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2,354,007

PAPER MACHINE FLOW MIXER

Original Filed Sept. 27, 1938 2 Sheets-Sheet 1

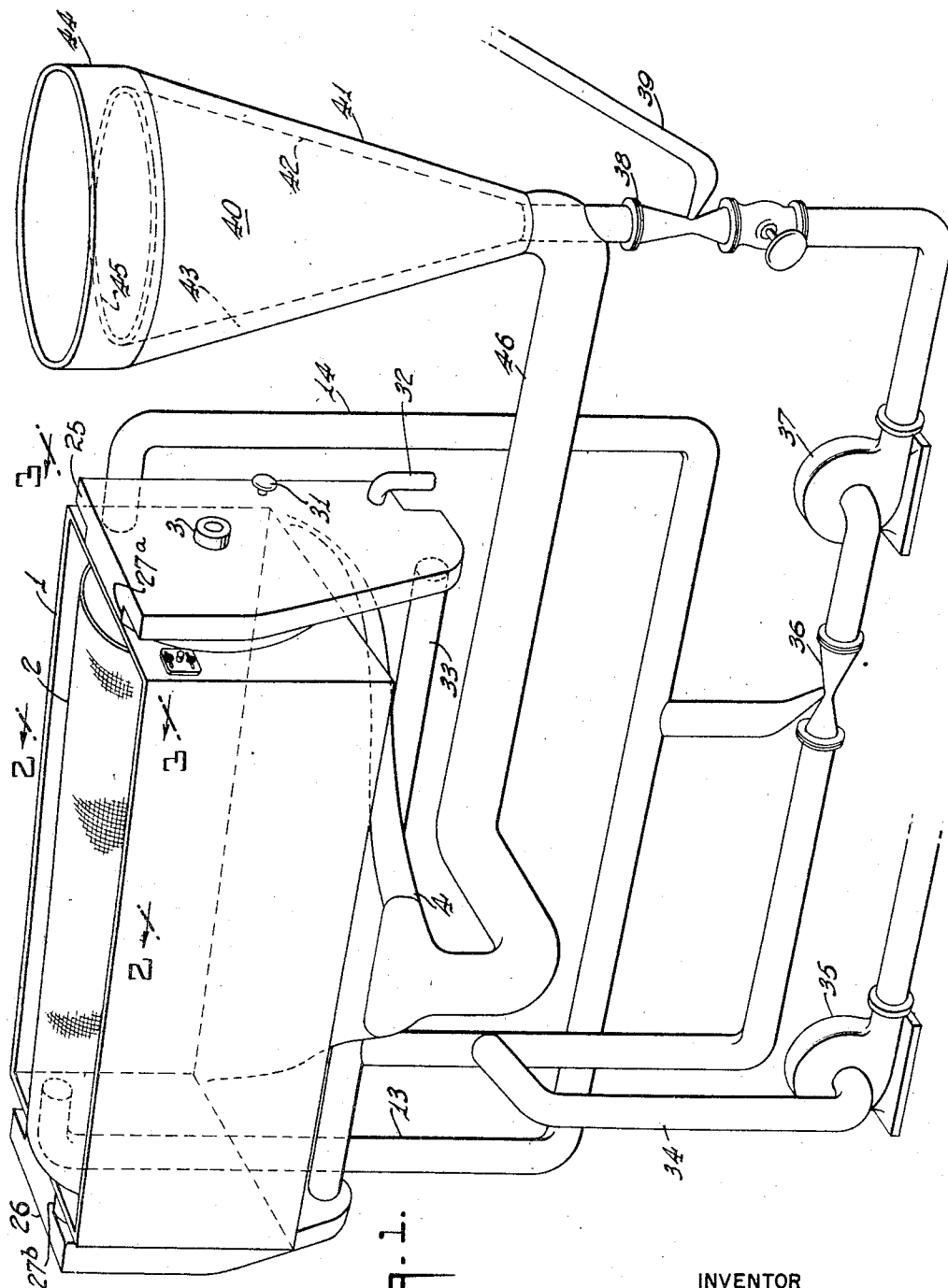


Fig. 1.

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Fig. 2.

