end of the screen; and

Fig. 10 is a composite cross-sectional view of the packing mechanism, divided into four quadrants, the plane of section of the quadrant A being indicated in Fig. 9 by the line *a—a;* that of the quadrant B by the line *b—b;* that of the quadrant C by the line *c—c;* and that of the quadrant D by the line *d—d.*

The machine shown in Fig. 1 is of the duplex type including two separate screening machines or units A and B which are substantially identical in construction, both units being supported on a base 2 and driven by belt connections to a central pulley 3. The other figures of the drawings show the details of one unit only.

Referring more particularly to Figs. 3 and 4, it will be seen that each screening machine includes a stationary casing comprising ends 5 and 6 and a shell 7. Mounted within the casing is a rotary screening cylinder 8 which is bolted to the flange of an end piece 9 mounted on the shaft 10 to which the pulley 3 is secured.

The paper stock or other material to be screened, hereinafter referred to as pulp, is conducted into the open end of the screen through a spout 12 and this spout, as here

shown, encircles, and is formed integral with, a stationary tailings conduit or chute 14 that extends axially through the screen. When the machine is in operation the screen 8 is rotated with sufficient speed to produce a substantial centrifugal effect on the pulp in contact therewith, and the centrifugal force so created forces the pulp through the screen and discharges it from the casing 7. The screened pulp finds an outlet at 15, Figs. 1, 2 and 4, and is backed up in the casing by a weir 16 so that the screen is submerged in screened pulp. The weir is vertically adjustable by the usual mechanism including a hand wheel 17. The submergence of the screen is an important feature in the operation of this apparatus and the weir should be adjusted at such a height as to ensure such submergence and prevent the tendency of the pulp to mat or adhere to the inside of the screen, which would happen if the screen were not submerged. I find that when the screen is not submerged the fibres form, in effect, a filter on the inside of the screen so that little except water comes through. On the other hand, with the screen submerged, even the long fibres pass freely through it. The most satisfactory head for the screened stock varies according to the screen speed and other conditions, but can readily be determined in practice. I have obtained very satisfactory results by running a screen of 27 inches in diameter at 280 revolutions per minute under a head of 104 inches of screened stock above the center of the screen.

In order to clear the screen 8 of knots, slivers, and other materials which will not pass through the meshes, one or more bars 20 are mounted close to the inner surface of the screen, each bar being supported at one end by an arm 19 secured to a flange 21 which encircles the tailings conduit, and at its other end by a circular plate or partition 22 which is secured to the conduit 14 and projects almost to the inner surface of the screen. If desired an arm similar to 19 and similarly secured may be used in place of said partition. Each of these bars is inclined rearwardly so that as the tailings strike them, the bars will force the tailings toward the tailings outlet at the right-hand end, Fig. 3, of the screen. This arrangement, therefore, results in continuously moving the tailings along the surface of the screen in an indeterminate path toward the tailings outlet, the rate of this movement being greater as the degree of inclination of the bars is increased.

The partition 22 performs the double function of supporting the bars 20 and preventing good stock from splashing past the partition where it would be mixed with the tailings. That is, it divides the space within the screen into two chambers, a large chamber in which the greater part of the screening operation takes place, and a small chamber 23, Fig. 3, in which the tailings are washed in order to separate them from any good stock which may still cling to them as they approach the tailings outlet. Arms like 19 may however be substituted for the partition 22 if desired, as the washing will usually proceed well enough without dividing the interior of the screen into chambers. For the purpose of washing the tailings, water under pressure is conducted through a pipe 24 into an annular casing 25 having a series of holes 26 in its peripheral edge through which the water is discharged. These streams of water strike stationary deflectors 27 which break up the streams into a spray and direct it on to the stock carried by the inner surface of the screen. This spray washes the greater part of the good stock out of the tailings and enables such stock to pass through the screen. The tailings are next brought into contact with a series of inclined blades 28, Figs. 3 and 8, which project from the periphery of the casing 25, and these blades force the tailings into the tailings chamber 30 and thence into the tailings outlet 29 and through the discharge conduit 14.

In the construction shown the tailings are backed up by a weir 31, Fig. 1, mounted in a weir box 32, into which the conduit 14 discharges, the weir being adjusted by means of a hand wheel 33. The inclination of the blades 28 is such that as the rapidly rotating stock, then consisting only of tailings, is brought in contact with them, they eject the tailings with sufficient pressure to force them through the discharge conduit and over the weir. I prefer to so adjust the weir that the tailings are discharged against a substantial head. For example a head of one foot above the top of the casing has been found satisfactory. This is considerably higher than in any prior machine of which I am aware and permits the discharge of the tailings by gravity to another machine on the same floor.

