Aug. 28, 1962 J. BAXTER, JR 3,051,233

PAPER MACHINERY

Filed May 1, 1958 2 Sheets-Sheet 1

FIG-1

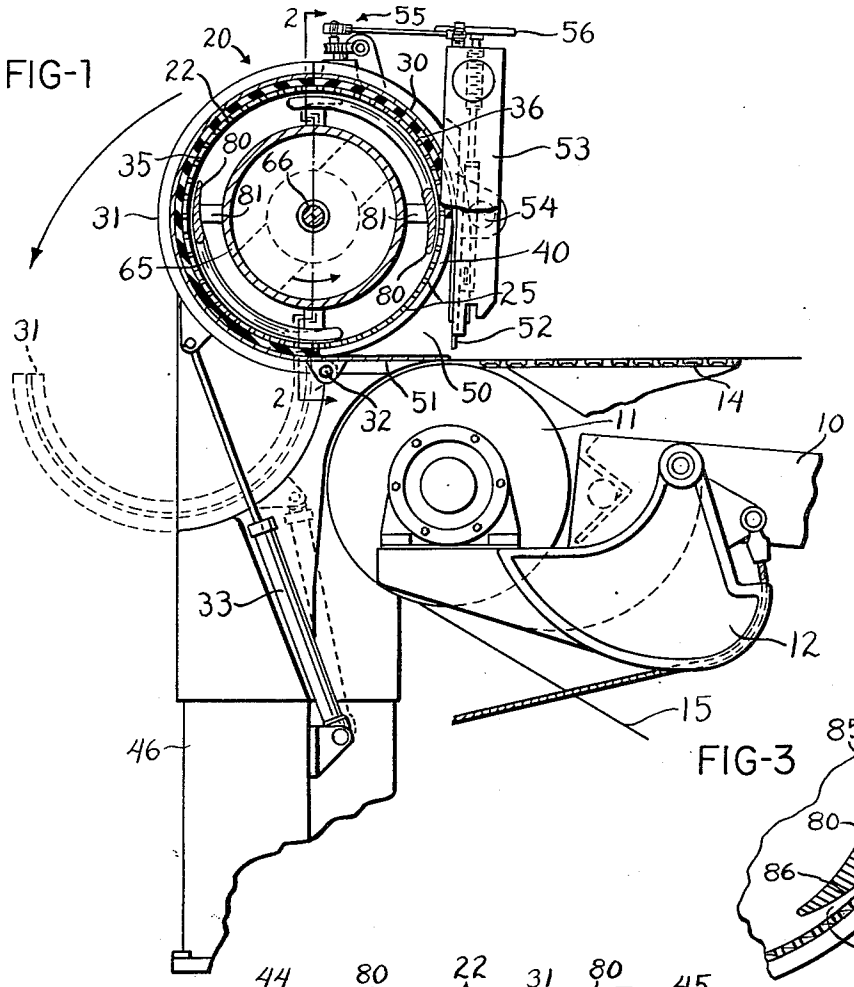


FIG-3

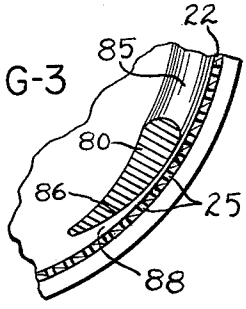
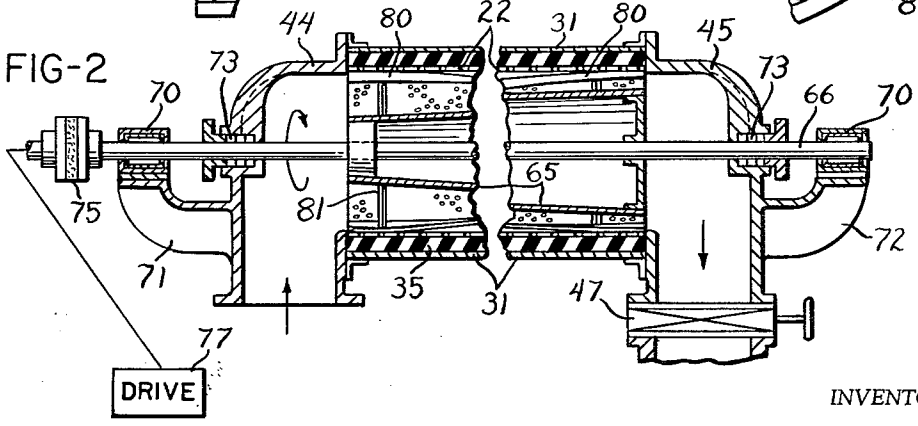


