

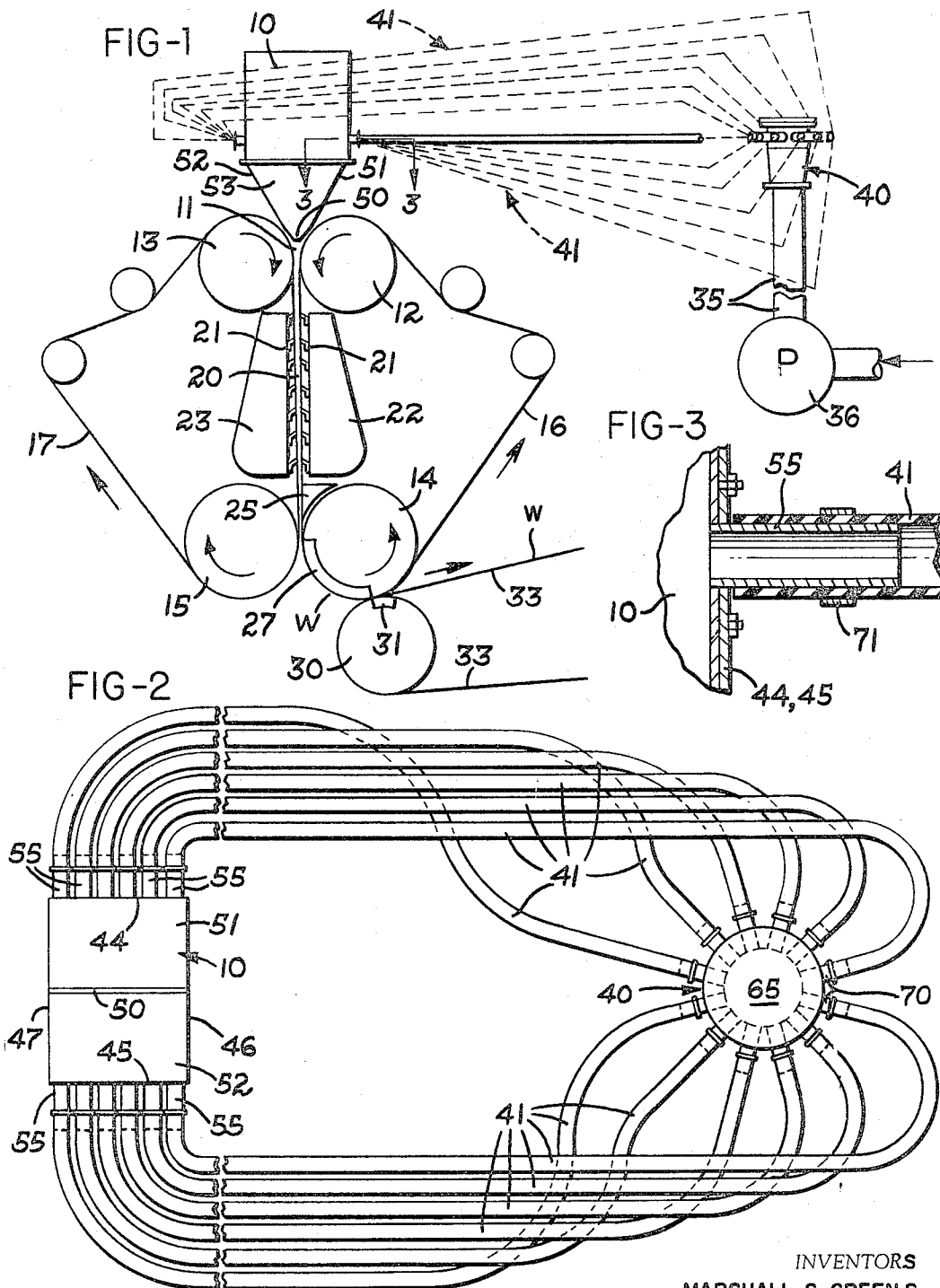
Jan. 3, 1967

M. S. GREEN ET AL
HEADBOX FOR PAPERMAKING MACHINE
AND STOCK DISTRIBUTOR THERETO

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2 Sheets-Sheet 1



INVENTORS
MARSHALL S. GREEN &
BY SVEND H. HANSSON

Marshall, Bibel, French & Bugg
ATTORNEYS

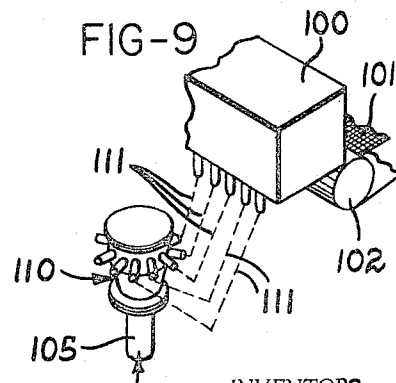
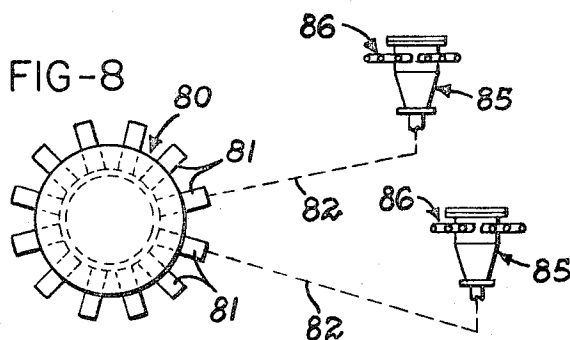
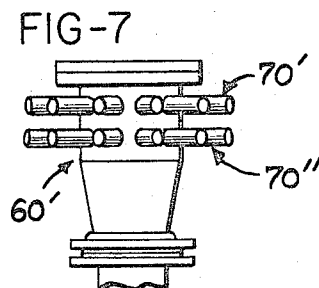
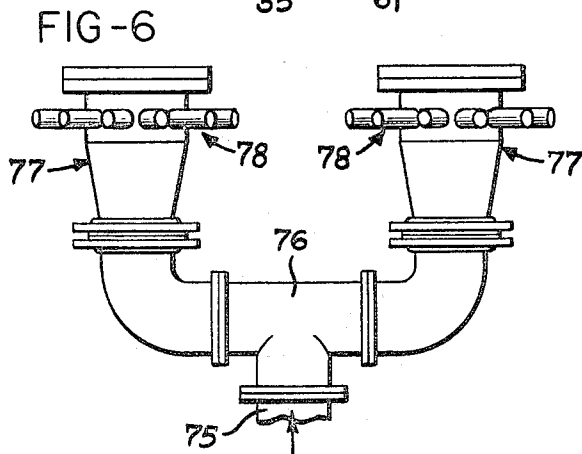
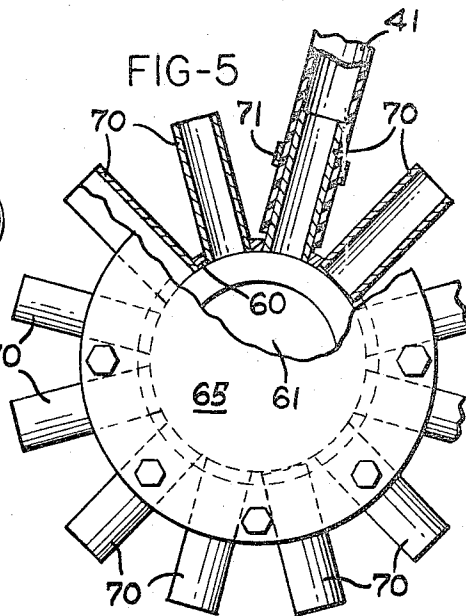
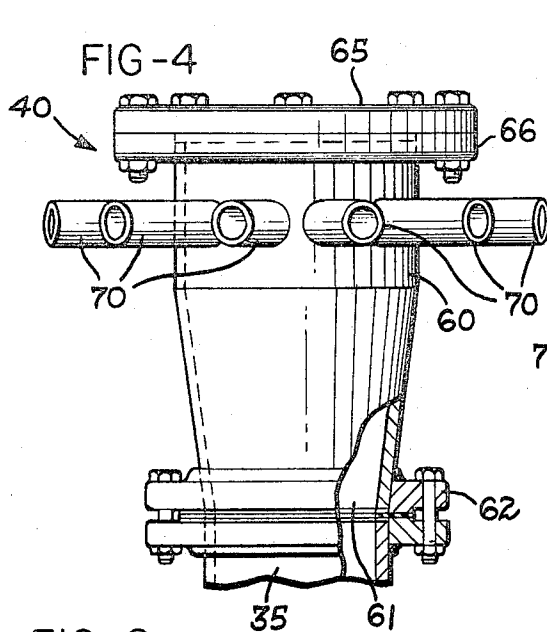
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INVENTORS
MARSHALL S. GREEN &
SVEND H. HANSSON
BY

Marshall, Biebel, French & Bugge
ATTORNEYS

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HEADBOX FOR PAPERMAKING MACHINE AND STOCK DISTRIBUTOR THEREOF

Marshall S. Green and Svend H. Hansson, Watertown, N.Y., assignors to The Black Clawson Company, Hamilton, Ohio, a corporation of Ohio

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6 Claims. (Cl. 162—338)

This invention relates to paper machinery.