In order to wash the screen 8 at intervals, if desired, a spraying apparatus is mounted in the casing at 35, Figs. 4 and 5. This apparatus comprises a housing 35 bolted to the casing 7 and a pipe 36 fitting within said housing and arranged to rotate about its longitudinal axis, this pipe being provided with spray openings 37. Pipe connections 41, Figs. 1 and 5, conduct water to the pipe 36. The pipe has a handle 38 secured thereto by means of which it may be rotated to bring the openings 37 either into register with a slot 40 in the inner side of the housing, where the spray will be directed against

the outside of the screen, or to move said openings into position to cut off the spray. This provides a very convenient spraying apparatus and avoids the presence of any projections within the casing which would interfere with the flow of the pulp.

As shown in Fig. 3, the screen 8 is supported at one end only. Any suitable packing may be used between the ends of the screen and the casing, but I prefer to employ a packing arrangement which will reduce the friction so far as possible. The particular packing shown will be made the subject matter of a separate application. For the purposes of the present application a very brief description only of this feature is necessary. The packing at the right-hand end of the screen is shown in Figs. 3, 9 and 10, and it includes an annular series of blades 44 secured to the end plate 9 of the screen. The stationary annular plate 5 of the casing lies closely adjacent to the end plate 9, as is clearly shown in Fig. 9, and the blades 44 are located between these plates. The blades are so curved that when the screen is in motion they create a strong centrifugal force on any liquid tending to escape between the plates 5 and 9, and this force is sufficient to effectually overcome the hydraulic head acting on the liquid. This arrangement is, in effect, a centrifugal pump. Another set of blades 45 is formed integral with a ring 46 which is secured to an annular flange 47, preferably formed integral with the head 9. The blades 45 are located between two annular disks 47 and 48, both of which are bolted to the stationary part 5 of the casing. A series of radial channels or ducts 49 is formed in the disk 48, these ducts being separated from each other by partitions 50, and the ducts open at their outer ends into the spaces between vanes 51 formed in the disk 47, while at their inner ends they communicate with the space at the inner edges of the blades 44. Consequently, as the blades 45 rotate with the screen they exert a strong centrifugal action on the air or any fluid with which they are in contact, thus forcing this air or other fluid through the ducts 49 and thence into the annular chamber in which the blades 44 revolve. The two pumps, therefore, are in series, the outlet of the pump 45 discharging into the inlet of the pump 44. Consequently, any liquid tending to force its way back between the blades 44 is met by the air pressure created by the blades 45.

A ring 52 preferably is secured to the flange 47, and is encircled by a stationary ring 53 having an inwardly extending flange or beading at its inner edge. The ring 52 has a radial flange which operates in case any water reaches it to throw such water against the ring 53 where it runs down to the lower side and escapes through the port 54, Fig. 9.

This type of packing is particularly useful in a machine of this character since it reduces the friction losses, and hence economizes power. Furthermore, it will last indefinitely and avoids the necessity for renewals.

A packing of the same general construction including blades 44 and 45 is employed at the left-hand end of the screen, Fig. 3, but the screen is open at this end for the inflow of pulp, a stationary plate or partition 55 being provided to retain the stock in the screen. This partition is secured to the spout 12, and has an opening at any desired point, as for instance at 56, to admit the stock to be screened. The escape of stock between the partition 55 and the annular end plate 57 of the screen is prevented by a series of blades 58 secured to said plate 57, these blades being similar to the blades 44.

Since each screen is supported at one end only, the machine lends itself with particular advantage to the duplex arrangement, one pair of bearings and a single driving pulley only being required for the two screening machines. While the driving means for the machine has been shown simply as a pulley, other driving arrangements may be used, as for example, a direct motor drive. It is contemplated that such a drive could be used by dividing the screen shaft into sections instead of making it in a single piece, the motor shaft forming one section of the shaft for the entire machine.

Notwithstanding the advantage of the combination of two screens "A" and "B" in one duplex screen, it is not necessary to employ such a combination, as with the screen "A" or screen "B" omitted entirely the remaining screen will easily screen fifty tons per day and at a very low expenditure of power per ton. In many installations, it will be found desirable to use a single screen rather than the duplex combination.