FIG-2



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Filed May 1, 1958 2 Sheets-Sheet 2

FIG-4

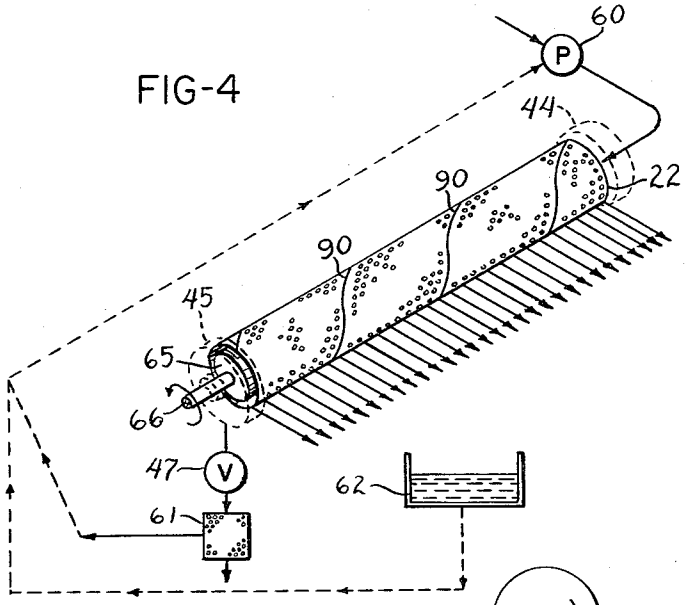


FIG-5

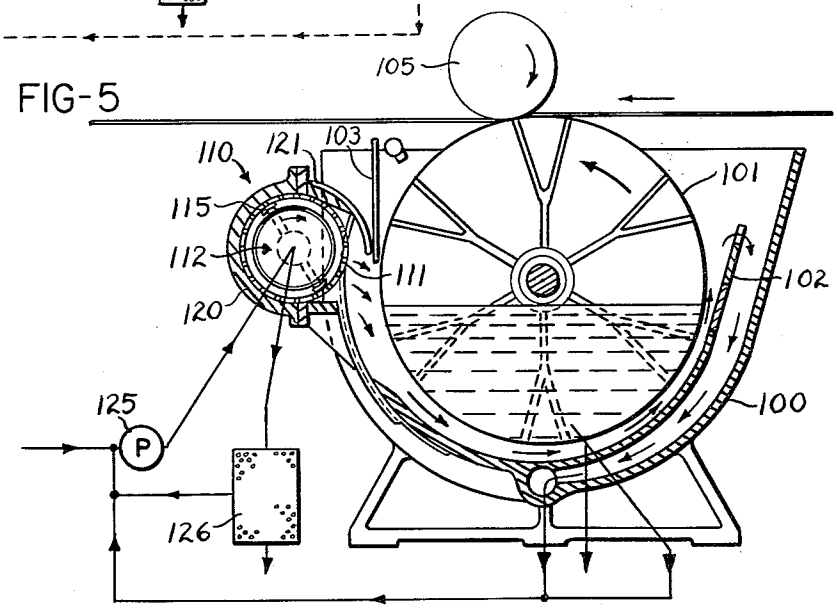
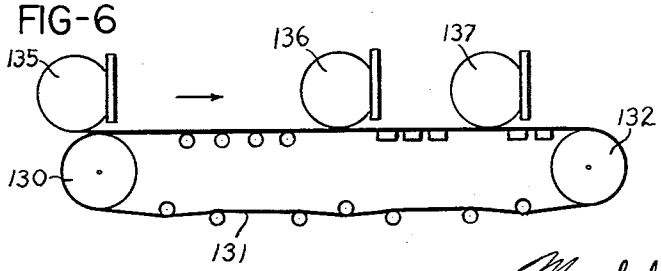


FIG-6



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United States Patent Office

3,051,233

Patented Aug. 28, 1962

3,051,233

PAPER MACHINERY

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Filed May 1, 1958, Ser. No. 732,324
10 Claims. (Cl. 162—337)

This invention relates to a headbox for delivering paper making stock to the forming member of a paper making machine.

