

April 7, 1942.

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2,278,729

APPARATUS FOR SCREENING PULP

Filed Dec. 2, 1937

2 Sheets-Sheet 1

FIG. 1.

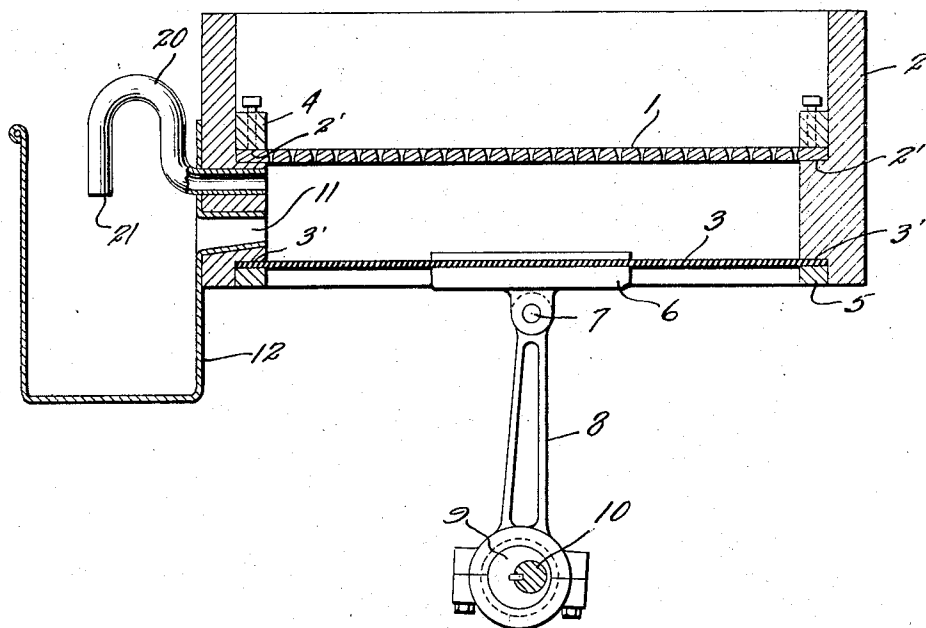
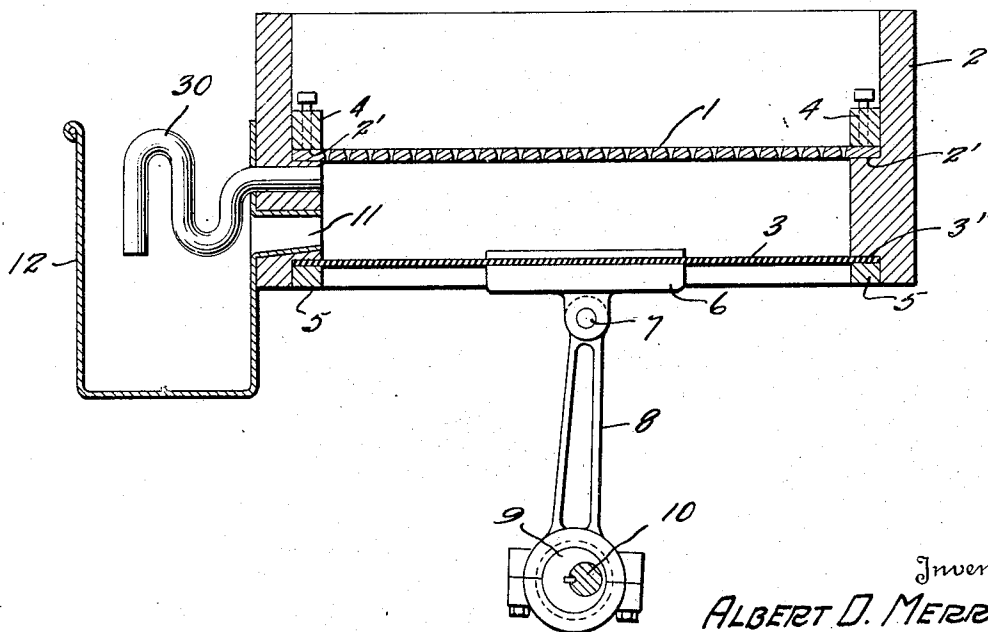


FIG. 2.



