June 27, 1967 W. C. NOTBOHM 3,328,237

HEADBOX FOR PAPER MACHINE

Filed July 23, 1964 3 Sheets-Sheet 1

FIG-1

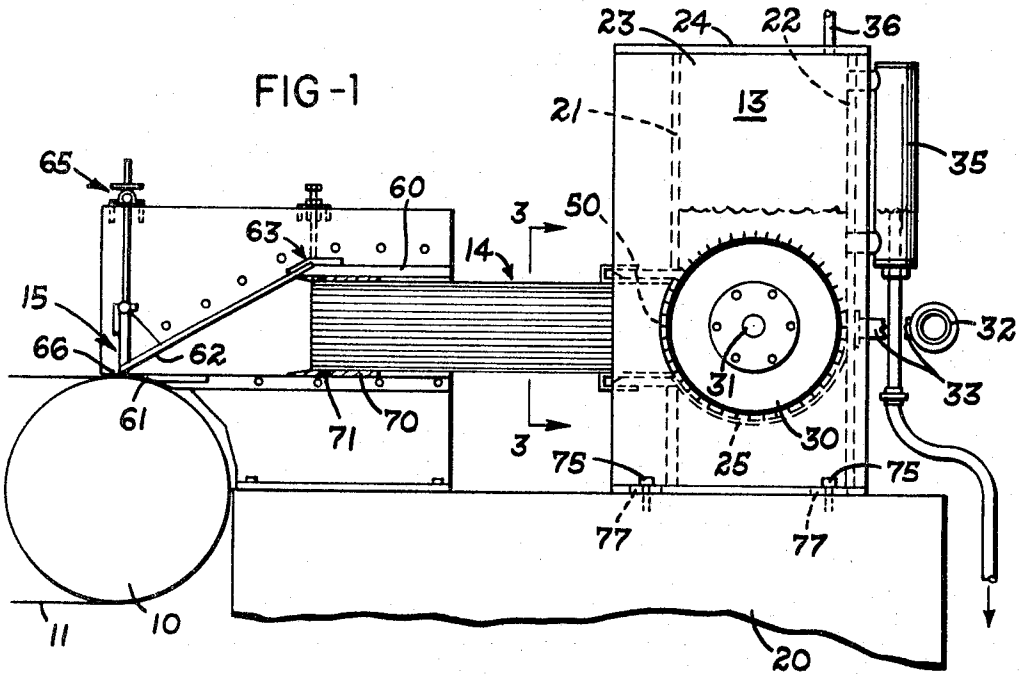


FIG-2

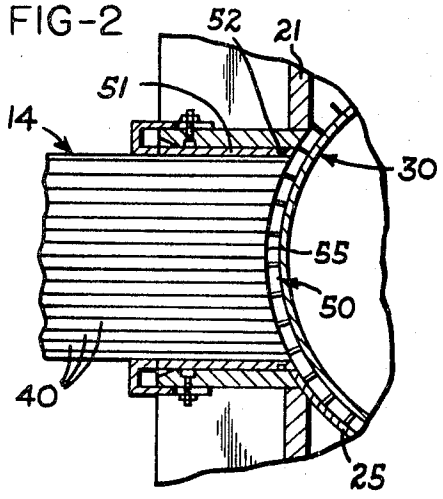


FIG-3

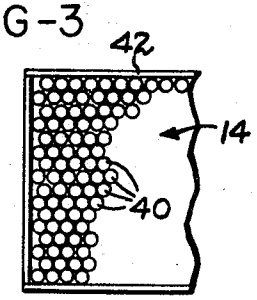


FIG-4

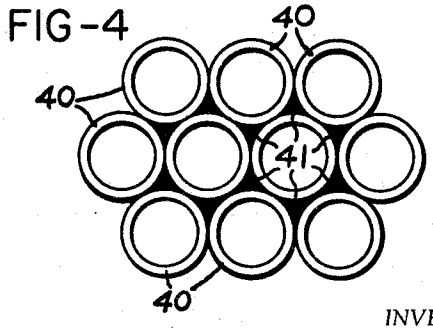
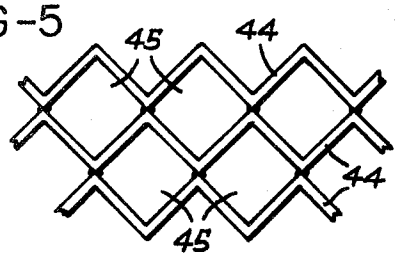