The invention has as its ultimate objective the provision of a paper machine having a stock supply system, including a headbox, of such structural and operational characteristics that the paper making stock is delivered from the main pump and supply pipe to the forming member under conditions of maximum uniformity of flow and fiber distribution across the entire width of the paper machine. More specifically, the invention has the ultimate objective of providing such a stock supply system wherein each unit of stock reaches the forming wire under as nearly as possible the same velocity and pressure conditions for maximum uniformity of sheet formation.

The paper industry has for many years recognized that one of its major problems lies in obtaining a uniform flow distribution in the stock supply system of a paper machine, especially from the standpoint of conversion of the essentially cylindrical flow of stock from the main supply pump and pipe to the narrow ribbon of stock which is delivered to the forming member, and many attempts have been made to design flow distributors which would successfully accomplish this conversion while maintaining uniform flow conditions across the width of the forming member. In recent years, much development effort has been placed on tapered cross flow distributors, such as the type illustrated in Mardon et al. United States Patent No. 2,929,449. Satisfactory results have been obtained with some of these tapered distributors, but in general it has been found that a given design of such distributor will give optimum results under only one set of operating conditions, and the quality of the results declines as these conditions are varied, as may be necessary to effect change in the product of the machine.

It is accordingly a basic objective of the present invention to provide a stock supply system for a paper machine which will give uniformly satisfactory results from the standpoint of flow division and distribution and from the standpoint of uniform sheet formation over a wide range of machine speeds, flow rates and other operating conditions.

This basic objective of the invention is accomplished in accordance with the invention by the provision of a flow distributor of such structural and operational characteristics that it receives the stock flow from the main supply pipe, effectively extinguishing the velocity thereof, and then redirects the flow into multiple individual flows each of which is delivered to the paper machine headbox under substantially identical conditions of velocity and pressure, with each individual flow traveling the same distance from the flow divider to the headbox.

Among more specific objects of the invention is the provision of a flow distributor as outlined in the preceding paragraph which comprises a header for an inlet and for receiving the main stock flow, a closed end for extinguishing the velocity of the delivered stock flow, and a multiplicity of outlets each substantially smaller than the inlet and each arranged to direct the flow therethrough

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at substantially right angles to the delivering flow into the header.

Another objective of the invention is to provide a stock supply system for a paper machine which includes a flow divider as outlined in the preceding paragraph and a plurality of individual supply lines all of the same length, each of which leads from one of the header outlets to the paper machine headbox and all of which are connected to the headbox in uniformly spaced relation across the paper machine.

A further object of the invention is to provide a stock supply system for a paper machine which includes a headbox of novel construction having its discharge slot arranged generally centrally of one end thereof and having multiple inlets of individually relatively small flow area connected along opposite walls thereof across the width of the paper machine and arranged to deliver multiple opposed flows of stock into the interior of the headbox in directions extending substantially normal to the direction of discharge from the headbox to the paper machine.

It is a particular object of the invention to provide a stock supply system for a paper machine as outlined in the preceding paragraph which also includes a novel flow divider constructed and arranged to deliver stock to all of the multiple inlets of the headbox under conditions of uniform velocity and pressure.

Still further objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings:

FIG. 1 is a somewhat diagrammatic view generally in side elevation illustrating a paper machine provided with a headbox and stock supply system in accordance with the invention;

FIG. 2 is a fragmentary and somewhat diagrammatic plan view of the headbox and stock supply system shown in FIG. 1;

FIG. 3 is an enlarged fragmentary view of the headbox of FIGS. 1 and 2, taken in section on the line 3—3 of FIG. 1;

FIG. 4 is a view partly in side elevation and partly broken away in section showing the flow divider in accordance with the invention which is incorporated in the stock supply system in FIGS. 1—2;

FIG. 5 is an end elevation of the flow divider of FIG. 4, partly broken away to show internal structures;

FIG. 6 is a fragmentary view illustrating the use of plural flow dividers in accordance with the invention, arranged in parallel;

FIG. 7 is an elevation view showing a modified construction of flow divider in accordance with the invention;

FIG. 8 is a diagrammatic view illustrating the use of plural flow dividers in accordance with the invention, arranged in series; and

FIG. 9 is a fragmentary perspective view showing a conventional Fourdrinier paper machine headbox provided with a flow divider and stock supply system in accordance with the invention.

