June 4, 1963 J. D. PARKER 3,092,538

METHOD AND APPARATUS FOR FEEDING STOCK TO PAPER MAKING MACHINE

Filed Nov. 9, 1960 2 Sheets-Sheet 1

Fig. 1

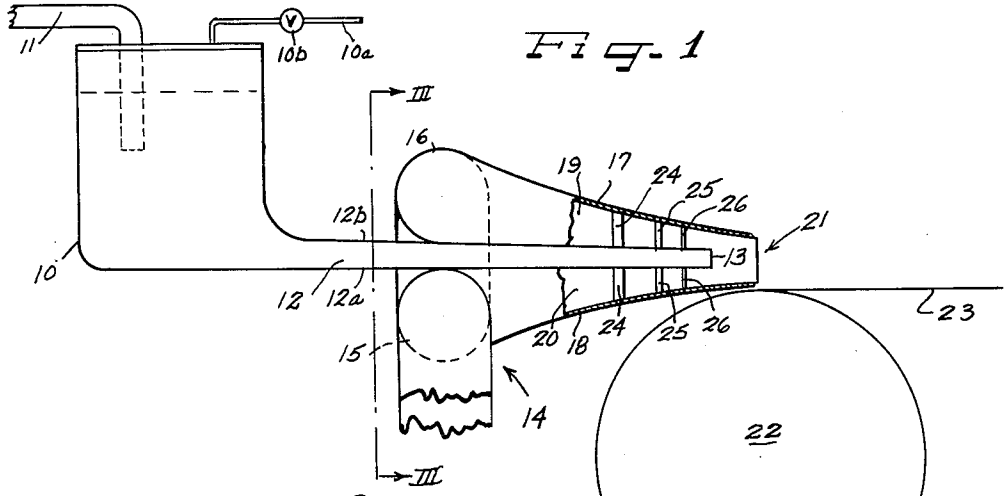


Fig. 3

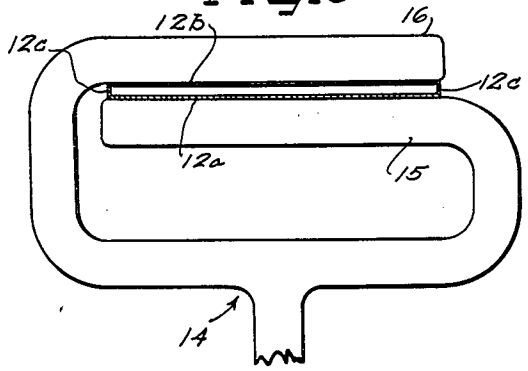


Fig. 2

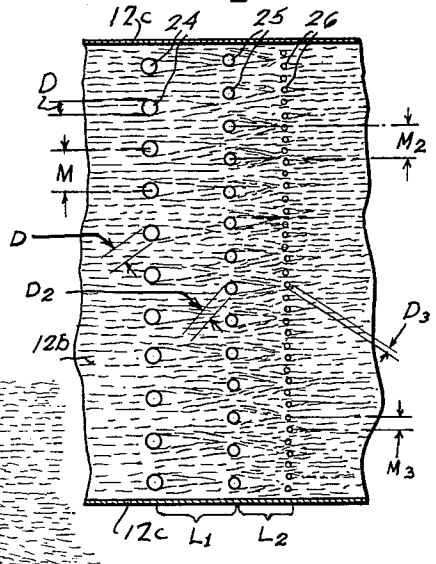
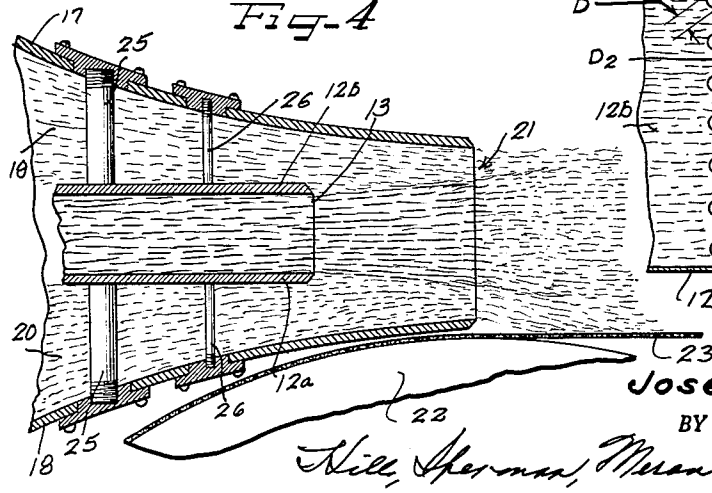