FIG-5



INVENTOR.
WILLARD C. NOTBOHM
BY
Marechal, Biebel, French & Bugg
ATTORNEYS

June 27, 1967 W. C. NOTBOHM 3,328,237

HEADBOX FOR PAPER MACHINE

Filed July 23, 1964 3 Sheets-Sheet 2

FIG-6

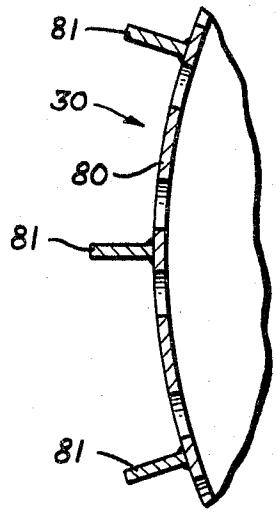


FIG-7

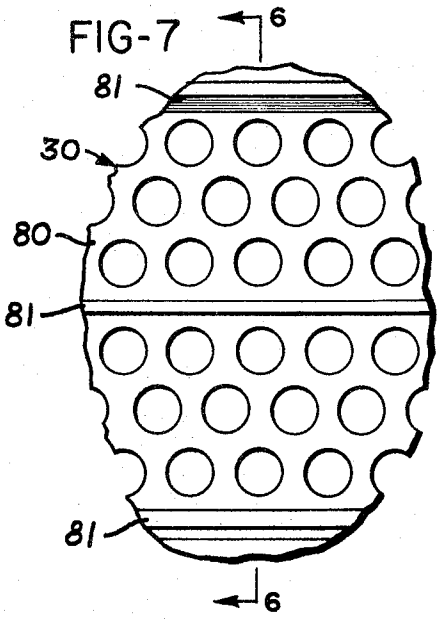


FIG-8

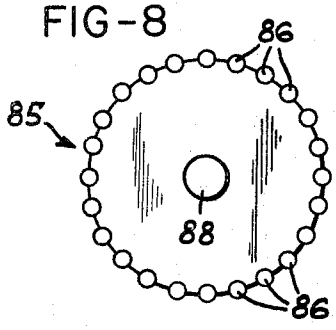


FIG-9

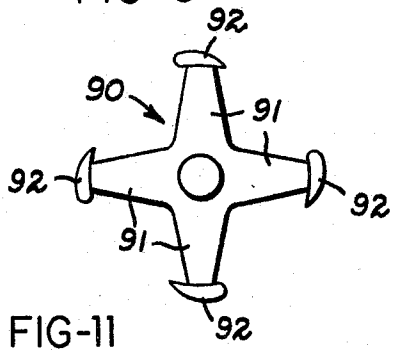


FIG-10

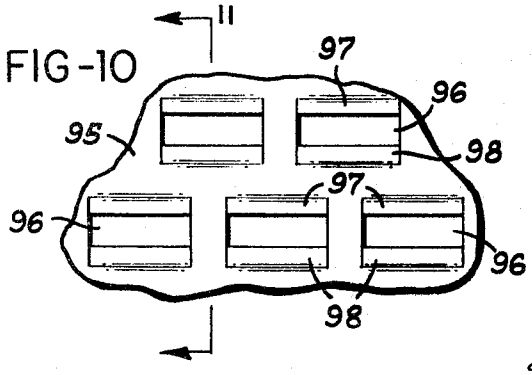
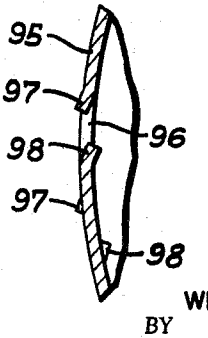