It is a primary object of the invention to provide a headbox of improved, simplified and novel construction which is capable of delivering the stock to the forming member under controlled conditions of resistance in close proximity to the forming member assuring maximum uniformity of discharge pressure across the entire width of the machine, and which also carries out an effective screening operation on the stock as it is discharged therefrom to assure maximum uniformity of fiber distribution throughout the entire width of the newly formed sheet.

An additional object of the invention is to provide a headbox as outlined above which is of small volume in comparison with the size of the paper machine whereon it is used, an in which there is therefore minimum opportunity for settling, flocculation and the development of other conditions tending to cause nonuniformity in the fiber distribution.

It is a specific object of this invention to provide a headbox of such construction and mode of operation that all stock delivered to the forming member is subjected to a positive screening action immediately before its delivery to the forming member, and it is also an object of the invention to provide such a headbox wherein any reject material resulting from such screening action is discharged from the headbox separately from the screened stock.

Another object of the invention is to provide headboxes as outlined above which are equally adapted for use on any type of paper making machine including both Fourdrinier and cylinder type machines, and including also use as a secondary headbox on a Fourdrinier machine.

Still another object of the invention is to provide a headbox having some or all of the characteristics outlined above which is constructed for maximum ease of maintenance and particularly for maximum simplicity of access to the interior thereof.

Many 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 view partly in side elevation and partly broken away in vertical section showing a headbox constructed in accordance with the invention and mounted in conjunction with the breast roll of a Fourdinier paper machine;

FIG. 2 is a view in horizontal section taken substantially on the line 2—2 of FIG. 1;

FIG. 3 is an enlarged fragment of FIG. 1;

FIG. 4 is a diagrammatic view in the nature of a perspective and including a flow diagram illustrating the operation of the headbox of FIGS. 1 and 2;

FIG. 5 is a view in vertical section showing a cylinder type paper machine incorporating a headbox in accordance with the invention; and

FIG. 6 is a diagrammatic view illustrating the application of the invention to secondary headboxes.

Referring to the drawings, which illustrate preferred embodiments of the invention, FIG. 1 shows a fragment of the wet end of a Fourdinier paper machine including a fragment 10 of the machine structure on which the

breast roll 11 is supported by means of segmental arms 12 which cooperate with cables 13 to raise and lower the breast roll during wire changing as described in detail in Wisner et al. Patent No. 2,799,209, issued July 16, 1957, to the assignee of this application. FIG. 1 also shows a fragment 14 of the forming board over which the forming wire 15 travels after leaving the breast roll 11. The present invention is concerned primarily with the structure and mode of operation of the headbox indicated generally at 20 which supplies the stock to the forming wire 15.

The major component of the headbox 20 is a cylindrical casing 22 which is of sufficient length to extend across the full width of the paper machine on which it is to be used. This casing 22 is provided with multiple small perforations 25 over an area thereof which extends the full length of the casing and over at least a minor portion of its circumference, and in operation the stock is supplied to the interior of the casing 22 for flow axially thereof and discharge radially thereof through these perforations 25. This supply and discharge flow is directed and controlled by portions of the supporting structure for the casing 22 as now described.

Referring particularly to FIG. 2, the casing 22 is shown as supported within a housing comprising front and back sections 30 and 31 having a hinged connection at 32 providing for relative opening and closing movement controlled by one or more fluid pressure cylinders 33. The rear housing section 31 is shown as semi-cylindrical and includes a lining 35 of rubber-like material for close fitting engagement with the outer surface of casing 22. The front housing section 30 similarly extends the full length of the casing 22 and is provided with a similar lining 36, but it covers only a minor portion of the circumference of casing 22 to leave a slot 40 which overlies a corresponding minor portion of the casing, shown as 90°.