Fig. 4



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Filed Nov. 9, 1960 2 Sheets-Sheet 2

Fig. 5

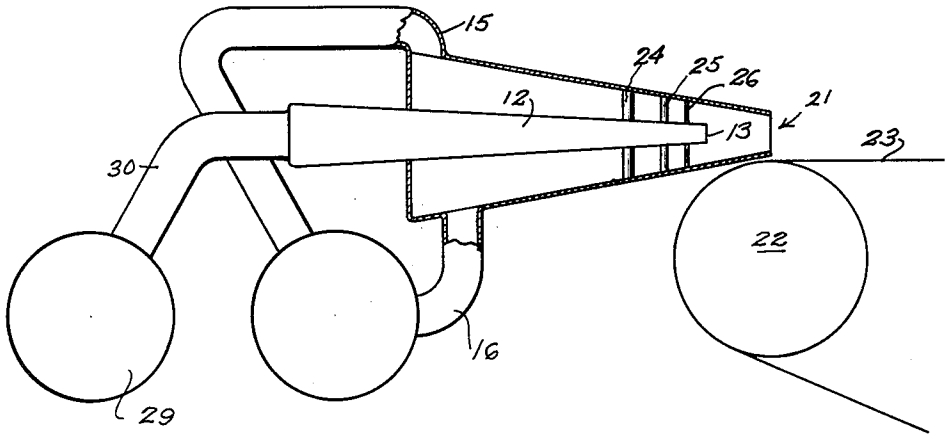
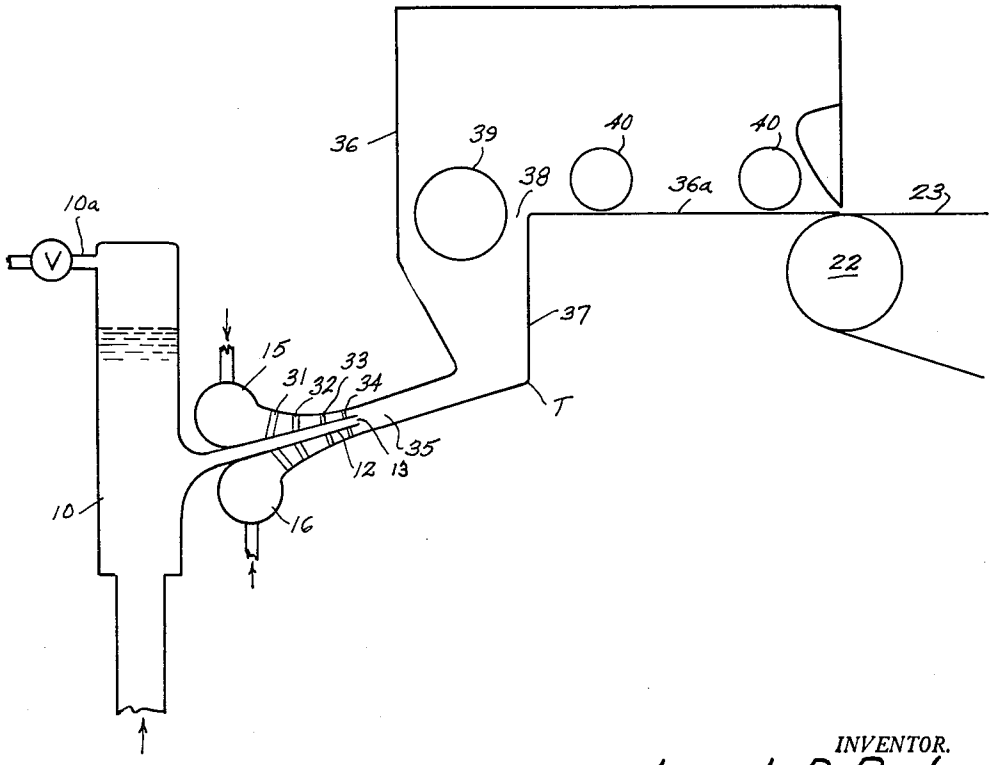


Fig. 6



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3,092,538

METHOD AND APPARATUS FOR FEEDING STOCK TO PAPER MAKING MACHINE

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18 Claims. (Cl. 162—216)

This invention relates to the handling of fluid slurries and is more particularly directed to the generating of fiber dispersion in stock slurries for papermaking and like processes.