FIG-11



INVENTOR.
WILLARD C. NOTBOHM
BY
Marechal, Biebel, French & Bugg
ATTORNEYS

June 27, 1967 W. C. NOTBOHM 3,328,237

HEADBOX FOR PAPER MACHINE

Filed July 23, 1964 3 Sheets-Sheet 3

FIG-13

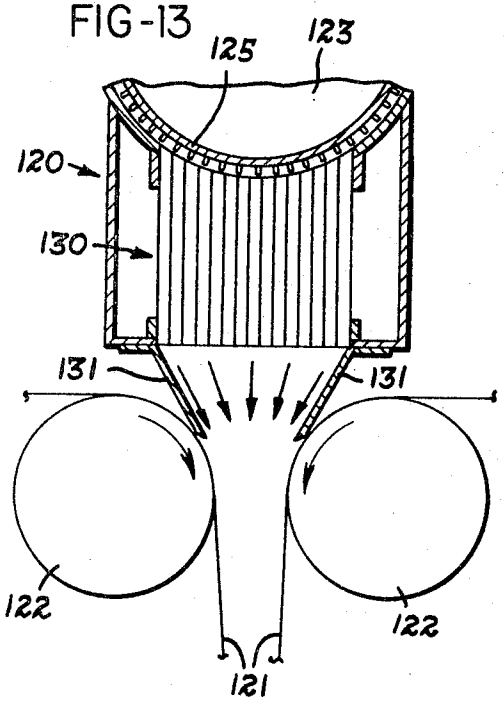


FIG-14

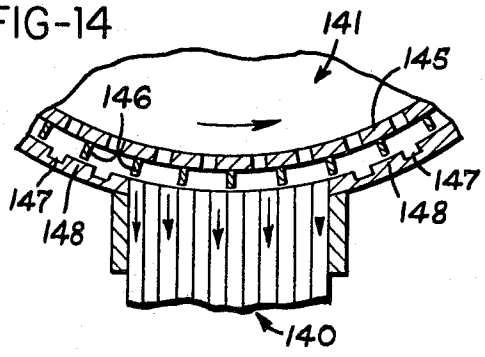
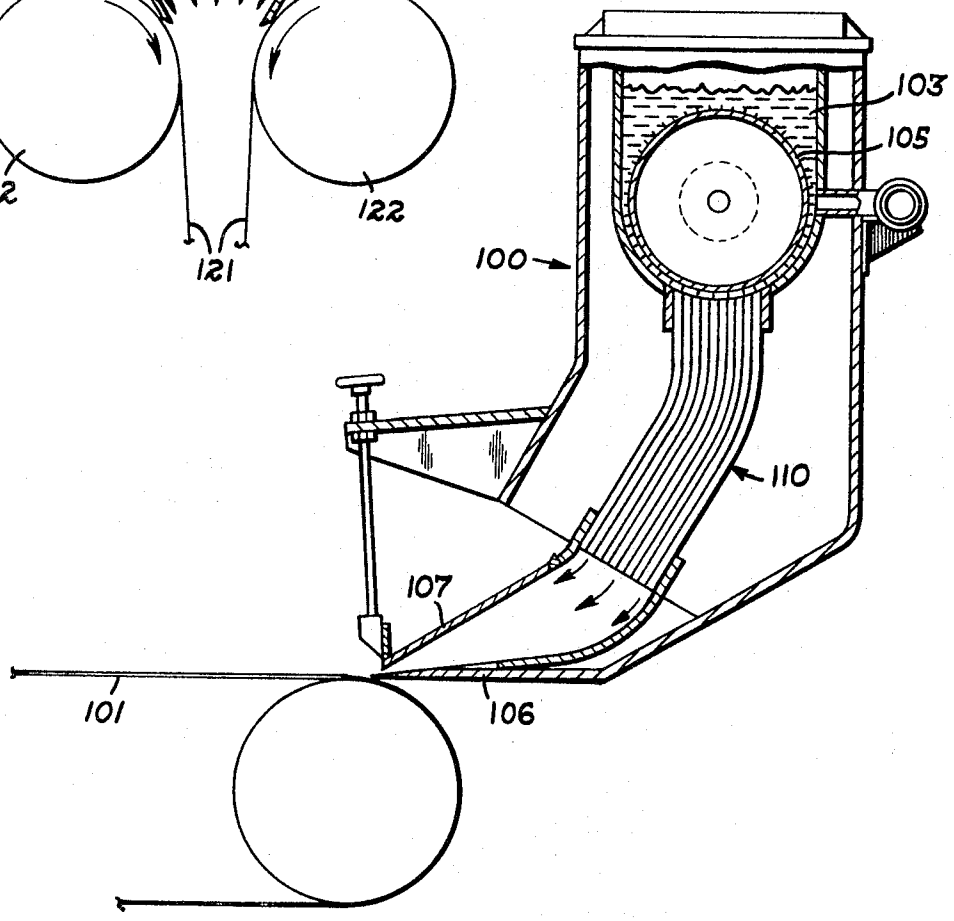


FIG-12



INVENTOR.