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FIG. 3.

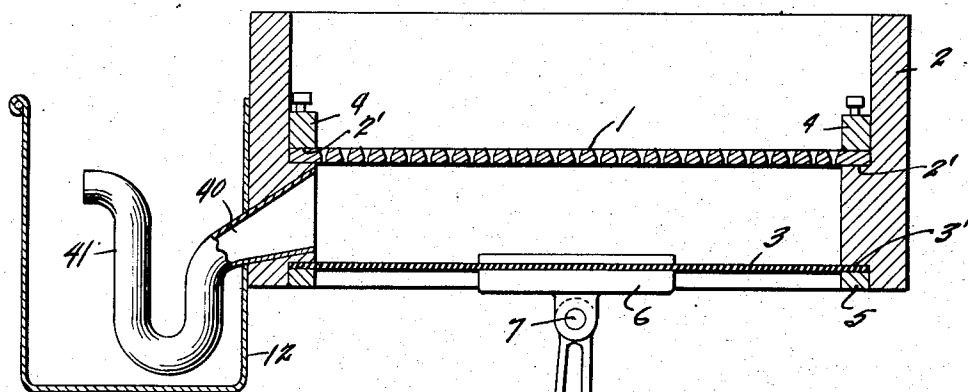


FIG. 4.

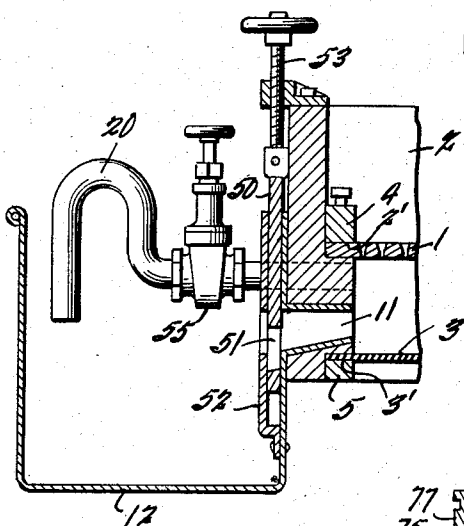


FIG. 5.

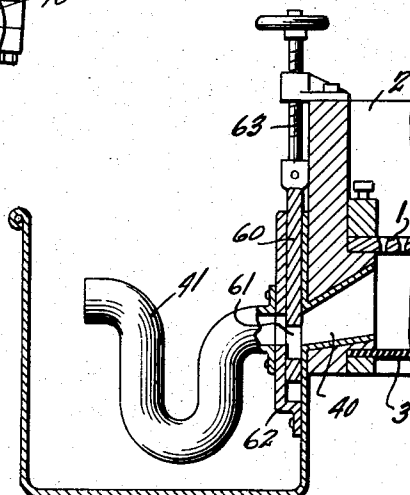
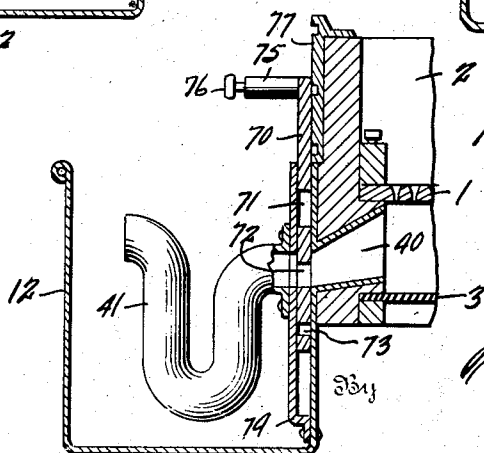


FIG. 6.



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APPARATUS FOR SCREENING PULP

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Application December 2, 1937, Serial No. 177,795

1 Claim. (Cl. 92—32)

This invention relates to pulping apparatus, more particularly to an improved apparatus for screening of pulp.