Prior attempts to establish uniform distribution of the fibers in the stock slurry and to maintain fiber distribution, once established, along the entire flow path in the head box prior to deposition of the slurry on the forming surface of the papermaking machine have involved employment of such complicated auxiliary equipments as perforated rotary rolls, commonly referred to as rectifier rolls, holey rolls, or silencing rolls, and other mechanical vibrating, shaking and stirring devices, all of which induced turbulent flow currents of large amplitude in the slurry.

A major disadvantage attendant use of such prior art devices resides in the tendency of the fibers to form clots, floc, or agglomerations which, when deposited on the forming surface, result in undesirable localized irregularities of high density in the forming mat. In some instances, such clots and the like break down the mat, thereby interrupting production.

By employment of the present invention, I eliminate the requirement for rotary, vibrating or other moving auxiliary means in the head box and provide for delivery of the stock slurry to the forming surface of a paper making machine under conditions of substantially uniform mean velocity, minimum large scale flow turbulence, and minimum gross secondary flow patterns wherein the fiber distribution in the liquid vehicle is substantially uniform thereby permitting formation on the forming surface of a mat having substantially uniform density and fiber distribution throughout. The practice of the present invention also substantially reduces the formation of undesirable clots, floc or agglomerations in the turbulent slurry.

It is, therefore, an object of the present invention to provide improved methods and means for establishing substantially uniform mean distribution of particles in a liquid medium and to substantially reduce formation of undesirable clots, floc and agglomerations in a stock slurry in the headbox or flow channel of a paper making machine.

It is a further object of the present invention to control the condition of flow of a stock slurry immediately before its delivery to the forming surface of a paper making machine.

It is a further object of the present invention to provide improved methods and means for delaying addition of the fiber stock to the clear or white water until the clear or white water is in a condition of fine scale turbulent flow throughout whereby combination of the fibers with the fine scale turbulent clear or white water results in enhanced distribution of the fibers throughout the slurry.

These and other objects, features and advantages of the present invention will become more apparent from a careful consideration of the following detailed description, when considered in conjunction with the accompanying drawing wherein like reference numerals and characters refer to like and corresponding parts throughout the several views.

On the drawings:

FIGURE 1 is a generally diagrammatic view in partial section of apparatus constructed in accordance with the principles of the present invention;

FIGURE 2 is a view illustrating the banks of abutments for inducing a condition of fine scale turbulence in the clear or white water channel of FIGURE 1;

FIGURE 3 is a view taken along lines III—III of FIGURE 1.

FIGURE 4 is a view illustrating the location wherein the fine scale turbulent clear or white water combines with the thick stock stream in the apparatus of FIGURE 1.

FIGURE 5 is a generally diagrammatic view illustrating an alternative embodiment of the present invention; and

FIGURE 6 is a diagrammatic view of another embodiment.

As shown on the drawings:

Briefly stated, the present invention involves the formation of a stock slurry for delivery to the forming surface of a papermaking machine wherein improved distribution of fibers results in formation of a mat of substantially uniform density and fiber distribution. In accomplishing this purpose, a high density mixture of stock and water is first prepared, the fiber content of which may be an amount within the range of from about 1% to about 4%. For purposes of the present application, the mixture of the fibers in such consistency range will hereinafter be referred to as the "thick stock." The thick stock is then supplied under pressure from a source through a channel. In a convergingly tapered channel, such as appears in FIGURE 1, the flow characteristics of the thick stock are comparable to that found in conventional extrusion processes. Between relatively closely spaced channel walls, the resistance of the thick stock to flow is sufficient to suppress cross velocity flow components created as well as possible oscillations in the thick stock. Thus, the distribution of the fiber and the thick stock across the width of the channel may be said to assume the form dictated by the channel outlet area.

In order that the fibers in the thick stock be uniformly dispersed throughout the clear water, a condition of fine scale turbulence is induced in the clear water or white water before mixture thereof with the thick stock.

Banks of grid elements cooperate to produce successively smaller scale turbulence in the slurry while increasing the uniformity of the distribution of fibers across the width of the flow channel with a minimum amount of flocculation.

It will be appreciated that in the area of combination, the flow velocities of each of the components of the slurry should be substantially equal.

Referring to FIGURES 1 through 4, wherein a preferred embodiment of the present invention is shown, the thick stock may be introduced into a chamber **10** from the chest (not shown) through a conduit **11**. Conduit **10***a* and valve means **10***b* are provided for applying air pressure to the thick stock in the channel **10** for delivery thereof to the outlet of the delivery channel **12** under controlled velocity conditions. The thick stock, then, under the pressure influence, flows in laminar or plug form through the outlet channel **12** which includes a bottom or floor **12***a*, a top wall **12***b* and side walls **12***c* defining therebetween the enclosed flow path. The top and bottom walls of the flow channel **12** are gradually tapered inwardly to the outlet **13** of the channel.