WILLARD C. NOTBOHM

BY

Marechal, Biebel, French & Bugg

ATTORNEYS

United States Patent Office 3,328,237 Patented June 27, 1967

3,328,237

HEADBOX FOR PAPER MACHINE

Willard C. Notbohm, Watertown, N.Y., assignor to The Black Clawson Company, Hamilton, Ohio, a corporation of Ohio

Filed July 23, 1964, Ser. No. 384,640
8 Claims. (Cl. 162—343)

This invention relates to paper machinery, and in particular to a headbox for delivering papermaking stock to the forming member of a papermaking machine.

It is a primary object of the present invention to provide a headbox which is of such construction and operational characteristics that it is capable of distributing the stock at low head loss and low velocity compatible with good paper making practice as distinguished from conventional headboxes which are designed to operate on the principle of high head loss and high velocity for uniform distribution.

The object outlined in the preceding paragraph is accomplished in accordance with the invention by a headbox comprising a supply chamber from which the stock is conducted under uniform pressure conditions by a multiplicity of relatively small passages to a slice lip assembly where the multiple flows from the passages are combined into a single sheet of stock and delivered to the breast roll or other forming member.

It is another object of the invention to provide a headbox having the structural and operational characteristics outlined in the preceding paragraph, and particularly to provide such a headbox wherein the combination of the multiple flows from the small passages and their delivery to the forming member is accomplished without the necessity for rectifying means within the slice lip assembly.

An additional object of the invention is to provide a headbox having some or all of the characteristics outlined above wherein the supply chamber incorporates a device such as a suitable rotor which creates eddy currents of relatively small magnitude in the stock immediately adjacent the inlet ends of the small passages leading from this chamber to the slice lip assembly and thereby minimize flocculation in the stock and maintains these passages clear and free of plugging.

A further object of the invention is to provide a headbox having some or all of the characteristics outlined above wherein the slice lip assembly is constructed and arranged for adjustment with respect to the outlet ends of the passages leading thereto from the supply chamber in order to effect corresponding variation of the spacing from the ends of these passages to the slice outlet.

It is also an object of the invention to provide a headbox having some or all of the characteristics outlined above wherein the inlets for the stock into the supply chamber are located on the opposite side thereof from the outlet passages leading to the slice lip assembly, and wherein a roll having a discontinuous outer surface is mounted for rotation on an axis spaced between the inlets and outlets of the flow box for maximum effectiveness in minimizing flocculation.

Additional 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 generally in vertical section showing a headbox constructed in accordance with the invention and mounted in conjunction with the breast roll of the Fourdrinier paper machine;

FIG. 2 is an enlarged fragment of FIG. 1;

FIG. 3 is a fragmentary section on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged fragment of FIG. 3;

FIG. 5 is a view similar to FIG. 4 showing a modified construction;

FIG. 6 is an enlarged fragmentary section of the rotor in the supply chamber of the headbox in FIG. 1, as indicated by the section line 6—6 of FIG. 7;

FIG. 7 is a fragmentary view of the face of the rotor of FIG. 1, looking from left to right in FIG. 6;

FIG. 8 is a fragmentary view showing another form of rotor which may be used in the flow box of FIG. 1;

FIG. 9 is a view similar to FIG. 8 showing another form of rotor;

FIG. 10 is a fragmentary view of the face of still another form of rotor;

FIG. 11 is a section on the line 11—11 of FIG. 10;

FIGS. 12 and 13 are somewhat diagrammatic views similar to FIG. 1 and showing alternative forms of headboxes constructed in accordance with the invention; and

FIG. 14 is a fragmentary view similar to FIG. 2 and showing a special form of the invention.