A typical pulp screening apparatus, employed at the present time, comprises a screen member on which the stock to be filtered or screened is fed and below which a flexible diaphragm is positioned. The diaphragm is associated with mechanical means to effect its vibration. In use the pulp which is to be screened is forced or drawn through the screen plates by the pulsating movement of the body of pulp or liquid, established by the vibratory movement of the diaphragm. The body of liquid is normally maintained at a predetermined level by utilizing an outlet seal so that a suitable depth of the stock is maintained over the diaphragm. In the operation of this type of structure, the pulsating movement of the body of liquid causes the finer fibers to be forced or sucked through the interstices in the screen while withholding or screening out the larger particles.

In the past, a number of different methods of effecting the vibration of the diaphragm have been proposed. Among such methods is the so-called positive drive, that is to say, a driving mechanism which is connected to the resilient diaphragm so that the diaphragm is positively moved in each direction of its reciprocating motion.

It is a fact, in actual practice, that when positive drives are used, a great deal of difficulty is encountered because of clogging and possible ultimate breakage of the screen. When a positive drive is employed as the operative medium for the diaphragm, on the upstroke of the drive, as there is no resilience the device may function as a hydraulic hammer or ram. The slots in the screen, as is known, are quite small. When the diaphragm is given a positive upward stroke by means of a non-resilient connecting rod, the body of liquid similarly tends to pulsate upwardly. In some circumstances, the fibers may clog the interstices in the screen, thus establishing a hydraulic hammer or ram. In other words, when the interstices of the screen are plugged, the upwardly moving body of liquid is suddenly arrested and a considerable percussive pressure is applied to the screen in consequence of the upward momentum of the liquid magma. In many circumstances, this is of such a magnitude as to cause a rupture of the screen. When a resilient device is employed, i. e., the well known cam and spring type, this type of action does not obtain to any appreciable degree.

The present invention relates not only to a simple and efficacious method of preventing such breakage, but also to a method of increasing production of a screening apparatus. The broad concept of the present method involves the elimination of such breakage by providing a special type of outlet such that the liquid below the screen may be caused to flow outwardly of the screen on each reciprocation of the diaphragm, thus relieving the undesired dangerous pressure. The concept, stated in its simplest form, involves, in a sense, the utilization of a type of safety valve positioned on the screen box and adjacent the lower portion of the screen and adapted to function to drain or bleed off liquid on the upstroke and thus to preclude the establishment of the described hydraulic ram effect. In addition, as will be seen, the operation increases the production by reason of an increased flow of stock through the device. An additional and novel feature of the invention is effectually to adapt the screening unit to different types of fiber stock so as to correlate the speed of the discharge of stock with respect to the particular characteristics of that stock.

With this fundamental concept in view, it will be appreciated that a number of different specific mechanical structures may be utilized to secure these results. In order to more clearly explain the invention, several illustrative mechanisms for insuring these results are shown in the accompanying drawings, in which:

Figure 1 is a transverse section of a pulp screen according to the invention.

Figure 2 is a similar view of a modified form of construction.

Figure 3 is a similar view of another modification of the invention.

Figure 4 is a detailed view illustrating the utilization of a positively controlled flow of screened pulp in the type of apparatus shown in Figures 1 and 2.

Figures 5 and 6 illustrate, similarly, methods of positively controlling the flow from screen boxes of the type shown in Figure 3.

As shown in the drawings, a series of slotted screen plates 1 are supported in a framing indicated generally at 2, which framing serves as a container for the pulp to be treated. A diaphragm 3, constructed of suitable resilient material, such as rubber, is spaced below the screen. The screen is suitably secured to the framing in any desired manner, as for example by being locked between the shoulders 2' and the removable plate fastening frames 4. Obviously, any

other suitable method of firmly and detachably securing the screen plates in position may be employed.