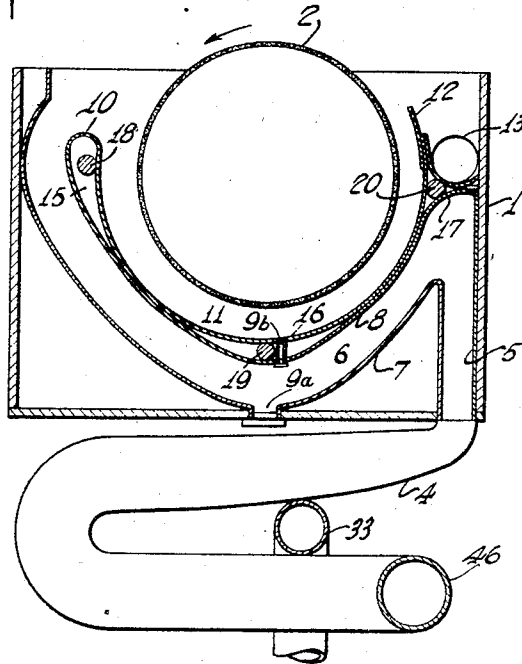
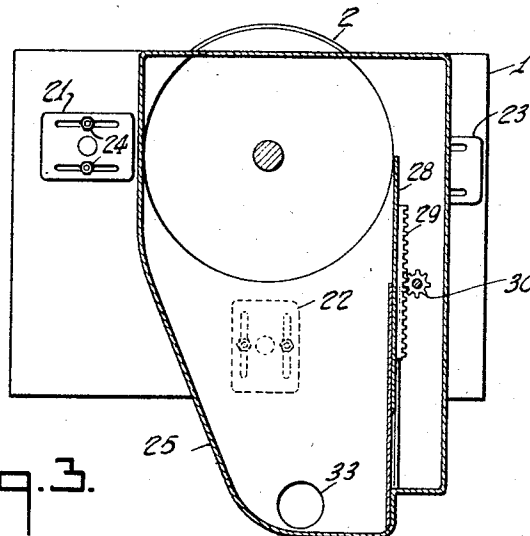


Fig. 3.

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PAPER MACHINE FLOW MIXER

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Original application September 27, 1938, Serial No. 231,854. Divided and this application May 9, 1941, Serial No. 392,717

2 Claims. (Cl. 92-43)

This invention relates to the art of paper making and more particularly to an improved type of mixing device for use in conjunction with a paper making machine. The present application is a division of my co-pending original application Serial No. 231,854, filed September 27, 1938.

In most paper making machines a sheet or web is formed by bringing a paper stock comprising a pulp suspension into contact with a foraminous forming surface and permitting or causing the water of the pulp suspension to flow through the holes in the forming surface leaving a matted layer of fiber on the forming surface. The paper stock is usually supplied under a hydraulic head sufficient to cause a desired flow of stock to the forming surface and it has been common practice to obtain this head by employing an open top rectangular box, commonly called a headbox, in which a level of stock is maintained at a sufficient height above the forming surface to give the desired head.

As pointed out in my original application, a paper stock is frequently composed of various components including water which has drained through the forming surface (commonly called white water), recirculated stock, and fresh incoming stock. It has heretofore been a common practice to mix the various components of the paper stock in the headbox. According to this practice each of the components is introduced into the headbox through a separate pipe and it has been assumed that the natural turbulence resulting from such a procedure would produce adequate mixing. However, this is usually not accomplished under present day operating conditions. Pockets of different consistency stocks tend to form in the corners of the headbox and this segregation causes streaks of uneven consistencies of stock to pass to the forming surface and cause irregularities in the sheet. These irregularities tend to produce blemishes in the formation, irregular caliber in finish across the sheet, and numerous operating troubles. It is also desirable that air or other gaseous materials be removed from the mixed stock before it passes to the forming surface. It has been assumed that the adequate elimination of air could be obtained with the conventional type of headbox referred to above, whereas actually the extreme turbulence of the mixing operation tends to increase the air content of the stock.

In accordance with the disclosure of my original application, the mixing of the various com-

ponents of stock is accomplished at a point sufficiently remote from the forming surface to permit subsequent removal of air and the establishment of a smooth and uniform flow of stock before the stock reaches the forming surface. The mixing step and the air removal step are physically separated from one another. The mixing is accomplished before the stock reaches the headbox and hence does not interfere with the desired functions of the headbox which are the maintenance of a constant flow level and the elimination of air or other gaseous material from the stock. An improved type of headbox and mixing device or flow mixer is disclosed, the claims of the present divisional application being directed to the improved flow mixer construction.