Referring to the drawings, which illustrate preferred embodiments of the invention, FIG. 1 shows a fragment of the wet end of a Fourdrinier paper machine including the breast roll 10 and a fragment of the forming wire 11. The headbox of the invention which delivers the stock to the breast roll and forming wire comprises three components, which are the supply chamber 13, a tube assembly means 14 defining a multiplicity of small parallel passages leading from the chamber 13, and the slice lip assembly 15 which receives the stock from the tube assembly 14 and delivers it to the breast roll and forming wire.

The chamber 13 comprises a rectangular box extending the full width of the breast roll 10 and supported by suitable base structure as indicated at 20 and having a vertical front wall 21, a vertical back wall 22, end walls 23 and a top wall 24. The bottom wall 25 of chamber 13, however, is cylindrically curved about an axis located within the chamber and extending parallel with the breast roll 10. Within this chamber 13 is a rotor 30, the structural details of which and its function in the practice of the invention are described in detail hereinafter. At this point it is significant only to note that rotor 30 is mounted by shaft member 31 for rotation in chamber 13 on the axis of curvature of the bottom wall 25.

Inlet means for supplying stock to the chamber 13 comprises a crossflow header 32 and a plurality of spaced inlet pipes 33 leading from the header 32 through the back wall 22 and centered in the same horizontal plane as the axis of the rotor 30. A liquid level control unit 35 for regulating the liquid level within the chamber 13 is shown as mounted on the back wall 22 and may comprise any suitable control device for this purpose, such for example as any of the units shown in Crittenden et al. Patent No. 2,736,246, issued Feb. 28, 1956. In addition, the chamber 13 is preferably provided with an inlet connection 36 for supplying pressure air thereto to maintain an air cushion within the top of the chamber.

The tube assembly 14 is shown in detail in FIGS. 2–4 as comprising a multiplicity of individual cylindrical tubes 40 brazed or otherwise secured together at 41 in closely packed parallel relation providing a honeycomb arrangement in section as shown in FIGS. 2–4, and they may be enclosed in a rectangular housing 42. In accordance with the invention, the individual tubes 40 are of relatively small cross-sectional flow area, for example of an inner

diameter in the range of 0.25 to 1.00 inch, to provide a corresponding plurality of small parallel flow passages, and by the description of these passages in the claims as of relatively small individual cross-sectional flow area, inner diameters of this order are meant. It is not essential, however, that individual or cylindrical tubes **40** be used, and FIG. 5 shows a modified equivalent construction composed of multiple corrugated sheets **44** secured together to provide a honeycomb arrangement of small parallel flow passages **45**. Accordingly, references herein to "tubes" in connection with the assembly **14** are to be understood as including such modified constructions.

The chamber **13** is provided with an outlet opening **50** opposite the inlet **33** and having a rectangular outline to receive the inlet end of the assembly **14**, and a suitable sleeve **51** surrounds the inlet end of the tube assembly **14** and is sealed with respect to the surrounding structure of the outlet as by an O-ring seal **52**. The inlet end of the assembly **14**, including the ends of the tube therein, is preferably finished to a cylindrical curvature **55** substantially matching that of the bottom wall **25** of chamber **13**. Then during installation, the assembly **14** is adjusted to position its curved end surface **55** with its center of curvature on its axis of shaft means **31** so that it forms a continuation of the inner surface of wall **25**.

The slice lip assembly **15** comprises a tubular housing **60** adapted for telescoping engagement over the outer end of the tube assembly **14**, and this housing is mounted on a suitable base such as the structure **20**. The assembly **15** includes the usual lower slice lip **61** and cooperating upper slice lip **62** having its upper edge adjustably mounted at **63** on the housing **60**, and having its lower edge provided with the usual multiplicity of adjustable screws indicated generally at **65** to adjust the effective opening of the discharge outlet **66** to the breast roll **10**.

The connection between the slice lip assembly **15** and the tube assembly **14** is preferably constructed for relative adjustment lengthwise of the tube assembly, in order to vary the effective distance from the inlet ends of the tubes **40** to the discharge outlet **66**. As shown, the connection between the assemblies **14** and **15** includes a sleeve **70** which surrounds the end of the housing **42** and is in turn provided with a suitably sealed connection to the surrounding portion of the housing **60**, as indicated by an O-ring seal **71**. The mating surfaces of the sleeve **70** and housing **42** are in slidably sealing relation permitting the tube assembly **14** to be moved axially with respect to the housing **60**. Since the slice lip assembly **15** is necessarily fixed with relation to the breast roll **10**, the supply chamber **13** is preferably provided with a slidable mounting on the supporting structure **20**, as indicated by the mounting bolts **75** and slots **77**.