A manifold arrangement generally indicated by the numeral **14** is provided for the supply of the clear water or white water from a source (not shown) to the channel **12**. As more clearly appears in FIGURE 3, the manifold **14** includes a cylindrical branch conduit **15** for supply of the clear water or white water adjacent the underside **12***a* of the channel **12** across the full width of the channel and a cylindrical branch conduit **16** for supply of the clear water or white water adjacent the top wall

12*b* of the channel 12. Flow therefore of the clear water or white water, after it enters the branch conduits 15 and 16, is substantially parallel to the direction of flow of the thick stock in the channel 12.

The branch conduits 15 and 16 distribute the clear water or white water across the full width of the channel 12. The water in the branch conduit 16 then flows through an outlet channel 19 defined by the top wall 12*b* of the thick stock channel side walls 12*c* and an upper wall portion 17 which is shown as being convergingly tapered to the end thereof remote from the conduit 16. Similarly, branch conduit 15 communicates with an outlet channel 20 defined by the bottom wall 18 which may be convergingly tapered to the end thereof remote from the branch conduit 15. The water flows through the outlet channels for mixture with the thick stock adjacent the forming surface of the papermaking machine. The channels 19 and 20 are preferably of the same cross-sectional width as the channel 12 which is substantially the same as the width of the forming surface 23 of the paper machine.

The apparatus thus far described is positioned with its outlet indicated by the numeral 21 terminating substantially at the top center of a breast roll 22 over which is looped the forming wire 23 of a conventional Fourdrinier machine so that the stock slurry or furnish flowing thereover from the stock outlet 21 may flow onto the upper run of the forming wire 23 while the wire is supported by the breast roll 22 and the usual Fourdrinier structure in a substantially horizontal plane as it passes over the top center of the roll behind the top peripheral portion.

Secured to the top and bottom walls in each of the white water or clear water flow channels 19 and 20 respectively are a plurality of banks or arrays of stationary and preferably vertical grid elements indicated by the numerals 24, 25 and 26 respectively.

Since it is preferable to employ the same number of banks or arrays of grid elements in each of channels 19 and 20, the discussion now to follow will refer only to the banks of grid elements located in channel 19, it being understood that the structure and operation of the grid elements in channel 20 are similar.

As appears in FIGURE 2, a first bank or array of stationary and preferably vertical grid elements 24 extend transverse of the direction of the flow of the water the full width of the flow channel 19. The grid elements 24 are preferably cylindrical rods, preferably equally spaced in the bank, each parallel to the other, and symmetrically located about the center line of the channel. The grid elements 24 are preferably sized relative to the total transverse flow area or width of the channel to occupy approximately 50% of the width thereby leaving between the grid elements 24 a total open flow area of approximately 50% of the width of the channel. The grid elements 24 may be spaced so as to provide a total flow area therebetween within the range of from about 10% to 90% of the width of the channel, while I prefer to employ a sufficient number of grid elements 24 to define a total flow area therebetween within the range of from about 20% to about 80%, and, as yet set forth herein, excellent fiber distribution is obtained where the said total flow area between grid elements is approximately 50% of the width of the channel. Otherwise stated, the ratio of the cross-sectional dimension D (FIGURE 2) of each grid element 24 and the distance M, the distance from the center of one grid element 24 to the center of an adjacent grid element 24 is equal to 1/2. Experience has indicated that with D/M ratios less than 1/2, the turbulence produced downstream of the bank of grid elements is not as great as is desired for distributing and dispersing the stock. On the other hand, extremely large D/M ratios produce undesirable jetting velocities through the open area between grid elements because of the pressure drop experienced in the flowing stream.

The grid elements 24 are provided for increasing the intensity and reducing the scale of turbulence in the white water. The condition of the flow pattern of the water downstream of the grid elements 24 is thus changed to a condition exhibiting a uniform pattern of first order eddy currents of a first magnitude.

Located a distance L_1 downstream from the first bank of grid elements 24 is a second bank of grid elements 25. The distance L_1 is approximately equal to about two to about five times the distance M of the first bank of abutments 24. This distance L_1 is chosen for advantageous employment of the behavior of the turbulent wakes induced behind each of the grid elements 24. Maximum intensity of the flow turbulence, experience indicates, presumably occurs from about two to about four distances M from the upstream bank of grid elements 24 at high flow velocities, it being understood, of course, that turbulence intensity is dependent on velocity and, thus, the distance between the banks of grid elements in turn is dependent on these factors. At greater distances, the turbulent flow induced in the white water or clear water by the grid elements 24 tends to dissipate or decay and to merge into a uniform mean flow pattern.