Referring to the drawings, wherein preferred embodiments of the invention are illustrated, the paper making machine of FIG. 1 is shown as generally of the type disclosed in Baxter Patent Re. 25,333, and it includes a headbox 10 for delivering stock to the space above the nip 11 of a pair of two breast rolls 12 and 13. The couch rolls 14 and 15 are respectively positioned in parallel relationship below the breast rolls 12 and 13, and each pair of breast and couch rolls has a forming wire 16 and 17

entrained therearound so that a vertical forming zone 20 is defined between the breast and couch rolls.

The wires 16 and 17 move downwardly from the nip 11 through the forming zone 20 in a gradually converging path guided by the supporting deflectors 21 to exert a squeezing action on the stock between the wires which expels the white water therefrom through the wires, thus forming a paper web W. The deflectors 21 also serve the important purpose of removing this water from the rear side of the wires 16 and 17 by deflecting it outwardly and downwardly therefrom into the collection pans 22 and 23 from where it is returned to the white water supply system. Specifically the deflectors 21 are shown and described in the copending United States application for Paper Machinery, Serial No. 232,337, filed October 8, 1962, now Patent No. 3,215,594, issued November 2, 1965 to the assignee of this application.

As the wires 16 and 17 leave the last pair of deflectors 21, the suction box 25 holds the newly formed web W on the right-hand wire 16 and separates it from the wire 17, and the suction box 27 in the couch roll 14 holds the web thereon until engagement with the transfer roll 30, which has a suction box 31 therein for transferring the web from the forming wire 16 to the press felt 33.

The stock supply system in FIG. 1 includes the main stock supply line 35 which is fed by the main pump 36 from the usual supply lines or chests, not shown, of fresh stock and white water. The main pipe 35 is connected with a flow divider 40 of novel construction in accordance with the invention, and multiple lines 41 lead from this flow divider to the headbox 10, as now described.

The headbox 10 is shown as relatively narrow in proportion to the diameters of the rolls 12-15, but this has been done for convenience of illustration, and it is to be understood that the headbox will in every case be proportioned to extend across the full width of the paper machine on which it is used. The headbox 10 comprises principally a rectangular flow box having opposed side walls 44-45 and end walls 46 and 47. The discharge slot 50 through which the stock is delivered to the forming nip 11 is defined by side wall edge portions 51 and 52 which converge downwardly at equal angles from the main side walls 44-45 to locate the slot 50 substantially centrally of the bottom of the headbox 10. The side wall portions 50 and 51 are shown as parts of an outlet section, including end walls 53, which is secured to the main side walls 44-45, but they may if desired be pivotally connected to walls 44-45 for relative adjustment to vary the width of slot 50, as described in copending application Serial No. 253,858 filed January 25, 1963, now Patent No. 3,215,593, issued November 2, 1965, to the same assignee as this application.

In accordance with the invention, the stock is delivered to the interior of the headbox 10 by multiple inlets 55 which are arranged in uniformly spaced relation across the full extent of the side walls 44 and 45 above their edge portions 51-52. More specifically, each of these inlets 55 is formed by a short length of pipe secured in substantially perpendicular relation to the associated side wall 44 or 45, and the inlets 55 preferably are located directly opposite each other and define a plane normal to the direction of discharge of stock through the slot 50. Provision is also made in accordance with the invention to deliver stock to all of the inlets 55 under essentially equal velocity and pressure conditions, from the flow divider 40 and lines 41 as now described.

Referring particularly to FIGS. 3-4, the flow divider 40 comprises a header 60 having an inlet end 61 proportioned for connection to the main supply pipe 35 and provided with a conventional flange 62 for effecting such connection. The opposite end of the header 60 is closed, as by a closure plate 65 secured to the header 60 by a flange 66, and the closure plate 65 preferably has a smooth inner surface 67 extending normal to the axis of header

60 and the entering flow of stock through its inlet end 61.

The header 60 is provided with multiple outlets comprising short lengths of pipe 70 radiating from the outer surface thereof and preferably arranged to define a plane parallel with and relatively closely spaced from the inner surface 67 of closure plate 65. Each of these outlet pipes 70 is connected by one of the lines 41 to an inlet pipe 55 of the headbox 10, and the lines 41 are shown as formed of lengths of flexible hose, each of which is fitted over its associated pipes 55 and 70 and secured thereto as by a suitable clamp 71. It is important for optimum performance in the practice of the invention that all of these lines 41 be of equal length.

