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STOCK CROSS-FLOW DISTRIBUTION

Filed June 7, 1957

3 Sheets-Sheet 1

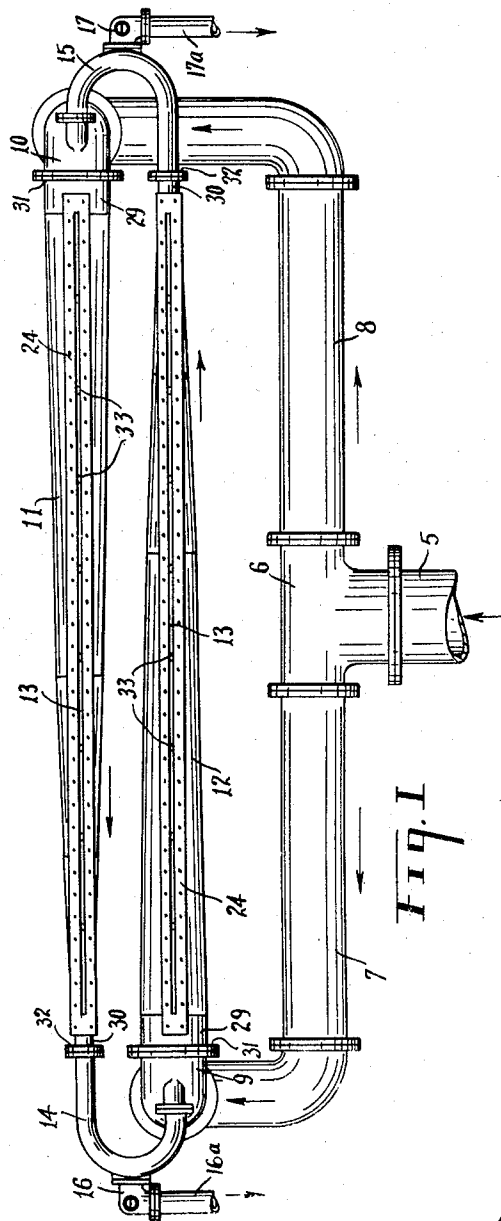


Fig. 1

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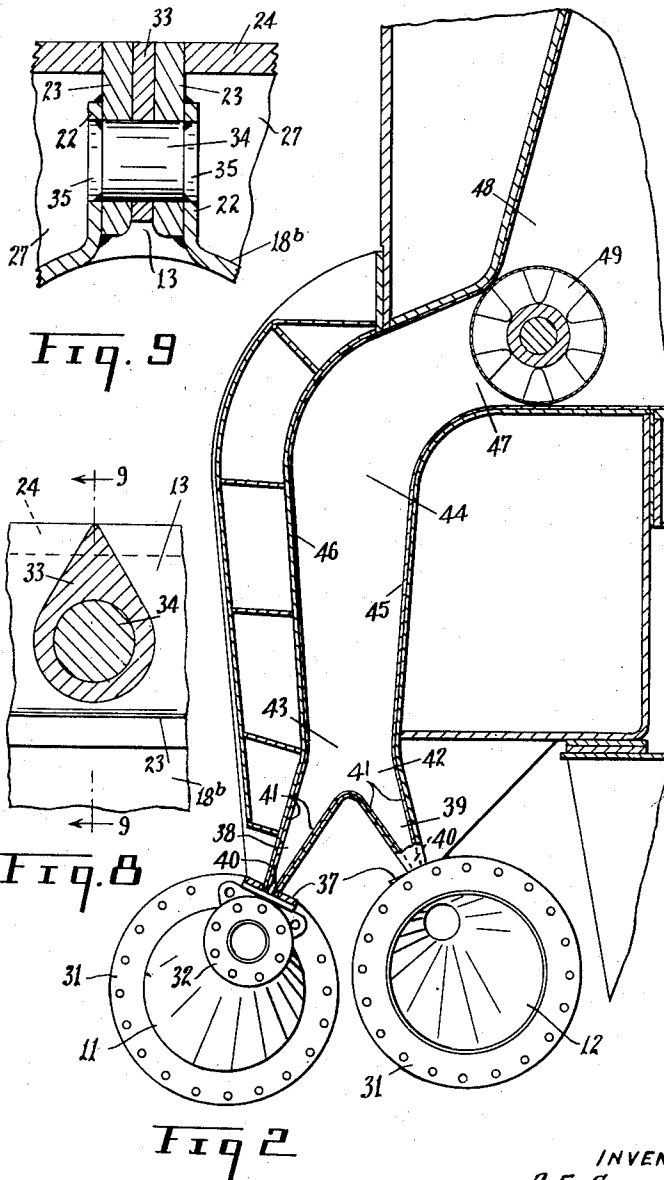
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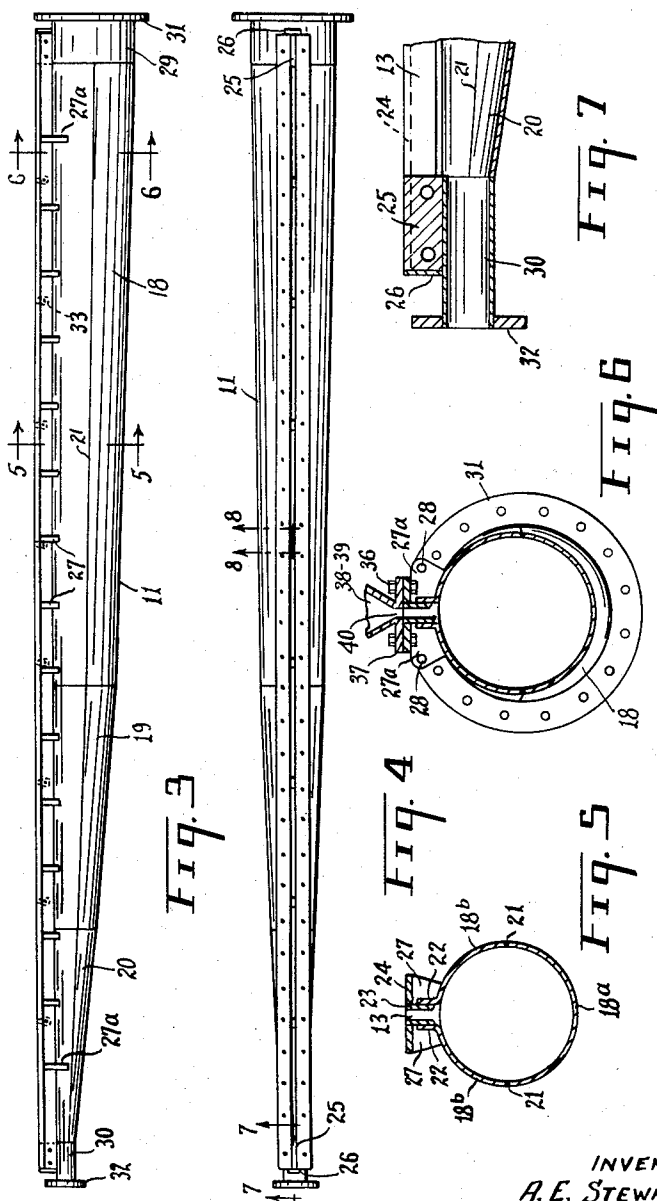
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STOCK CROSS-FLOW DISTRIBUTION

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13 Claims. (Cl. 92—44)

This invention relates to stock cross-flow distribution and particularly to the distribution of fluid paper stock to the headbox of a paper machine.

The invention consists essentially in means whereby two or more cross-flows of fluid paper stock are diverted from a path transversely of the paper machine into a single stock flow path in a direction parallel with the normal flow of stock on a paper machine, and to maintain constant velocity and a constant rate of flow of the paper stock per inch of width of the pond opening of the head box. The flow of paper stock is directed, at opposite sides of a paper machine, into the large end of a pair of cones set along side of each other transversely of the machine in opposite directions. Each cone is provided with a transverse discharge slot extending the full width of the pond opening and opening into a primary decelerating chamber of rectangular section, the walls of which are suitably inclined for optimum flow condition. The primary decelerating chambers discharge into a common mixing chamber which in turn discharges with a slight increase in stock velocity into a main or common decelerating chamber leading to the head box of the paper machine.

Various attempts have been made to secure a constant velocity and flow of paper stock across the full width of the machine particularly at the point where the stock first enters the machine without causing changes of pressure and eddy currents and turbulence in the stock. These attempts have in most cases corrected one feature of stock flow only to introduce other features of a detrimental nature.

The primary object of the present invention is to convert the flow of paper stock into an even flowing mass of constant velocity, in the direction parallel with the normal flow of the stock in the paper machine without turbulence.

A further object of the invention is to so blend cross-flows of stock that the separate flows come together at a constant rate of flow across the full width of the machine.