The second bank of grid elements 25 are located about two to about five times the distance M of the first bank of abutments, which is within an area wherein the initially induced pattern of turbulence is partially decaying. A second pattern of turbulence of finer scale but greater intensity is generated in the water passing through the open area between the grid elements 25 of the second bank. Thus, the second bank of grid elements is located a distance downstream from the first bank, said distance being greater than the distance to the zone of maximum intensity of the first order flow turbulence but less than the distance where a uniform means flow occurs in the water.

It will be appreciated that in order to generate a greater number of eddy currents, the cross-sectional dimension D_2 of each of the grid elements 25 and the dimension M_2 of adjacent grid elements 25 in the second bank of grid elements are less than the dimensions D and dimension M of the first bank of grid elements. The number of grid elements in the second bank, therefore, will be greater than the number in the first bank and the cross-sectional dimension of each grid element in each bank is preferably equal.

The white water, in this condition, may be then flowed past a third bank of grid elements 26 located a distance L_2 from the second bank of grid elements, the distance L_2 being determined in the same manner as the distance L_1. However, if the bank of grid elements 26 constitutes the last bank of grid elements adjacent the area wherein the clear or white water is to be mixed with the thick stock, the distance relationship between the last bank of grid elements and the outlet 13 must be taken into consideration in determining the proper location for the last bank of grid elements 26, and will lie in the range of from about three to about seven times M_3.

For increasing dispersion or distribution of the fibers in the slurry, once formed, and, in order to generate the finest scale turbulence possible, each of the grid elements in the final bank should be of the minimum cross-sectional dimension D_3 permissible in terms of structural strength and the like. In addition, the location of the last bank of grid elements should be at a distance from the outlet 13 sufficient to permit a partial decay of turbulent eddy currents induced by the last bank of abutments whereby the clear water or white water is delivered to the area of combination or mixture with the thick stock in a condition of fine scale turbulence.

Preferably, the dimension D and distance M and ratio of D/M is determined for each bank of abutments, and additional intermediate banks of abutments may be employed if desired, in accordance with the procedure outlined above in connection with determining the dimension

D, distance M, and dimension-to-distance ratio D/M of the first bank of grid elements. In addition, the total open area between the grid elements of each bank is preferably about 50% of the width of the channel.

The grid elements **24**, **25** and **26** may be of any cross-sectional shape desired, for example, round or square, but I prefer to employ cylindrical rods. It is also contemplated within the scope of the present invention to substitute perforated or slotted plates or grids for the banks of grid elements and similar means may be employed such as a plurality of jets of water.

The white or clear water is supplied through the branch conduits **15** and **16** and past the plurality of banks of grid elements which generate successively finer scale turbulence in the white water or clear water while increasing uniform distribution of fibers and minimizing clot formation.

As appears in FIGURE 4, the thick stock flows in jet form from the outlet **13** of the centrally located channel **12** while the upper layer of clear water or white water flows past the last bank of abutments **26** from the channel defined by the walls **12***b* and **17** and another layer of clear water or white water flows from the channel defined by walls **18** and **12***a* for mixture with the thick stock in a mixing zone or area. It might be said that the thick stock is sandwiched between the upper and lower layers of clear water or white water adjacent the thick stock outlet **13**. This sandwiched condition exists a short distance downstream from the outlet **13** with very little mixing of the water and thick stock. There is mixing to some extent; however, dispersion of the thick stock throughout the clear water or white water occurs a short distance downstream from the outlet **13** under the influence of the fine scale turbulence in the white water or clear water. The area of the mixing zone, of course, will depend upon such factors as the end product desired, the fiber consistency of the slurry, and the delivery velocities of the thick stock and white water or clear water.

In the alternative embodiment of the present invention appearing in FIGURE 5, the thick stock is delivered from a transverse manifold **29** through a transverse channel **30** to the thick stock slice channel **12**. In this arrangement the white water or clear water is delivered through the branch conduits **15** and **16** and past the turbulence generators or banks of abutments **24**, **25** and **26**. The operation of this arrangement is similar to that of the apparatus of FIGURE 1.