The headbox structure includes at opposite ends thereof an inlet 44 for incoming stock and an outlet 45 which may for convenience be of similar construction as shown and be connected directly with adjacent ends of the housing 30—31. These parts may be supported in any suitable way such as by means of standards at opposite sides of the paper machine, one such standard 46 being shown in FIG. 1. In addition, the outlet 45 is equipped with a throttling valve 47 of suitable construction providing a controlled restriction to the flow of stock outwardly from the interior of the chamber formed by the casing 22 and its associated housing structure.

The headbox 20 also includes walls forming a discharge outlet passage 50 extending the full length of the casing 22 in overlying relation with the slot 40 for delivering to the wire 15 the stock discharged through the perforations 25. One such wall 51 is shown as projecting tangentially from the lower end of the housing section 30 to form the lower slice lip or apron board. The upper slice lip 52 forms the other wall of the outlet passage and is shown as mounted in a supporting structure 53 pivoted at 54 on the housing section 30 for movement on a substantially horizontal axis controlled by a mechanical adjusting drive 55. The upper slice lip 52 is also indicated as vertically adjustable in the supporting structure 53 through an adjusting drive including the hand wheel 56.

FIG. 4 represents diagrammatically the stock flow through the headbox 20 in the operation of the invention. Stock is supplied from a suitable pump 60 to the inlet 44 at a somewhat higher rate than is desired at the forming wire 15, for example 125% of the desired production rate. The valve 47 is adjusted to permit discharge through the outlet 45 of only the excess 25% of the incoming stock, so that the stock will be discharged through the perforations 25 and the outlet passage 50 on to the wire at the

desired production rate. The excess stock from the outlet 45 is delivered to a suitable screen 61 for removing reject particles too large for passage through the perforations 25, and the remaining good stock may be recirculated to the pump 60 for return to the headbox along with the white water from the wire pit 62.

Special provision is made in accordance with the invention for assuring a continuously effective removal from the inner surface of the casing 22 of all particles in the stock which are too large to pass through the perforations 25 so that such reject particles can be continuously removed from the interior of the casing with the excess stock discharged through the outlet 45. Referring to FIGS. 1 and 2, a tapered mandrel 65 is mounted centrally of the casing 22 on a shaft 66, with the mandrel 65 being arranged to diverge from the inlet 44 in coordinated relation with the diameter of the casing 22 to provide effectively even pressure discharge through the perforations 25 over the entire length of the casing. The shaft 66 may be mounted in any suitable way, as represented by bearings 70 on bracket portions 71 and 72 of the inlet 44 and outlet 45, and it is also indicated as provided with suitable packing units 73. Assembly and disassembly of the headbox will be facilitated if the inlet 44 and outlet 45 are of split construction permitting the shaft 66 to be removed laterally therefrom, and the shaft 66 is also shown as connected by a flexible coupling 75 to a suitable drive 77.

The mandrel 65 also acts as a rotary hub on which are mounted a plurality of bars 80 which operate to maintain the inner surface of the casing 22 free of accumulated large reject particles. These bars 80 are mounted on the mandrel 65, as indicated at 81, in such manner as to sweep in relatively closely spaced relation with the inner surface of the casing 22, and they are of generally airfoil shape in section, satisfactory results having been obtained with these bars of essentially the same construction disclosed in the copending application of James H. Martindale, Serial No. 491,831, filed March 3, 1955, now Patent No. 2,835,173, issued May 20, 1958, to the same assignee as this application. More specifically, as shown in detail in FIG. 3, each of the bars 80 is formed with a leading edge 85 curved about a relatively short radius to diverge relatively rapidly from the inner surface of the casing 22, and the remainder 86 of the outer surface of the bar is convexly curved on a substantially longer radius than its leading edge about a center located to cause this surface to diverge relatively slowly from the inner surface of the casing 22. In addition, each of the bars 80 may be generally helically curved from end to end thereof.