A further object of the invention is to bring cross-flows of stock into primary decelerating chambers before passing the stock into a common mixing chamber.

A further object of the invention is to provide stock cross-flow chambers in the form of cones in which the cones are set transversely across the paper machine and have their large end inlets disposed at opposite ends of the machine, the cones being provided with lengthwise slots discharging into a common decelerating and mixing chamber.

A further object of the invention is to provide means whereby pressure build-up is eliminated at the apex end of the cone chambers and ensure uniform flow throughout the full length of the discharge slots of the cones.

These and other objects will be apparent from the following specification and the accompanying drawings in which:

Figure 1 is a plan view of the two cross-flow distribution chambers removed from the head box assembly of the paper machine and showing the stock feed and pressure equalizing connections.

Figure 2 is a vertical side elevation of the stock cross-flow distribution chambers and showing in section the primary decelerating chambers, the mixing chambers and the common decelerating chamber connecting with the head box of the paper machine.

Figure 3 is a longitudinal vertical elevation of one of the conical cross-flow distribution chambers.

Figure 4 is a plan view of the cross-flow distribution chamber shown in Figure 3 showing the stock discharge slot.

Figure 5 is a vertical cross section of one of the cross-flow distribution chambers taken on the line 5—5 of Figure 3.

Figure 6 is a vertical cross-section on the line 6—6 of Figure 3 showing the lifting lugs and inlet end flange.

Figure 7 is a partial vertical longitudinal cross section of the small end of the cross-flow distribution chamber taken on the line 7—7 of Figure 4.

Figure 8 is an enlarged vertical section through the discharge slot on the line 8—8 of Figure 4 and showing one of the discharge slot spacers.

Figure 9 is a vertical section on the line 9—9 of Figure 8 showing the slot spacer welded to the side walls of the discharge slot.

Referring to the drawings, the fluid pulp stock is pumped through the pipe 5 and through the T 6 into the pipes 7 and 8 and thence through the elbow connections 9 and 10 into the large end of the conical distribution chambers 11 and 12.

These conical distribution chambers 11 and 12 are laid side by side and have a discharge slot 13 extending the full length of the distribution chambers and are equal in length to the width of the flow of stock through the head box and the slice leading to the forming wire of the machine.

In order to prevent pressure build up of the stock fluid at the ends of the discharge slots 13, pressure equalization pipes 14 and 15 connect the small end of one distribution cone with the inlet of the other distribution cone. The pressure in the equalization pipes 14 and 15 is controlled by the valves 16 and 17 which drain off through the pipes 16a and 17a, the required volume of pulp stock to prevent a pressure build up at the small end of the distribution cones. The small end of the cones 11 and 12 may discharge directly to the wire pit but shall be equipped with full bore valves 16 and 17 for control purposes.

The conical distribution chambers 11 and 12 are made up of a series of short truncated cones 18, 19 and 20, permanently joined end to end. The physical dimensions of the component cones shall, when placed end to end approach as nearly as possible the limiting boundaries of the theoretical constant velocity parabolic contour governing the design of the main truncated cone. Each of the short truncated cones 18, 19 and 20 are preferably made up of separate sections as shown in Figure 5 where the bottom segment 18a is welded at 21 to two quarter segments 18b. The two quarter segments 18b are flanged at 22 to form a part of the discharge slot 13 construction. The discharge slot 13 proper is formed of the side plates 23 which are welded to the flanges 22 and support the flange 24 through which the conical distribution chambers 11 and 12 are secured to the head box structure of the paper machine. The ends of the discharge slots 13 are closed off by means of the filler plates 25 and end plate 26. Gussets 27 support and reinforce the flange 24 at spaced intervals along the length of the flange, the end gussets 27a being enlarged and

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are drilled at 28 to provide lifting lugs for distribution chamber assembly.

The ends of the conical distribution chambers 11 and 12 are extended by tubular portions 29 and 30 carrying the flanges 31 and 32 through which the distribution chambers are connected to the inflow connections 9 and 10 and to the equalization piping 14 and 15.

The long narrow rectangular discharge slot 13 is held to its designed width of opening by a series of spacers 33 which are mounted on the pins 34 set in the apertures 35 drilled in the side plates 23. The spacers 33 are here shown as being of tear drop shape in order to give the least possible interference with the passage of the stock up through the slot 13 and to ensure an unturbulent flow of stock at the mouth of the slot. However, these spacers 33 are relatively small and are spaced as wide apart as is permissible so that in fact they offer no appreciable interference with the flow of stock. Alternatively, the discharge slot or opening 13 may contain or consist of a multiplicity of openings of circular or hexagonal cross section. The spacers 33 may be secured by other means which will be proof against leakage at this point.