In using the machine I consider it preferable to flow the unscreened pulp into the screen under just enough head to produce the desired rate of flow, and to rely upon the centrifugal action of the screen to lift the screened pulp to the desired height. It will be evident that the rate of discharge of the screened pulp, other things being equal, will depend upon the relationship between the centrifugal force exerted on the pulp by the screen and the hydraulic head imposed on the screened pulp by the weir 16. Each of these forces may be adjusted, but ordinarily it is more convenient to adjust the height of the weir than to change the speed of the machine. The rate of flow of the pulp through the screen may therefore be controlled accurately, and this is an important

advantage in producing the desired screening effect and in preventing the matting of the fibres on the screen. The rate of rotation of the screen may be varied within relatively wide limits, but should be sufficient to create a substantial centrifugal effect on the stock in contact therewith. In practice I find that a peripheral speed of approximately 1800 feet per minute gives satisfactory results.

The fact that both the tailings and screened stock are lifted to a level above the top of the screen is an important practical advantage since it permits the delivery, by gravity, of both these materials to other machines located on the same floor with the pulp screen. Without this arrangement it would be necessary to use pumps or some other apparatus for raising these materials to the desired level.

The application of a back pressure to either the screened stock or the tailings may be regulated in other ways than that above described. For example, back pressure may be applied to the tailings by locating a pivoted vane 60, Figs. 6 and 7, in the tailings conduit 14, and arranging an adjustable weight 61 on an arm 62 which is secured to the rock shaft that supports the vane, so that a constant pressure will always be applied to the vane and hence to the stream of tailings flowing under it. The same arrangement may be used in the outlet for the screened stock. Usually, however, it is preferable, for the reasons above described to use a weir.

The machine has proved in practice to be very economical of power and it has a very high screening capacity for a given area, apparently due to the fact that the entire screening surface is always used and the screen is kept remarkably free of tailings and mats of fiber which otherwise would seriously interfere with the screening operation. A further advantage of this machine is that the removal of the tailings from the screen is effected without interfering appreciably with the flow of the stock through the screen under the action of centrifugal force, and without creating any material turbulence or agitation of the stock.

It will be observed that the machine shown embodies many of the features of the invention disclosed in my prior application above designated, and in this sense the present application is a continuation of my prior application. The broad claims covering subject matter common to the two applications are presented in my earlier case, above designated, the claims of this application being confined to those features which are not disclosed in my former application.

Having thus described my invention, what I desire to claim as new is:—

1. In a pulp screening machine, the combination of a rotary screen, means for rotating said screen, means for conducting pulp to be screened into the screen, a stationary conduit mounted within said screen and extending longitudinally thereof, and a plurality of bars supported by said conduit and located closely adjacent to the inner surface of said screen, said bars extending longitudinally of the screen and being inclined with reference to the axis of said screen.

2. In a pulp screening machine, the combination of a rotary screen, means for rotating the same, means for conducting pulp to be screened into said screen, a conduit for conducting tailings out of said screen, means within the screen for advancing the tailings along the screening surface toward the intake end of said conduit, and means external to the screen for resisting the discharge of the tailings through said conduit.

3. In a plup screening machine, the combination of a rotary screen, means for rotating the same, means for conducting pulp to be screened into said screen, a conduit for conducting tailings out of said screen, means within the screen for advancing the tailings along the screening surface toward the intake end of said conduit, and a weir at the discharge end of said conduit over which the tailings are discharged at a level above the top of the screen.

4. In a pulp screening machine, the combination of a rotary screen, means for rotating the same, a casing in which the screen is mounted, means for conducting pulp into said screen, a plurality of stationary bars mounted in said screen closely adjacent to the screening surface and so inclined as to urge the tailings along the surface of the screen toward the tailings outlet, and a series of stationary inclined blades mounted within said screen near said outlet for directing the tailings into said outlet.

5. In a pulp screening machine, the combination of a rotary screen, a stationary inlet, a tailings outlet, means for rotating said screen, means within said screen for directing the tailings along the surface of the screen toward said outlet, a conduit into which the tailings ejected through said outlet are discharged, means external to the screen for applying back pressure to said tailings, and additional means for applying back pressure to the screened pulp.

6. In a pulp screening machine, the combination of a rotary screen, means for rotating the same, means for conducting pulp to be screened into said screen, a conduit for conducting tailings away from said screen, means within the screen for advancing the tailings along the surface of the screen toward the intake end of said conduit, a weir at the discharge end of said conduit,

said casing having a discharge outlet for the screened pulp, and a weir over which the screened pulp is discharged, the latter weir and said casing being arranged to maintain said screen submerged in screened pulp.