As aforesaid, the present invention may be employed for cross flow distribution of the slurry to feed the combined slurry into a standard head box for subsequent delivery to the forming surface of a paper making machine. A contemplated arrangement for cross-flow distribution of the slurry upstream of the head box appears in FIGURE 6. The thick stock is fed from the chest into a pond or channel **10** wherein pressure is applied to the thick stock. The stock is fed through the converging channel **12** and the white water or clear water fed through the manifold arrangement and branch conduits **15** and **16**, past a plurality of banks of grid elements **31**, **32**, **33** and **34** for sandwiching of the thick stock adjacent the outlet **13** and mixing with the thick stock.

In the modified arrangement shown in FIGURE 6 the banks of grid elements **31**, **32**, **33** and **34** are shown positioned at an angle to the respective top and bottom walls of the thick stock channel **12**. The orientation of the grid elements does not appear to be critical except to the extent that a fine scale turbulence should be created in the white water or clear water as a result of passage therethrough. The slurry, while mixing, passes from the region adjacent the outlet **13** through a channel **35** preferably axially aligned with the slice channel **12**. The transverse width of the slice channel **12** and the mixing channel **35** is preferably the same width as the head box

36 to ensure cross flow distribution of the stock fibers across the entire width of the forming surface.

The mixing stock is then forced under a pressure head developed from a source through conduit **10***a* from pond **10** through a right angle turn designated by the letter T. The conduit portions **35** and **37** define in cross-sectional elevation an L. The inlet box **36** is provided with a bottom opening **38** extending the full width of the inlet **36** and opening downwardly therefrom along the rear wall **36***a*. A rectifier roll **39** is mounted in close running relation to the wall portions defining the bottom opening **38**.

The inlet box **36** is also equipped with a plurality of rectifier rolls having the customary rectifier roll design and function and indicated by the numeral **40**.

In the head box it will be appreciated that the stock flow rate decreases considerably. Thus cross flow fiber distribution of the slurry in a conventional head box may be enhanced.

Apparatus constructed in accordance with the present invention is particularly adaptable for incorporation in the stock distributor assembly disclosed in Beachler U.S. Patent No. 2,911,041. Additionally, while the present invention has been disclosed in connection with the Fourdrinier type former, its application to the cylinder type of web formers is readily apparent.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. Apparatus for distributing fibers in a stock slurry for delivery of the slurry to the forming surface of a papermaking machine comprising: means extending transverse of a liquid vehicle flow path for generating first order eddy currents of a first magnitude in the liquid vehicle, means for generating in the liquid vehicle second order eddy currents greater in number but of lesser magnitude than the first order eddy currents, and means for delivering the fibers in a liquid carrier into the flow path of the liquid vehicle upstream of the forming surface of the papermaking machine and while the liquid vehicle is in a condition exhibiting small scale turbulent flow patterns to thereby form the stock slurry.

2. Apparatus for delivering a stock slurry to the forming surface of a papermaking machine with improved fiber distribution throughout comprising: means for supplying a liquid vehicle component of the slurry along a flow path to the forming surface of the papermaking machine and past a plurality of abutments sized to generate fine scale turbulent flow patterns in the liquid vehicle, means for flowing a liquid carrying fibers to form a slurry with the said liquid vehicle containing from about 1% to about 4% fiber content along a flow path to the forming surface of the papermaking machine, means for merging the flow paths upstream of the forming surface while the liquid vehicle is in a condition of fine scale turbulence for mixture thereof with the fibers into a slurry, and means for delivering the forming slurry to the forming surface of the papermaking machine.

3. Apparatus for delivering a stock slurry to the forming surface of a papermaking machine with improved fiber distribution comprising: means for merging the flow from at least a pair of channels upstream of said forming surface for delivering a liquid vehicle component of the stock slurry to the forming surface of the papermaking machine, at least one bank of abutments in one of the liquid vehicle flow channels for generating fine scale turbulence in the liquid vehicle, and means for flowing the fiber content component of the stock slurry in a liquid carrier into the merging path of the liquid vehicle thereby forming the stock slurry for delivery to the forming surface of the papermaking machine.

4. Apparatus for delivering a stock slurry to the form-

ing surface of a paper making machine with improved fiber distribution comprising: an upper and a lower convergingly tapered channel for delivering a liquid vehicle of the slurry in a pair of merging flow paths to a mixing zone adjacent the forming surface of the paper making machine, at least one bank of abutments in one of the channels for inducing fine scale turbulent flow patterns in the liquid vehicle, and a convergingly tapered channel for flowing the fiber content of the stock slurry in a liquid carrier into the merging path of the liquid vehicle and in the same direction of flow as the liquid vehicle to thereby initiate formation of the stock slurry in the mixing zone for delivery to the forming surface of the paper making machine.