As indicated above, the present construction involves particularly a positively driven diaphragm. The diaphragm is shown as supported in position on the frame by being locked between the shoulders 3' and the removable frames 5. The diaphragm is provided with the usual metal plate 8 on which is formed an apertured shoulder 7 to which the connecting rod 9 is pivotally connected. At its other end the connecting rod 9 is associated with any suitable mechanism which functions to impart a predetermined reciprocating motion to the connecting rod and thence to the diaphragm. Such connection is shown as comprising the driving eccentric 9 which is keyed to the main drive shaft 10.

The container is provided in the usual manner with a passageway or duct 11, through which screened stock passes to the trough 12. As will be understood by those skilled in the art, the screened stock passes from the trough 12 through the usual outlet seal (not shown), which is operative to maintain a body of the liquid pulp at a predetermined depth in the screening chamber.

It will be understood that, in the operation of such mechanism, the vibratory movement of the diaphragm transmits a corresponding pulsating movement to the liquid mass in the screening chamber. This pulsating movement at the one time tends to draw the liquid and the finer fibers through the screen apertures, and by reason of the constant agitation, due to the pulsation in the liquid body, to prevent immediate lodgment of the fibers in the screen apertures.

In actual practice, however, it is found that some fibers attach to the sides of the apertures, or slots, in the plates, and tend progressively to build up to ultimately form a matted aggregation of fibers, thus, in effect, diminishing the effective size of the apertures and ultimately blocking such apertures. As previously explained, the body of the liquid in the chamber is itself reciprocated or pulsated. Hence, when the screen becomes clogged up to a certain point, the upward movement of the liquid body is suddenly arrested, thereby applying a pressure of considerable magnitude on the underside of the screen. In view of the relatively large mass of the liquid, this percussive force may reach such a magnitude as to fracture the screen.

In operating under the principles of the present invention, such danger of breaking the screen is positively eliminated. This is done by providing a series of safety outlets for the liquid and preferably in the area of this potential water-hammer action, that is to say, adjacent the underside of the screen. As shown in Figure 1, this beneficial result may be achieved by the simple expedient of employing a seal outlet adjacent the underside of the plate. Such outlet may comprise the usual form of U-tube seal, such as the member 20.

It will be seen that such a structure establishes a new mode of operation for the screening device in that it provides for what in function may be considered a check valve, allowing a flow of the liquid from the area subjacent the screen, under predetermined pressure conditions, and preventing this flow under certain different pressure conditions. During operation, it will be understood, that the outlet tube 20 is sealed and hence does not break the suction on the down-

stroke of the diaphragm. In other words, on the downstroke of the diaphragm, the flow of the suspended finer particles down through the screen is induced. On the up-stroke of the diaphragm, since the pressure of the liquid adjacent the screen increases considerably above that in the sealing tube 20, a predetermined amount of the screened pulp flows outwardly through the tube. This flow of liquid obviously relieves the impact pressure on the bottom of the screen and thus eliminates the possibility of such pressure building up to the danger point, that is, to the extent of breaking the screen plate.

It will also be seen that this type of operation considerably increases the output of the machine, as well as serving to clean the screen. As will be observed from the figures, the flow of liquid through the auxiliary outlet 20 tends to be substantially parallel the bottom of the screen, in contradistinction to the main movement of the pulp which, under the action of the diaphragm, is substantially vertical or reciprocatory. In these circumstances therefore, the flow of liquid through the tube 20 tends to shear away fibers which may have adhered to the underside of the screen. It will also be appreciated that, in the older type of structure, under the pulsating action of the diaphragm, on the up-stroke, a considerable amount of liquid was forced upwardly through the screen apertures and effective flow of pulp through the machine was dependent largely on the down or suction stroke of the diaphragm. In the present type of structure, however, the diaphragm in combination with the two outlets 11 and 20 functions essentially as a double acting pump. On the down-stroke, liquid is drawn through the screen and overflows into the trough to be discharged in the usual manner. On the upstroke, as explained, not an inconsiderable quantity of the pulp is forced outwardly through the seal 20. It will thus be observed that the output from this type of machine is considerably greater than from one which is not so constructed.