In use, the stock is delivered through the main supply pipe 35 by the pump 36 under proper conditions of volumetric flow and pressure as determined by the desired operating conditions of the paper machine. The entering flow of stock to the flow divider header 60 has its velocity substantially extinguished by impingement against the closure plate 65, and this stock is then distributed among all the outlets 70 and the lines 41 leading to the headbox 10. For preferred results, the total flow areas of all of the outlets 70 will be equal to or somewhat less than the flow area of the header inlet 61, and the outward flow through the outlets 70 will accordingly be equally distributed as to volumetric rate, velocity and pressure. With all of the lines 41 of equal length as stated, these uniform flow conditions will be maintained through the lines 41, and the stock will similarly be delivered to the interior of the headbox through all of the inlets 55 under similarly equal flow conditions.

The arrangement of the inlets 55 as described in equally spaced opposed relation along the side walls 44 and 45 of the headbox is believed to contribute to the desired uniformly high quality of sheet formation on the paper machine. Apparently the entering flows from opposed pairs of inlets 55 having a cancelling effect on each other which substantially extinguishes their velocities and produces thorough intermixing of the fibers in the desired uniform distribution throughout the remainder of their passage to the forming zone 20 of the paper machine.

As stated, the headbox and associated parts are shown diagrammatically and in conjunction with a paper machine of narrow width for convenience of illustration, and it should be understood that all these parts are to be appropriately proportioned in accordance with the principles of the invention for all sizes of paper machines. For example, highly satisfactory test results have been obtained with a paper machine and stock supply system constructed as described and built with rolls of normal operating diameters but relatively short length, namely 20 inches. This paper machine has produced paper of high quality at operating speeds as high as 1500 feet per minute with a headbox constructed as disclosed and provided with six inlets 55 each 2 inches in diameter and spaced on 3-inch centers.

The flow divider 40 for this paper machine was constructed as disclosed with the header 60 having an inlet end 61 of a diameter of 8 inches and provided with twelve outlets 70 each 2 inches in diameter and thus having a total flow area equal to three quarters of the flow area of the inlet 61. It will be noted that the closed end portion of header 60 is of larger diameter than its inlet end to provide adequate surface area for mounting all of the twelve outlets 70, and it will therefore be understood that similar changes in the configuration of the header can be made to accommodate a greater number of outlets. The design of the header 60 and the total number and size of individual outlets 70 will normally be determined by the width of a given paper machine and the range of gallonages expected to be required thereby throughout its calculated range of operating speed.

The design of the flow divider 40 in accordance with the invention is therefore subject to substantial variation within the principles of the invention. For exam-

ple, it may be found desirable to provide the flow divider with two or more circumferential rows of outlets, as indicated in FIG. 7 wherein the header 60' has one row of outlets 70' and an additional row of outlets 70'' parallel with and closely spaced from the first row. Apparently there will be no practical difference between the flow conditions through the outlets 70'' as compared with outlets 70', and any theoretical such difference can be compensated for by connecting the lines from the outlets 70' and 70'' to the associated headbox in alternating relation.

It is also within the principles of the invention to use multiple flow dividers in parallel or in series, depending upon the size of the paper machine and the flow distribution conditions desired there. For example, FIG. 6 shows a main supply pipe 75 connected with a T section 76 each end of which is connected to a flow divider 77 having the same essential structural and operational characters as the flow divider 40. The multiple outlets 78 of each of the flow dividers 70 will be connected to the headbox in accordance with the principles already described in connection with the flow divider 40 and lines 41.

FIG. 8 shows another arrangement of multiple flow dividers in accordance with the invention wherein the flow divider 80 is of essentially the same characteristics as the flow divider 40. Each of the outlets 81 of the flow divider 80 is connected by a line 82 to a different flow divider 85 similar to but correspondingly smaller than the flow divider 80. The outlets 86 of the flow dividers 85 may be connected directly to a headbox as in FIG. 1, or they can be connected to a third stage of similar flow dividers, depending upon the size and supply requirements of the particular paper machine. Each flow divider in the arrangement of FIG. 8 will operate in the same manner and provide all the same advantages as the flow divider 40 as already described.