5. Apparatus for delivering a stock slurry to the forming surface of a paper making machine with improved fiber distribution comprising: an upper and a lower convergingly tapered channel for directing a pair of merging flow paths for delivering a liquid vehicle of the stock slurry to a mixing zone, a plurality of abutments in each of the channels for inducing fine scale turbulent flow patterns in the liquid vehicle, and a convergingly tapered channel intermediate the upper and lower channels for flowing the fiber content of the stock slurry in a liquid carrier into the merging paths of the liquid vehicle in the mixing zone thereby initiating formation of the stock slurry for delivery to the forming surface of the paper making machine.

6. Apparatus for delivering a stock slurry to the forming surface of a paper making machine with improved fiber distribution comprising: an enclosed convergingly tapered flow channel for delivering the fiber content of the stock slurry in a liquid carrier to a mixing zone, convergingly tapered channels for flowing a liquid vehicle of the stock slurry along flow paths merging in the said mixing zone with the flow path of the fiber content of the stock slurry, means extending transverse of the liquid vehicle flow path for generating fine scale turbulent flow patterns in the liquid vehicle of the stock slurry prior to mixing with the fiber content, said respective channels being of a cross sectional width substantially equal to the paper forming width of the forming surface of the paper making machine, manifold means for delivering the liquid vehicle to said channels, manifold means for delivering the fiber content in a liquid carrier to the fiber content channel whereby the fiber content mixes with the liquid vehicle to form the stock slurry while the liquid vehicle is in a condition of fine scale turbulence, and means for controlling the relative flow rates of said liquid vehicle and said fiber content whereby said liquid vehicle and fiber content are flowing at the same rate and in the same direction when merging to form the stock slurry.

7. Apparatus for delivering a stock slurry to the forming surface of a paper making machine with improved fiber distribution comprising: a flow channel for delivering the fiber content component of the stock slurry to be formed into a mixing zone for mixing with a liquid vehicle of the stock slurry, the channel having a convergingly tapered outlet adjacent the mixing zone, an upper and lower channel for delivering the liquid vehicle component of the stock slurry into the mixing zone along merging flow paths, said liquid vehicle channels having convergingly tapered outlets adjacent the mixing zone, at least one bank of abutments in each of the liquid vehicle component channels for inducing fine scale flow turbulent patterns in the liquid vehicle, whereby said liquid vehicle may be flowed into the mixing zone in a condition of fine scale turbulence, a cross flow channel communicating the slurry flow delivery channel to the paper forming surface of the paper machine with the mixing zone, said channel having a 90° turn therein for distributing the forming slurry across the width of the slurry flow delivery channel to the forming surface of the paper making machine whereby the stock slurry is delivered through the slurry flow delivery channel to the forming surface of the paper making machine in a condition of improved fiber distribution.

8. Apparatus for distributing fibers in a stock slurry for delivery of the slurry to the forming surface of a paper making machine, which comprises means defining a plurality of superimposed channels feeding into a merging chamber upstream from said forming surface, means extending transversely of said channels for generating small scale turbulence flow patterns in a liquid vehicle flowing in said channels and into said merging chamber, and means defining a channel interposed between each pair of superimposed channels for delivering stock fibers in a liquid carrier into said merging chamber, thereby to form stock slurry.

9. Apparatus for distributing fibers in a stock slurry for delivery of the slurry to the forming surface of a paper making machine, which comprises means defining a plurality of superimposed channels feeding into a merging chamber upstream from said forming surface, means extending transversely of said channels for generating first order eddy currents of a first magnitude in a liquid vehicle, means extending transversely of said channels for generating in the liquid vehicle second order eddy currents greater in number but of lesser magnitude than the first order eddy currents, and means defining a channel interposed between each pair of superimposed channels for delivering stock fibers in a liquid carrier into said merging chamber, thereby to form stock slurry.

10. Apparatus for distributing fibers in a stock slurry for delivery of the slurry to the forming surface of a paper making machine, which comprises means defining a plurality of superimposed channels feeding into a merging chamber upstream from said forming surface, a plurality of abutments extending across said channels sized to generate fine scale turbulence flow patterns in a liquid vehicle flowing in said channels and into said merging chamber, and means defining a channel interposed between each pair of superimposed channels for delivering stock fibers in a liquid carrier into said merging chamber, thereby to form stock slurry.

11. The method of improving distribution of particulate material in a liquid vehicle comprising: delivering the liquid vehicle along a flow path, generating fine scale turbulent flow patterns in the liquid vehicle, delivering the particulate material in a liquid carrier along a flow path, merging the flow paths of the particulate material and the liquid vehicle while the liquid vehicle is in a condition exhibiting fine scale turbulent flow patterns, and controlling the relative flow rates of the particulate material and the liquid vehicle so that said flow rates are substantially equal when said flow paths merge.