The rotor **30** may be constructed in a variety of forms which will carry out its major function, which is to create multiple eddy currents of small magnitude in the stock immediately adjacent the inlet ends of the tubes **40**, for the dual purpose of minimizing flocculation in the stock and preventing clogging or plugging of the tubes, as a result either of flocculation or stapling of fibers around the ends of the tubes. FIGS. 6 and 7 show one form of rotor **30** which has been found satisfactory in the practice of the invention, which comprises a roll having a perforated shell **80** of essentially the same basic construction as the perforated rectifier rolls commonly used in paper machine headboxes. The discontinuous outer surface of the perforate shell **80** provides for through flow of stock from the inlets **33** to the tubes **40** by way of the interior of the roll. For some purposes the perforated shell **80** will by itself produce desired operating conditions, but for preferred results, the shell **80** is equipped with axially extending bars **81** welded or otherwise secured on its outer surface in axially spaced relation and proportioned to extend into closely spaced relation with the curved surface **55** of the tube assembly **14**, for example a spacing of the order of ¼ inch.

FIGS. 8 and 9 are somewhat diagrammatic views illustrating other forms of construction of the rotor **30**. In FIG. 8, the rotor **85** comprises multiple rods **86** carried by disk or hub members **88**. For example, the rotor **85** may be of the construction shown in U.S. Patent No. 2,860,552 to Wesley S. Corbin. In FIG. 9 the rotor **90** comprises spiders **91** carrying at their tips a plurality of airfoil bars **92**, each of which may be individually of the configuration shown in United States Patent No. 2,835,173 to James H. Martindale. It will be seen that both of the rotors **85** and **90** comprises discontinuous surfaces similar to that of the shell **80**, and the rod or bar members thereof will act similarly to the bars **81** to create the desired eddy current in the stock adjacent the ends of the inlet ends of the tubes **40**.

FIGS. 10 and 11 show still another form of construction for the rotor **30** comprising a roll shell **95** having its surface pierced and formed to provide multiple perforations **96** defined by tab portions **97** and **98** bent in opposite directions with respect to the remainder of the shell. The resulting discontinuous shell surface will act similarly to that of the shell **80**, and the tabs **97** and **98** will function similarly to the bar or rod members of the other forms of rotor already described.

As already noted, the rotor in the headbox of the invention serves two functions, one being to keep the face of the tube assembly clean, and the other being to create sufficient turbulence in the supply chamber for maintained deflocculation. The energy put into the stock by the rotor will depend on the number and size of the rods, bars or comparable discontinuous portions of the periphery of the rotor, plus the mating configuration of the supply chamber and the speed of the rotor as determined by its input horsepower. The peripheral speed of the rotor should be such that its discontinuous portions move past the inlet and into the tube assembly at a frequency such that the individual impulses are substantially blended by the time the stock reaches the forming wire **11**. This result is further contributed to by the overall design of the headbox, nad particularly by the fact that the tube assembly effectively isolates the slice outlet from the effects of the high energy input in the supply chamber. As an illustrative example, satisfactory test results have been obtained with a rotor frequency of the order of 100 per second and with the tube assembly **14** having an overall length of 48 inches.

The adjustable mounting arrangement of the tube assembly **14** with respect to the slice lip assembly **15** is related to the function of the rotor **30** and also to the speed of the paper machine with which the headbox of the invention is used. More specifically, it is important for maximum uniformity of sheet formation that the eddy currents created at the inlet ends of the tubes **40** have sufficient time to decay before the stock is deposited on the wire **11**, but this time interval should not be of such length that the distribution characteristics imparted to the stock in the chamber **13** have the opportunity to deteriorate. This time interval is a function of the velocity of the paper machine and therefore the velocity of flow of the stock from the chamber **13** to the slice lip assembly **15**, the distance traversed by this flow is preferably established to provide the desired time interval in accordance with the flow velocity.