In operation with this hub structure as just described, the rotation of the mandrel 65 causes the bars 80 to drive continuously through the stock within the casing 22 in closely spaced relation with the inner surface of this casing. The leading edge 85 of each bar therefore creates a positive pressure wave in the stock tending to force particles in the stock outwardly through the perforations 25, but this positive wave is followed immediately by a negative pressure wave in the space 88 between the trailing outer surface 86 of the bar and the casing 22 which tends to draw inwardly from the surface of the casing any particles too large for passage through the perforations 25. Thus these alternating positive and negative pressure waves travel around the inner surface of the casing periodically at a frequency determined by the number of bars 80 and the speed of rotation of the mandrel 65, and they are therefore continuously operative to effect removal from the inner surface of the casing 22 of particles too large for discharge therefrom into the outlet passage 50. Since there is at the same time a continuous flow of stock axially of the casing to the outlet 45, these reject particles will be entrained in this flow and thus continuously removed from the casing. The result is that the perforations 25 are continuously swept clean of any material tending to clog them, so that the desired substantially constant discharge flow therethrough is assured over the entire discharge area through slot 40.

It will be apparent that irrespective of how great an area of the casing 22 is provided with perforations 25, only the area overlying the slot 40 will be effective in the operation of the headbox, and if the entire surface is perforated, the remaining portion thereof will be sealed by the liners 35 and 36. It would therefore be possible to provide the casing 22 with perforations only in the area intended to overlie the slot 40, and in fact if the casing were differentially perforated in such manner, it could be adjusted rotationally in the casing to vary the effective discharge area thereof. As a practical matter, however, it would usually be more satisfactory to perforate the entire casing, and this is particularly true for long casings to be used on wide paper machines and which cannot as a practical matter be readily produced as a cylindrical shell prior to perforation. For such units, the casing is constructed as indicated in FIG. 4 by winding perforate sheet stock in spiral fashion with its edges abutting and welded or otherwise bonded together along spirally extending seams 90. With this construction, since the seams will similarly run spirally, they will not interfere with the desired uniform discharge axially of the open area of the casing, since the perforations on either side thereof will in effect discharge stock across the seam in such manner as to compensate for its presence and thus eliminate any corresponding streaks or otherwise irregular formation in the sheet.

The headbox of the invention is not limited to use on Fourdrinier paper machines, as is shown in FIG. 4 which represents the application of the invention to a cylinder type paper machine. In FIG. 5, the vat 100, cylinder mold 101 and overflow control gate 102 may be of conventional construction, as well as the adjustable dam 103 and couch roll 105. The flow box 110 is of essentially the same construction already described in connection with FIGS. 1 and 2, and it includes a perforate casing 111 incorporating a rotary hub structure 112 of essentially the same structure and mode of operation as the mandrel 65 and its associated parts already described, as indicated by the airfoil bars 115. The housing for the casing 111 is also shown as similar in construction and includes a removable imperforate section 120 at the back and a section 121 at the front having diverging walls which form the outlet passage into the interior of the vat 100.

The operation of the flow box in FIG. 5 will be essentially the same as already described in connection with FIG. 4. The pump 125 supplies stock to the inlet end of the housing 120—121, and the excess stock and reject material will be discharged at the opposite end of the headbox to a screen 126. The good stock recovered by the screen 126 will return to the main flow along with the overflow from the vat and the fresh stock supplied to the pump 125. The bars 115 will function continuously in combination with the other parts of the hub structure 112 to maintain the inner perforate surface of the casing 111 free for the desired uniform discharge flow of screen stock into the vat 100 along the entire length of the casing 111.

The headbox of this invention offers a variety of important practical advantages in use. In particular, it provides for more positively assured uniformity of fiber distribution and pressure discharge across the entire width of the paper machine than has heretofore been obtainable, due in part to the fact that this headbox provides more uniform restriction across the width of the machine than has previously been possible. Thus, for example, since the invention provides for continuously effective cleaning of the perforate screening area within the headbox, it is possible to employ perforations 25 of much smaller size and in much more closely spaced relation than are customarily usable in perforate rolls of the type which conventionally have been installed in headboxes, for example perforations of the order of 1/16 inch in diameter on 5/16 inch centers in contrast to 3/4 inch perforations on 1.25 inch centers in conventional perforated rolls.