12. In the method of improving fiber distribution in a stock slurry for delivery of the slurry to the forming surface of a paper making machine, the steps comprising: generating first order eddy currents of a first magnitude in a liquid vehicle, generating second order eddy currents greater in number but of lesser magnitude than the first order eddy currents in the liquid vehicle, and flowing the fibers in a liquid carrier into the flow path of the liquid vehicle upstream of the forming surface of the paper making machine at a location where the liquid vehicle is in a condition exhibiting small scale turbulent flow patterns to thereby form the stock slurry.

13. In the method of delivering a stock slurry to the forming surface of a paper making machine exhibiting improved fiber distribution conditions, the steps comprising: supplying liquid vehicle component of the slurry along a flow path to the forming surface of the paper making machine and past a plurality of abutments sized to generate fine scale turbulent flow patterns in the liquid vehicle, flowing along a flow path to the forming surface of the paper making machine a liquid carrying fibers to form a slurry with the said liquid vehicle, said liquid carrying fibers in an amount sufficient to form a

stock slurry containing from about 1% to about 4% fiber content, merging the flow paths of the liquid vehicle and the liquid carrying the fibers upstream of the forming surface while the liquid vehicle is in a condition of fine scale turbulence for mixture thereof into the slurry, and delivering the forming slurry to the forming surface of the paper making machine.

14. In the method of delivering a stock slurry to the forming surface of a paper making machine with improved fiber distribution, the steps comprising: flowing a liquid vehicle component of the stock slurry along at least a pair of channels into a mixing zone upstream of the forming surface of the paper making machine, generating small scale turbulent flow patterns in the liquid vehicle component of the slurry in the channels by flowing the liquid vehicle component past at least one group of abutments upstream of the mixing zone, and flowing the fiber content component of the stock slurry in a liquid carrier into the mixing zone to thereby initiate formation of the stock slurry for delivery thereof to the forming surface of the paper making machine.

15. In the method of delivering a stock slurry to the forming surface of a paper making machine in a condition exhibiting improved fiber distribution, the steps comprising: flowing a liquid vehicle component of the slurry through an upper and lower convergingly tapered channel and past at least one bank of abutments in the channels for inducing fine scale turbulent flow patterns in the liquid vehicle component, merging the liquid vehicle components from the said channels in a mixing zone, and flowing the fiber content of the stock slurry in a liquid carrier into the merging path of the liquid vehicle components in the same direction of flow as the liquid vehicle components to thereby initiate formation of the stock slurry in the mixing zone for delivery thereof to the forming surface of the paper making machine.

16. The method of delivering a stock slurry to the forming surface of a paper making machine in a condition exhibiting improved fiber distribution, comprising: delivering the fiber content of the stock slurry in a liquid carrier to a mixing zone, flowing liquid vehicle components of the stock slurry along flow paths merging in the said mixing zone with the flow path of the fiber content component of the stock slurry, generating fine scale turbulent flow patterns in the liquid vehicle components of the stock slurry prior to mixing thereof with the fiber content component, and controlling the relative flow rate of the liquid vehicle and the fiber content whereby the liquid vehicle and fiber content are flowing at the same rate and in the same direction when they merge in the mixing zone to initiate formation of the stock slurry for delivery to the forming surface of the paper making machine.

17. In the method of delivering a stock slurry to the forming surface of a paper making machine exhibiting improved fiber distribution conditions, the steps of supplying liquid vehicle components of the slurry along upper and lower flow paths, generating small scale turbulence flow patterns in such upper and lower flow paths, merging such upper and lower flow paths upstream of the forming surface, and supplying stock fibers in a liquid carrier in a flow path intermediate said upper and lower flow paths and feeding such stock fibers in the liquid carrier into the merging upper and lower flow paths thereby to form the stock slurry.

18. In the method of delivering a stock slurry to the forming surface of a paper making machine exhibiting improved fiber distribution conditions, the steps of supplying liquid vehicle components of the slurry along upper and lower flow paths, generating first order eddy currents of first magnitude in such upper and lower flow paths, generating second order eddy currents greater in number but of lesser magnitude than the first order eddy currents in such upper and lower flow paths, merging such upper and lower flow paths upstream of the forming surface, and supplying stock fibers in a liquid carrier in a flow path intermediate said upper and lower flow paths and feeding such stock fibers in the liquid carrier into the merging upper and lower flow paths thereby to form the stock slurry.

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