It will readily be understood that, with the broad concept in mind, a number of specifically different types of structures may be provided, particularly in respect of the type of seal used. An example of such alternative construction is shown in Figure 2, in which the special double bend seal 30 is employed. As will have been appreciated, this seal functions essentially in the same manner as seal 20, shown in Figure 1. Since the essential function of the seal is that of a check valve, allowing a maintenance of suction on the down-stroke and an outward flow of pulp on the upstroke, it is clear that other types may be used. The auxiliary outlet, therefore, need not be a seal of the type shown, but may be of any other type of structure in which these essential functions are performed. In the type of structure shown, the size of the seal 20 or 30 will, of course, depend upon the relative size of the screening chamber, the depth of the stock, the speed of vibration of the diaphragm, and the like. In typical installations, such a seal may be of the order of from 2 to 6 inches. In any event, as explained, the seal is so constructed as to insure a maintenance of the suction or vacuum on the down-stroke and a positive outward flow of liquid on the upstroke, thus preventing the application of any considerable impact pressure on the screen.

Since a salient feature of the invention is the establishment of a positive outward flow of

screened stock on each stroke of the diaphragm while insuring the effective suction of the down-stroke, it will be appreciated that this may be accomplished by other methods. The device illustrated in Figures 1 and 2 show, in effect, the achievement of this new function in an existing type of machine having the usual low level discharge (11). In such a structure the benefits of the invention may be secured by providing a secondary or auxiliary outlet 20 (Figure 1) or 30 (Figure 2). The same essential functions may be secured by constructing a screening device having a special single outlet such as is shown in Figure 3. In such an apparatus, as indicated, the construction of the screen box and the relative location of the screen and diaphragm may be the same as that shown in Figures 1 and 2, and such have therefore been indicated by identical numerals. Under the invention as shown in Figure 3 a special type of single outlet 40 is provided. As shown this comprises a substantially U-shaped portion 41, constructed in a manner similar to that of the sealing discharge units 20 and 30 shown in Figures 1 and 2 respectively. Such a U-shaped discharge duct serves to permit outward flow of the screened stock under predetermined hydrostatic pressure conditions and also acts as a seal to maintain the desired suction in the screening chamber. As will be noted from an inspection of Figure 3, the discharge tube 40 is connected to the screen box and is therefore in fluid communication with the mass of pulp in the box at relatively high point and closely subjacent the screen. In these circumstances, the discharge tube performs the function of both the low level discharge 11 and the discharge tube 20 and 30 of the structure shown in Figures 1 and 2.

In operation, when the diaphragm 3 is vibrated under the action of the driving mechanism 8-10, the screen stock is caused to flow outwardly through the tube 40 on each stroke of the diaphragm. Due to the utilization of the U-tube section and, hence, the establishment of a liquid seal, the desirable suction on the down-stroke of the diaphragm is maintained. On the upstroke of the diaphragm the screened stock is caused to flow outwardly through the U-tube when the pressure obtaining in the body of pulp exceeds that established by the particular height of the seal, which is chosen. In this type of structure, therefore, in accordance with the general principles of the invention, the double pump action is secured, a greater thruput of stock is achieved, and the undesirable hydraulic hammer effect on the bottom of the screen is precluded.

As is known to those skilled in the art, a particular pulp mill may operate upon different types of cellulosic stock and may, in the course of its normal operations, cook materials varying from a very soft to a very hard stock. It has been found that the flow of the pulp through a particular screening apparatus is greatly influenced by the particular characteristics of the stock and, as a matter of fact, such flow is in part a function of such characteristic of the stock.

According to another feature of the invention, increased efficiency may be assured by providing means for regulating the discharge of pulp from the screening mechanism with respect to the character of the particular stock flowing through it. In these circumstances, the retention period in the screening device and the quality of the product can be predetermined and maintained.