The flanges 24 of both conical distribution chambers 11 and 12 are secured by bolts 36 to corresponding flanges 37 at the mouth of the primary decelerating chambers 38 and 39. These decelerating chambers 38 and 39 have rectangular openings 40 matching the discharge slots 13 of the distribution chambers 11 and 12. The walls 41 of the decelerating chambers 38 and 39 are inclined outwardly for optimum flow conditions of the stock into the common mixing chamber 42. The conical distributing chambers 11 and 12 have their discharge slots 13 angled inwardly with respect to each other and, with the projected decelerating chambers 38 and 39, carry the stock into the common mixing chamber 42 at an angle which will ensure thorough intermingling of the stock from the two counter-flow distributing chambers 11 and 12 into a stream flowing parallel to the normal flow of stock on the paper machine.

Combined with the mixing of the two streams of stock in the common mixing chamber 42, a slight increase in velocity is imparted to the stock as it flows upwards through the throat 43 into the main or common decelerating chamber 44. The front and rear walls 45 and 46 of the decelerating chamber 44 diverge towards the discharge opening 47 leading into the rear of the head box 48. A perforated roll 49 or other suitable rectifying device may be placed in the head box 48 at the mouth of the opening 47 for the purpose of further regulating the inflow and smoothing out any turbulence which may be present in the stock at this point.

In the operation of the above described invention the pulp stock is carried through the pipe 5 and distributed to each side of the paper machine through the pipes 7 and 8 to the large end of the conical distribution chambers 11 and 12. These distribution chambers 11 and 12 are so designed as to approach as nearly as possible to a theoretical constant velocity parabolic contour and the area of the discharge slots 13 are such that the ratio of discharge velocity of the stock through the slots to the intake velocity shall be in the range of approximately 3.5 to one or 4 to one. Due to the contour of the conical chambers 11 and 12 the stock flow through the discharge slot 13 will be maintained with a constant velocity and a constant rate of flow per inch of width of the pond opening unaffected by the change of direction of flow from crosswise of the machine into a directional flow parallel to the normal flow of stock on the paper machine.

In order that there shall be no possibility of pressure build up at the small end of the conical distribution chambers 11 and 12 which would affect the even flow of stock throughout the length of the discharge slot 13, equalization passages 14 and 15 join the small ends of the chambers 11 and 12 to the intake elbows 9 and 10 at the adjacent large ends of the chambers 11 and 12 and

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are provided with discharge outlets 16a and 17a provided with full bore valves 16 and 17. By adjustment of the valves 16 and 17 any excess pressure at the small ends of the chambers 11 and 12 can be controlled by draining of a portion of the stock and returning it to a sump or wire pit below the machine.

From the cross-flow chambers 11 and 12 the stock is directed into primary decelerating chambers 38 and 39 which open into a common mixing chamber. The stock from both decelerating chambers 38 and 39 has its velocity decreased to a value which will ensure that the mating streams will intermingle with each other with a minimum of turbulence and into a common flow directed upwardly through the throat 43. The throat 43 is designed to impart a slight increase in velocity to the upward flowing stock to assist in carrying the stock upwards into the main or common decelerating passage 44 and thence through the opening 47 into the head box 48.

The stock flow through the head box and on to the forming wire of a paper machine, when controlled in direction, pressure and velocity as above described, has a uniform consistency without turbulence hitherto unobtainable, resulting in a paper web of uniform strength and gauge which can be run at high speeds with less chance of breakage in the process.

While a pair of conical distribution chambers having a single stock discharge slot in each has been described in detail, it is to be understood that the invention is not to be limited to that construction. For instance, each of the two conical discharge chambers could have two or more discharge slots discharging into an equal number of primary decelerating chambers which in turn would open into a common mixing chamber. Alternatively, two or more pairs of conical cross-flow distribution chambers could be installed each having single or multiple discharge slots. This latter alternative could be of particular advantage in the supply of very large volumes of stock to large high speed paper machines.

What I claim is:

1. Stock feeding means of the character described comprising conical counter-flow stock feed passages directed across the width of a paper machine, the large end of one conical feed passage being adjacent the small end of the other conical feed passage, the said stock feed passages having discharge slots extending throughout their length, and outlet means disposed at the small ends of each said stock feed passages.