The advantages of the flow mixer of the present invention may best be appreciated by reference to the accompanying drawings which illustratively show a preferred form of the flow mixer incorporated in a paper machine of the cylinder type and in which

Figure 1 is a diagrammatic view of the cylinder machine in perspective showing the headbox and flow mixer construction;

Figure 2 is a cross-section of the vat and flow spreader taken along line 2-2 of Figure 1; and

Figure 3 is a view of the vat end showing the white water compartment in section taken along line 3-3 of Figure 1.

Referring to the drawings, and more particularly to Figure 1, there is shown a vat of generally rectangular shape indicated at 1 and containing a foraminous cylinder mold 2 rotatably supported by the bearings 3, only one of which is shown. The mechanism for rotating the cylinder mold forms no part of the present invention and hence is not shown. Stock is supplied to the vat 1 through a flow spreader 4, which is of such shape and cross-sectional area as to spread the flow of stock to the full machine width with substantially no change or with a slight increase in stock velocity. Upon entering the vat 1, the stock passes through a conduit 5 (see Figure 2) to the outer vat circle space 6 which is formed by an outer vat circle 7 of generally cylindrical contour, and an inner vat circle 8 of similar contour, the vat circle 7 being rigidly secured to the vat ends and the vat circle 8 adjustably secured to the vat ends in a manner more fully described hereinafter. The vat circles 7 and 8 are constructed of sheet metal, preferably of copper, in order that the desired degree of flexibility may be obtained. A washout con-

nection 9a is provided near the bottom of the vat circle 7 and a similar washout connection 9b is provided near the bottom of the vat circle 8 to facilitate cleaning of the vat circle spaces when it is necessary to change the type of stock supplied to the machine in order to produce a different type of paper board. From the vat circle space 8, the stock flows over the smoothly curved upper end 10 of vat circle 8 into the inner vat circle 11. The curved surface 10 is analogous to the making boards of the vats known to the prior art and may be so described.

As the stock passes through the inner vat circle space 11, the cylinder mold 2 rotates in a counterclockwise direction, as shown, and a portion of the water from the stock passes through the foraminous surface of the cylinder mold forming a web of fibers on the surface of the mold, which is removed near the top of the mold after it has emerged from the stock. The water passing through the surface of the mold, known in the art as white water, is removed in a manner which will be described later. The excess stock from the vat circle space 11 passes over an adjustable dam 12 and leaves the vat through the pipe lines 13 and 14 (best shown in Figure 1) to be recirculated in a manner hereinafter described.

The inner vat circle 8 is fabricated in such a manner as to be supported by three adjusting bars 18, 19, and 20, preferably of tubular cross-section. These adjusting bars are covered on both sides by the sheet metal forming the inner vat circle so that both of the vat circle spaces are completely streamlined and no obstruction is presented to the flow of stock. The adjusting bars are in turn supported by a series of movable plates 21, 22, and 23 located at the vat ends (best shown in Figure 3). Adjustment of the clearance between the vat circle 8 and the periphery of the cylinder mold is accomplished by loosening the bolts 24 which hold the movable plates in position and moving the plates in the desired direction. Normally the adjustable bar 18 will be positioned further from the periphery of the cylinder mold 2 than will the bar 20, and the bar 19 will be positioned at an intermediate distance from the cylinder mold in order to form a vat circle space having a decreasing cross-sectional area which will partially compensate for decreases in the quantity of stock due to water flowing through the surface of the mold.

The water which flows through the surface of the cylinder mold is removed at the end of the mold and flows into two white water compartments 25 and 26 at the vat ends, the compartments being separated from the vat ends by the spacer rings 27a and 27b. Suitable seals should be provided at the ends of the cylinder mold 2 to prevent stock in the vat circle space 11 from flowing into the interior of the cylinder mold. Such seals are well known in the art and hence are not shown in detail. As shown in Figure 3, the white water compartments contain an adjustable dam having a rack 29 rigidly attached thereto. Raising and lowering of the dam is accomplished by rotation of the pinion 30, which in turn is actuated by rotation of a knob 31 located on the outside of the white water compartment. The portion of the white water which overflows the dam 28 is the excess white water and flows out of the white water compartment through a line 32 which leads to a suitable point of disposal. The remainder of the white water, constituting the major portion thereof, is pumped by means of the white water pump from the

white water compartment through the line 33, whence it is again divided, one portion flowing through the line 34 and pump 35 to the screen or screens (not shown), where it is used as a diluent, and a second portion flowing to a mixing device 36. In the mixing device 36 the white water is thoroughly mixed with the recirculated stock coming from the lines 13 and 14. As pointed out in my original application it has been found that the most thorough and intimate mixture is obtained by joining the two streams of flow in such a manner that their cross-sectional areas are small and their velocities high at the point of mixing, and hence the diameters of both pipes are reduced at the point of joining. The recirculated stock is introduced at the most restricted portion of the mixer and hence at the point where the white water velocity is a maximum, thus insuring adequate mixing of the two components. From the mixer 36 stock passes through pump 37 to a second mixing device 38 of similar design where fresh incoming stock from the screens (not shown) is introduced through the line 39.