7. In a pulp screening machine, the combination of a rotary screen, means for rotating the same, a partition dividing the space in said screen into two chambers, means for conducting pulp to be screened into one of said chambers, means for forcing the tailings into the second chamber, and means for washing the tailings in said second chamber.

8. In a pulp screening machine, the combination of a rotary screen, means for rotating the same, a casing in which said screen is mounted, a stationary spout for conducting pulp into one end of said screen, a stationary conduit for conducting tailings away from said screen, a plurality of stationary bars mounted in said screen closely adjacent to the screening surface thereof and so inclined as to direct the tailings along the surface of the screen toward one end thereof, a spraying apparatus positioned in said screen at the latter end and arranged to direct a spray against the tailings, and a series of inclined blades for acting on the tailings at the latter end of the screen to direct them into said conduit.

9. In a pulp screening machine, the combination of a rotary screen, means for rotating the same, a casing in which said screen is mounted, a stationary spout disconnected from said screen for conducting pulp into one end of said screen, a stationary conduit for conducting tailings away from said screen, a plurality of stationary bars mounted in said screen closely adjacent to the screening surface thereof and so inclined as to direct the tailings along the surface of the screen toward one end thereof, a partition extending transversely across said screen and dividing the space therein into a chamber which receives the pulp and a second chamber into which the tailings are directed by said bars, means within said second chamber for washing the tailings, and a series of stationary blades arranged to engage the tailings and to utilize the rotary movement imparted to them by the screen to eject them through said conduit.

10. In a pulp screening machine, the combination of a screen, a housing mounted adjacent to the same and extending longitudinally of the screen at one side thereof, a spray pipe fitting in said housing and mounted for rotative adjustment about its longitudinal axis, and means for conducting water to said pipe, said housing being apertured in the side thereof adjacent to said screen, and said pipe having spray openings therein, whereby said pipe may be adjusted to direct a spray through the aperture of said housing or to cut off said spray.

11. In a pulp screening machine, the combination of a screen, means for driving the same, and means for ejecting the tailings from said screen in a substantially continuous stream and lifting said tailings to a point above the level of the screen.

12. In a pulp screening machine, the combination of a rotary screen, means for rotating said screen, means for conducting pulp to be screened into said screen, a conduit for conducting the tailings away from said screen, and means for forcing the tailings through said conduit in a continuous stream and lifting them to a point above the level of the screen.

13. In a pulp screening machine, the combination of a rotary screen, means for rotating said screen, and means for utilizing the motion of the screen to force the tailings out of the screen in a continuous stream and to lift them to a point above the level of the screen.

14. That improvement in the process of screening pulp which consists in performing the screening operation by centrifugal force created by the motion of the screen, and utilizing said motion to eject the tailings from the screening surface and to raise the tailings to a point above the level of the screen.

15. In a pulp screening machine, the combination of a rotary screen, a casing in which said screen is mounted, a shaft supporting one end only of said screen, the opposite end of the screen being unsupported, a stationary plate partially closing the latter end of the screen and having an opening therethrough, and a spout communicating with said opening for conducting pulp into said screen.

16. In a pulp screening machine, the combination of a rotary screen, a casing in which said screen is mounted, a shaft supporting one end only of said screen, the opposite end of the screen being unsupported, bearings supporting said shaft for rotation, and centrifugal means for preventing the escape of liquid at the unsupported end of said screen.

17. In a pulp screening machine, the combination of a rotary screen, a casing in which said screen is mounted, a shaft supporting one end only of said screen, the opposite end of the screen being unsupported, a stationary plate partially closing the latter end of the screen and having an opening therethrough, means for conducting pulp to said opening, and blades rotating with said screen and cooperating with said stationary plate to prevent the escape of liquid from the casing.

18. In a pulp screening machine, the combination of a pair of rotatable screens, a

shaft on the opposite ends of which said screens are mounted, bearings for said shaft mounted between the screens, means between said screens for driving said shaft, a casing enclosing each screen, and means cooperating with the casings to maintain the screens submerged in screened stock.

19. In a pulp screening machine, the combination of a rotary screen, means for rotating said screen rapidly, means for conducting pulp to be screened into said screen, and a stationary bar mounted within said screen close to the screening surface thereof and extending longitudinally of the screen but being inclined with reference to the axis of said screen.

20. In a pulp screening machine, the combination of a rotary screen, means for rotating said screen rapidly, means for conducting pulp to be screened into said screen, and a plurality of bars mounted therein closely adjacent to the screening surface thereof and extending longitudinally of the screen but being so inclined as to urge the tailings along the surface of the screen toward the tailings outlet.

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