The headboxes of the invention offer the further advantages of being considerably simpler in construction as well as smaller than in the conventional constructions to effect corresponding savings in initial cost, and maintenance is also correspondingly simpler for similar reasons. In addition, the headbox of the invention is particularly readily suited for use as a secondary headbox, and its simplicity of construction and mounting are particularly advantageous in such uses. This is indicated diagrammatically in FIG. 6, which shows the general outline of a Fourdrinier paper machine including the breast roll **130**, wire **131** and couch roll **132**. The primary headbox **135** is shown of essentially the same construction as already described in connection with FIGS. 1–3, and the secondary headbox **136** is of similar construction. It would be equally practicable to provide a third such headbox **137**, for example to apply a coating suspension on the sheet formed from the first two headboxes.

While the forms of apparatus herein described constitutes 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 headbox for delivering paper making stock to the forming member of a paper making machine, comprising a stationary casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof, said casing having multiple perforations therethrough over an area extending substantially the full length thereof and at least a portion of the entire circumference thereof, walls forming a discharge chamber extending the length of said casing in overlying enclosing relation with said perforate area and including an outlet passage leading to the forming member and forming the only connection between said discharge chamber and the atmosphere, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, continuously operative rotary means within said casing for effecting removal from the surface of said casing of particles too large for passage through said perforations to maintain a substantially constant flow therethrough over the entire axial length of said casing, and continuously operative means for effecting removal of such oversize particles from the opposite end of said casing.

2. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a stationary casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof, said casing having multiple perforations therethrough over an area extending substantially the full length thereof and at least a portion of the entire circumference thereof, walls forming a discharge chamber extending the length of said casing in overlying enclosing relation with said perforate area and including an outlet passage leading to the forming member and forming the only connection between said discharge chamber and the atmosphere, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, means within said casing for periodically causing a positive pressure wave to travel rotationally of said casing along the inner surface thereof tending to force the stock through said perforations and for causing a negative pressure wave to follow each said positive pressure wave tending to draw solid particles inwardly from the surface of said perforate casing section, and continuously operative means for effecting removal of said solid particles from the opposite end of said casing.

3. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a stationary casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof, said casing having multiple perforations thereof over an area extending substantially the full length thereof and at least a portion of the entire circumference thereof, walls forming a discharge chamber extending the length of said casing in overlying enclosing relation with said perforate area and including an outlet passage leading to the forming member and forming the only connection between said discharge chamber and the atmosphere, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, a rotary hub within said casing, a bar carried by said hub in close relation with said casing for constant movement adjacent the inner surface of said casing, said bar being of generally airfoil section arranged to create during each passage around said casing a positive pressure wave tending to force the stock outwardly through said perforations and a negative pressure wave following said positive pressure wave and tending to draw solid particles inwardly from the surface of said screen, and continuously operative means for removing said solid particles from the opposite end of said casing.

4. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a stationary casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof and having an inlet at one end thereof, said casing having multiple perforations therethrough over an area extending substantially the full length thereof and at least a portion of the entire circumference thereof, walls forming a discharge chamber extending the length of said casing in overlying enclosing relation with said perforate area and including an outlet passage leading to the forming member and forming the only connection between said discharge chamber and the atmosphere, means for supplying stock to said inlet at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, a mandrel mounted for rotation axially of said chamber, said mandrel being of tapered section away from said inlet providing a substantially equal pressure across said perforations along the entire length of said casing, means carried by said mandrel for causing a positive pressure wave to travel rotationally of said chamber along the inner surface of said casing tending to force the stock through said perforations and for causing a negative pressure wave to follow said positive pressure wave tending to draw solid particles inwardly from said perforations, and means at the opposite end of said casing from said inlet forming a restricted outlet for continuous outward flow of excess stock together with particles too large for passage through said perforations.

5. A head box for delivering paper making stock to the forming member of a paper making machine, comprising a stationary casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof, a minor portion only of said casing extending substantially the full length thereof having multiple perforations therethrough, walls extending towards each other substantially the full length of said casing adjacent and substantially tangent to opposite sides of said minor perforated portion to form a discharge outlet in overlying enclosing relation with said perforate portion thereof and leading to the forming member, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, rotary means within said casing for effecting continuous agitation of the stock within said chamber to prevent clogging of said perforations and to maintain a substantially constant flow therethrough over the entire axial length of said casing, and means at the opposite end of said casing for continuously effecting

removal therefrom of particles too large to pass through said perforations.

6. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a stationary casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof, a minor portion only of said casing extending substantially the full length thereof having multiple perforations therethrough, walls extending towards each other substantially the full length of said casing adjacent and substantially tangent to opposite sides of said minor perforated portion to form a discharge outlet in overlying enclosing relation with said perforate portion thereof and leading to the forming member, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, means within said casing for periodically causing a positive pressure wave to travel rotationally of said casing along the inner surface thereof tending to force the stock through said perforations and for causing a negative pressure wave to follow each said positive pressure wave tending to draw solid particles inwardly from the surface of said perforate casing section, and continuously operative means for effecting removal of said solid particles from the opposite end of said casing.

7. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a band of sheet material arranged in spirally wound fashion with the edges thereof abutting and bonded together along spirally extending seams to form the wall of a casing of cylindrical section, said casing wall having multiple perforations extending therethrough over the entire area thereof between said seams, means for supporting said casing in closely adjacent stationary and parallel relation with the forming member of a paper machine and with said perforations open over at least a portion of said casing extending the full width of said forming member, walls forming a discharge chamber extending the length of said casing in overlying enclosing relation with said open perforations and including an outlet passage leading to said forming member and forming the only connection between said discharge chamber and the atmosphere, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, continuously operative means within said casing for effecting removal from the inner surface thereof of particles too large for passage through said perforations, and continuously operative means for effecting removal of such oversize particles from the opposite end of said casing.

8. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a casing of cylindrical section having multiple perforations extending therethrough over the entire area thereof, means for supporting said casing in closely adjacent stationary and parallel relation with the forming member of a paper machine, said supporting means including means sealing a portion of the outer surface of said casing and leaving said perforations open only along a single predetermined portion of said casing extending the full width of said forming member, walls forming a discharge chamber extending the length of said casing in overlying enclosing relation with said open perforations and including an outlet passage leading to said forming member, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, continuously operative means within said casing for effecting removal from the surface thereof of particles too large for passage through said perforations, and continuously operative means for effecting removal of such oversize particles from the opposite end of said casing.

9. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a casing of cylindrical section adapted to extend across the width of the paper machine adjacent the forming member thereof, said casing having multiple perforations therethrough over an area extending substantially the full length thereof and at least a portion of the entire circumference thereof, a housing for supporting said casing in closely adjacent stationary and parallel relation with said forming member, said housing including an imperforate wall overlying the outer surface of said casing in effectively sealing relation therewith over a major portion of the entire circumference thereof and projecting outwardly from said casing along a minor portion of said casing surface extending the full length thereof to form an outlet passage, said casing being positioned in said housing with said perforate portion thereof in registry with said outlet passage, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, continuously operative means within said casing for effecting removal from the surface of said casing of particles too large for passage through said perforations to maintain a substantially constant flow therethrough over the entire axial length of said chamber, and continuously operative means for effecting removal of such oversize particles from the opposite end of said casing.

10. A headbox for delivering paper making stock to the forming member of a paper making machine, comprising a casing of cylindrical section adapted to extend across the width of the paper making machine adjacent the forming member thereof and having multiple perforations therethrough over an area extending substantially the full length thereof and at least a portion of the entire circumference thereof, a housing for supporting said casing in closely adjacent stationary and parallel relation with said forming member, said housing including a cylindrically curved imperforate portion extending the full length of said casing and around a major portion of the circumference thereof to leave an open slot overlying a corresponding minor portion of the outer surface of said casing, said casing being positioned within said housing with said perforate portion thereof in registry with said slot, walls projecting from said housing along opposite long edges of said slot and forming a discharge chamber which extends the length of said slot and includes an outlet passage leading to the forming member, means for supplying stock to one end of said casing at a sufficient rate to maintain said casing and said discharge chamber continuously full of stock, continuously operative means within said casing for effecting removal from the surface of said casing of particles too large for passage through said perforations to maintain a substantially constant flow therethrough over the entire axial length of said casing, and continuously operative means for effecting removal of such oversize particles from the opposite end of said casing.

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