The invention is not limited to practice with a vertical paper machine or to a headbox of the particular characteristics of the headbox 10. Thus FIG. 9 illustrates the practice of the invention with a headbox 100 of conventional construction arranged to discharge stock generally horizontally onto a forming wire 101 traveling over a single breast roll 102. The main stock supply pipe 105 connects with a flow divider 110 in the same manner as described for the pipe 35 and flow divider 40 in FIG. 1, and the multiple outlets of the flow divider 110 are connected with the headbox 100 by lines 111, which are connected in uniformly spaced relation along the rearward portion of the bottom of the headbox 100. It will be apparent that the flow divider 110 may be multiplied as described in connection with FIGS. 7 and 8 as required to provide adequate flow capacity and adequately spaced inlets to the headbox 100.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A flow divider for use in the stock supply system of a paper machine, comprising a header, means forming an inlet at one end of said header for connection to a supply line of stock, means closing the opposite end of said header, means forming multiple outlets in the side wall of said header arranged in uniformly spaced relation adjacent said closed end thereof, each of said outlets being of substantially smaller flow area than said inlet, said outlets extending radially of said header at substantially right angles to the direction of entering flow of stock through said inlet to effect corresponding redirection of the outgoing flows of stock therethrough with respect to such entering flow, the total flow area of said outlets being no greater than the flow area of said

inlet, and said closing means being so constructed and arranged that the inner surface thereof is essentially flat and defines a plane substantially normal to the direction of such entering flow and parallel with the plane defined by the centers of said outlets to effect substantially complete extinction of the velocity of such entering flow within said header prior to redirection thereof to said outlets.

2. A flow divider as defined in claim 1 wherein the total flow area of said outlets is less than the flow area of said inlet to effect corresponding acceleration of such outgoing flows of stock with respect to such entering flow.

3. A flow divider as defined in claim 1 wherein said outlet forming means comprises multiple pipes secured in mating openings in the wall of said header but not projecting inwardly of said header beyond the inner surface of said wall, said pipes being arranged to radiate from a common center symmetrically disposed within said header and to define a plane substantially normal to such entering flow of stock.

4. In a stock supply system for a paper machine having a main supply pipe and a headbox provided with a discharge slot at the bottom thereof for discharging stock generally vertically therefrom, the combination of a header having an inlet at one end thereof connected with said supply pipe, means closing the opposite end of said header, means forming multiple outlets in the side wall of said header arranged in uniformly spaced relation adjacent said closed end thereof, each of said outlets being of substantially smaller flow area than said inlet, said outlets extending radially of said header at substantially right angles to the direction of entering flow of stock through said inlet to effect corresponding redirection of the outgoing flows of stock therethrough with respect to such entering flow, a plurality of individual supply lines each leading from one of said outlets to said headbox, means connecting said supply lines to opposite sides of said headbox in uniformly spaced relation in a substantially horizontal plane, and all of said lines being of substantially the same length to provide correspondingly uniform flow conditions for all of the stock flowing from said header to said headbox.

5. A headbox structure and stock supply system for a paper machine having a main stock supply pipe, comprising a flow box having a pair of opposed side walls proportioned to extend the full width of the paper machine, edge portions of said side walls converging to define a tapered discharge passage having a discharge slot at the outer end thereof for discharging stock in a direction substantially parallel with said side walls, means defining a plurality of inlets in each of said side walls arranged in uniformly spaced relation and uniformly spaced from said converging edge portions of said side wall to deliver stock to the interior of said flow box in flows directed substantially normal to the direction of discharge flow from said discharge slot, a header having an inlet at one end thereof connected with said main supply pipe, means closing the opposite end of said header, means forming multiple outlets in the side wall of said header arranged in uniformly spaced relation adjacent said closed end thereof, each of said outlets being of substantially smaller flow area than said inlet, said outlets extending radially of said header at substantially right angles to the direction of entering flow of stock through said inlet to effect corresponding redirection of the outgoing flows of stock therethrough with respect to such entering flow, a plurality of individual supply lines each leading from one of said outlets to said headbox, means connecting said supply lines to said headbox in uniformly spaced relation, and all of said lines being of substantially the same length to provide correspondingly uniform flow conditions for all of the stock flowing from said header to said headbox.

6. A headbox structure and stock supply system for a paper machine as defined in claim 7 wherein said flow box is arranged with said converging edge portions of

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said side walls extending along the bottom of said box for downward discharge of stock through said discharge slot, and said inlets are arranged in a horizontal plane to deliver stock to the interior of said flow box in substantially horizontal flows.

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DONALL H. SYLVESTER, *Primary Examiner.*

J. H. NEWSOME, *Examiner.*

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