These advantages may be secured by the simple

expedient of providing for a variable size of the discharge orifice. A simple embodiment of this concept, as applied to the double discharge unit, is shown in Figure 4. As already explained in the description of Figure 1, the screen structure (shown partly) includes the lower discharge orifice 11 and the auxiliary seal discharge tube 20. The discharge tube 20 is provided with a suitable valve 55, such as a gate valve, whereby the effective cross-sectional size and hence the speed of stock therethrough may be controlled. Similar means are provided to control the size of the lower orifices 11. In a simple embodiment this comprises the gate valve member 50. This valve is provided with the aperture 51 and the valve is adapted to slide, in the known manner, in the apertured guide 52. At its upper portion the gate is provided with the threaded stem 53, on the end of which is provided the usual operating handle. It will be understood that with this type of structure, by rotating the handle on the gate valve 50, the aperture 51 may be moved vertically upwardly and downwardly so as to control the effective size of the discharge, and thus regulate the amount of stock discharged through the tube 20. Similarly, by regulation of the gate valve 55, the flow of stock on the upstroke of the diaphragm may be controlled. Regulation of these two valves therefore not only permits the regulation of the entire amount discharged but also permits the regulation of the relative amounts passing through the orifices of the discharge tubes 11 and 20, respectively.

It will be appreciated that this same type of controlled operation may be utilized with the single discharge screen structure of the type shown in Figure 3. Thus, as shown in Figure 5, the screen may be provided with a gate valve of the type shown in Figure 4. This valve may comprise the gate or plate 60 formed with the aperture 61. The gate is adapted to reciprocate in the apertured plate seat 62. The upper portion of the gate is connected with the threaded stem at the end of which is provided the usual operating handle. In this type of structure, by rotating the handle of the stem 63 in the proper direction, the aperture 61 may be moved in and out of register with the discharge duct 41 so as to control the effective size of the discharge tube and hence regulate the amount of pulp flowing therethrough.

It will be understood that the invention comprehends broadly the control of flow of the screened pulp outwardly of the screen box. Therefore, it will be understood that, while particular types of valves have been described, these are given as merely illustrative and any other equivalent mechanism may be employed. For example, if desired, a gate valve of the type shown in Figure 6 may be utilized. This valve comprises a gate valve plate which has a plurality of orifices of predetermined size. Such a valve may comprise the gate plate 70, provided with the differential size orifices 71, 72 and 73, respectively. The valve may be mounted for vertical movement in the valve seat plate 74. At the upper end the valve may be provided with an apertured handle or stud 75 in which the latch 76 is adapted to reciprocate. The latch 76, it will be understood, is adapted to project through the stud 76 and engage in the detents or depressions 77. Such detents are, in the manner known to those skilled in the art, suitably vertically spaced so that they conform to the several registering position of the apertures 71, 72 and 73.

In the structure shown in Figure 6, for example, the gate valve is set so that the middle sized aperture 72 is in register with the discharge line 40-41. By withdrawing the member 76 from register with a detent, the gate 70 may be elevated or depressed, by utilizing the stud handle 75 so as optionally to register apertures 71, 72 or 73 with the discharge opening 40-41.

The particular types of valves have been given as merely illustrative of any mechanism which functions in a similar manner to control the flow of stock through either the single discharge type of screen (Figure 3) or through the double type discharge (Figures 1 and 2).

It will be appreciated that the present invention presents a simple and effective method of eliminating a marked defect in pre-existing processes and furthermore insure the positive and additional advantage of a considerably greater

thruput of stock, the flow of which may accurately be controlled. While preferred modifications of the invention have been described, it is to be understood that these are given to exemplify the underlying principles involved, and not as limiting the fundamental concept to the precise apparatus chosen for illustrative purposes.

I claim:

10 A pulp screening apparatus comprising a container, a screen mounted at the upper part of the container, a resilient diaphragm mounted at the base of the container, positive driving means for the diaphragm; an outlet for the container located closely adjacent the screen, a valve in said outlet, a second outlet from the container located closely adjacent the diaphragm, a control valve in said outlet and means to effect a controlled flow of screened pulp through each of said outlets.

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