2. Stock feeding means of the character described comprising conical counter-flow stock feed passages directed across the width of a paper machine, the large end of one conical feed passage being adjacent the small end of the other conical feed passage, the said stock feed passages having discharge slots extending throughout their length, outlet means disposed at the small ends of each said stock feed passages, primary decelerating chambers connected at one end to the discharge slots of said stock feed passages and at the other end to a common stock mixing chamber receiving and mixing the stock fed from the counter-flow stock feed passages.

3. Stock feeding means of the character described comprising a pair of conical counter-flow stock feed passages directed across the width of a paper machine, the large inlet end of one conical feed passage being adjacent the small end of the other conical feed passage, each of said conical feed passages having a substantially constant velocity parabolic contour, the said stock feed passages having discharge slots extending throughout their length, outlet means at the small ends of said stock feed passages, primary decelerating chambers connected at one end to the discharge slots of said stock feed passages and at the other end to a common stock mixing chamber receiving and mixing the stock fed from the counter-flow stock feed passages.

4. Stock feeding means of the character described com-

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prising a pair of conical counter-flow stock feed passages directed across the width of a paper machine, the large inlet end of one conical feed passage being adjacent the small end of the other conical feed passage, each of said conical feed passages having a substantially constant velocity parabolic contour, the said stock feed passages having discharge slots extending over a major portion of their length, stock inlet pipe connection to the large ends of said conical feed passages, pressure equalizing passages connecting the small ends of said conical feed passages with the said stock inlet pipes, valve controlled discharge outlets to said equalizing passages, primary decelerating chambers connected at one end to the discharge slots of said stock feed passages, a stock mixing chamber connected to each of said primary decelerating chambers, and a main decelerating chamber connected at one end with said mixing chamber.

5. Stock feeding means of the character described comprising a pair of conical counter-flow stock feed passages directed across the width of a paper machine, the large inlet end of one conical feed passage being adjacent the small end of the other conical feed passage, each of said conical feed passages having a substantially constant velocity parabolic contour, the said stock feed passages having discharge slots extending over a major portion of their length, stock inlet pipe connections to the large ends of said conical feed passages, pressure equalizing passages connecting the small ends of said conical feed passages with the said stock inlet pipes, valve controlled discharge outlets to said equalizing passages, primary decelerating passages connected at one end to the discharge slots of said stock feed passages, the said primary decelerating passages having diverging walls opening into a common stock mixing chamber, the said common stock mixing chamber having a single constricted discharge opening and a main decelerating chamber, the said main decelerating chamber having walls diverging outwardly from the constricted discharge opening of said mixing chamber.

6. In stock feeding means for paper machines, a pair of conical feed compartments set horizontally parallel with each, the large stock inlet end of one compartment being adjacent the small end of the other compartment, each compartment comprising a conical tubular body sec-

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tion and end cylindrical sections, a discharge nozzle of narrow width extending the full length of said tapered body section on each of said conical feed compartments, and a series of spacers in said discharge nozzle, the said spacers holding said nozzle to its fixed narrow width.

7. In a stock feeding means for paper machines as set forth in claim 6, in which a flange surrounds the exit of the discharge nozzle and is disposed at right angles to the axis of the nozzle.

8. In a stock feeding means for paper machines as set forth in claim 7, in which a series of gussets anchor the said flange to the walls of said nozzle and said tapered body section.

9. In a stock feeding means for paper machines as set forth in claim 6, in which the top surface of the conical body section is slit lengthwise and the edges thereof are turned upwards to form the side walls of the said discharge nozzle.

10. In a stock feeding means for paper machines as set forth in claim 6, in which the conical body section is made up of truncated conical sections fastened end to end.

11. In a stock feeding means for paper machines as set forth in claim 10, in which the top surface of each truncated conical section is slit lengthwise and the edges thereof are turned upwards to form the side walls of the said discharge nozzle.

12. In a stock feeding means for paper machines as set forth in claim 6, in which the discharge nozzle is formed of side and end walls, a flange disposed at right angles to said side and end walls and supported by slit and upturned portions of the wall of the conical body section.

13. In a stock feeding means for paper machines as set forth in claim 12, in which spacers are mounted on pins supported in the side walls of the discharge nozzle and sealed therein by welding or other suitable means in the upturned portions of the wall of the conical body section.

References Cited in the file of this patent

UNITED STATES PATENTS

2,344,282	Berry	Mar. 14, 1944
2,589,639	Staeger	Mar. 18, 1952