Stock from the mixing device 38 passes to a conical upflow headbox 40 comprising an outer inverted cone 41 and an inner inverted cone 42 concentric therewith and forming an annular space 43. The outer cone 41 is provided at its top with a short cylindrical section 44. If desired, the inner cone 42 may also be provided with a cylindrical section which may be made adjustable in height. It is desirable that the dimensions of the cones 41 and 42 be such that at the top of the inner cone the annular area between the two cones approximately equals the cross-sectional area of the inner cone. Stock flows upwardly through the inner cone 42 at a constantly decreasing velocity, passes over the dam 45 formed by the upper edge of the cone 42 and flows downwardly through the annular space 43 at a constantly increasing rate. Because of the upward direction of flow of the incoming stock and the relatively low stock velocity at the dam 45, headbox 40 is well adapted to remove air and other gaseous materials from the stock and improve the smoothness of flow. Furthermore, variations in the rate of flow of stock will cause only relatively small turbulence or changes in the liquid level in the headbox because of the large overflow area of the dam 45 and the large area of the free liquid surface. It is to be noted that this type of headbox has no dead corners where stock segregation can occur and is much easier to "wash up" than the usual type of headbox.

From the annular space 43 stock flows through an underfeed supply pipe 46 which is preferably of a relatively large size and thence to the flow spreader 4 and the vat 1.

The machine of the present invention makes possible the production of a paper board having a substantially greater uniformity than was heretofore possible. The double circle vat enables the machine operator to control the stock velocity ratio in such a manner as to obtain the formation characteristics desired, uniform fiber deposition around the vat circle, and further provides a full pass in the machine direction to iron out minor irregularities in the flow of stock before the stock reaches the forming surface of the cylinder mold. The relative machine and cross tear and tensile tests, for example, can be varied at will between wide limits and the optimum stock velocity can be obtained at every

point around the vat circle. Positive, rapid, and complete mixing of the various components of the stock is insured by the improved mixing devices, and this mixing takes place at a point remote from the forming surface. The upflow head-box insures proper elimination of air from the stock and the flow spreader spreads the flow to the full width of the machine with no sudden changes in stock velocity to produce unnecessary turbulence at this critical point in the process. Thus when the stock finally reaches the forming surface, eddy currents have been substantially eliminated and the flow of stock approaches theoretical streamline flow much more closely than has heretofore been possible.

Since many embodiments might be made of the above invention, and since many changes might be made in the embodiment above disclosed, it is to be understood that all matter hereinbefore set forth is to be interpreted as illustrative only and not in a limiting sense.

I claim:

1. In a cylinder paper machine of the type wherein a portion of the paper stock supplied to the forming surface of said machine is continuously recirculated and wherein said recirculated stock is diluted with white water and mixed with fresh stock coming to said machine, apparatus for mixing said diluted stock and said fresh stock comprising, in combination, a conduit for said diluted stock having a portion of gradually diminished cross-sectional area to momentarily increase the rate of flow of said diluted stock

therethrough, and a second conduit for said fresh stock connected to said first conduit approximately at the point of minimum cross-sectional area of said first conduit, said second conduit having a gradually diminished cross-sectional area at the point of junction with said first conduit to increase the rate of flow of said fresh stock at said point of junction, whereby said fresh stock and diluted stock are intimately mixed to form a homogeneous stock supply for said machine.

2. In a cylinder paper machine of the type wherein a portion of the paper stock supplied to the forming surface of said machine is continuously recirculated and wherein said recirculated stock is diluted with white water and mixed with fresh stock coming to said machine, apparatus for mixing said recirculated stock and said white water comprising, in combination, a conduit for said white water having a portion of gradually diminished cross-sectional area to momentarily increase the rate of flow of said white water therethrough, and a second conduit for said recirculated stock connected to said first conduit approximately at the point of minimum cross-sectional area of said first conduit, said second conduit having a gradually diminished cross-sectional area at the point of junction with said first conduit to increase the rate of flow of said recirculated stock at said point of junction, whereby said white water and recirculated stock are intimately mixed.

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