Adjustability to accomplish the purpose just described is provided by the construction of the invention, which makes it possible to achieve the desired adjustment without alteration of any of the component parts of the headbox, namely by simple axial movement of the chamber **13** and tube assembly **14** with respect to slice lip assembly **15**. The extent of such adjustment is limited initially only by the relative length of the tube assembly **14** and the portion of the housing **60** into which its outlet end fits, and adjustments over an even wider distance can be accomplished by means of a plurality of tube assemblies of initially selected different lengths.

It will accordingly be seen that the headbox of the invention does not require high head loss and velocity of the stock since the rotor **30** operates similarly to a pump, and the entering flows of stock through the pipes **33** need only be at velocities sufficient to maintain the desired liquid level within the chamber **13**. In addition, since the inlet ends of the tubes **40** are of individually small size, they offer sufficient restriction to the outward flow of stock from within the chamber **13** to maintain uniform distribution conditions, especially in combination with the rotor **30** and its continuous clearing action with respect to all of the tubes. These combined actions in accordance with the invention contribute another advantage of the invention by eliminating the need for a perforated roll or other rectifying means immediately ahead of the discharge outlet **66** as in conventional headboxes, thus further contributing to the economy of manufacture and the operation of the headboxes of the invention.

It is not essential to the invention that the passageways provided by the tube assembly means be straight. Thus FIG. 12 shows a headbox **100** in accordance with the invention which is particularly adaptable for use as a secondary headbox for supplying stock to a forming wire **101** on which there is already a layer of fiber supplied from a primary headbox. In the headbox **100**, the supply chamber **103** and rotor **105** correspond to the supply chamber **13** and rotor **30**, and the headbox includes a lower slice lip **106** and an upper slice lip **107** which may be of conventional construction. The tube assembly means **110** corresponds in purpose and function to the tube assembly **14**, but its inlet end is located in the bottom of the supply chamber **103**, and it includes a generally vertical upper portion and an inclined lower portion leading to the slice lips. In the operation of this headbox **100**, the rotor **105** and tube assembly **110** operate essentially in the same manner as described for the corresponding parts in FIG. 1.

FIG. 13 shows another form of the headbox **120** in accordance with the invention which is especially adaptable for use with a vertical paper machine of the type disclosed in United States Patent No. Re. 25,333, and characterized by a pair of forming wires **121** each traveling over a different breast roll **122**. In the headbox **120**, the supply chamber **123** and the rotor **125** correspond to the chamber **13** and rotor **30** of FIG. 1. The tube assembly means **130** may be of any of the constructions described in connection with FIGS. 1–5, and it extends vertically from the bottom of the supply chamber **123** to a pair of converging lips **131** extending into the nip between the breast rolls **122**. It will be apparent that the cooperative functions of the rotor **125** and tube assembly means **130** in FIG. 13 are essentially the same as described for the corresponding parts in the other forms of the invention.

FIG. 14 shows a modified construction which may be used in any of the headboxes of the invention. The tube assembly means **140** corresponds in function to the tube assembly means **14**, **110** and **130** and leads from a supply chamber **141** having therein a rotor **145** which represents any of the different forms of rotor already described and is provided with a discontinuous outer surface represented by bars **146**. The surface of the supply chamber **141** is not smooth as shown in FIGS. 1 and 2 but is provided with axially extending alternate grooves **147** and lands **148** which define a working surface cooperating with the discontinuous surface of the rotor **145** to create increased force of hydraulic shear throughout the stock therebetween for increased deflocculation of the stock. Otherwise headboxes constructed as shown in FIG. 14 will function in substantially the same manner as the other forms of headboxes already described.

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 papermaking stock to the forming member of a papermaking machine, comprising a slice lip assembly including means defining a discharge outlet for the stock to the forming member, tube assembly means defining a plurality of separate and parallel passages of relatively small individual cross-sectional flow area connected at one end to said slice lip assembly for delivering stock directly to said slice lip assembly, means forming an adjustable connection between said slice lip assembly means to provide for variation in the total distance from the inlet ends of said passages to said discharge outlet, and means including a chamber connected to the other ends of said tube assembly means for supplying stock under substantially uniform pressure conditions to all of said passages for delivery to said slice lip assembly.

2. A headbox for delivering papermaking stock to the forming member of a papermaking machine, comprising a slice lip assembly including a pair of lips defining along one edge thereof a discharge slot for the stock to the forming member and diverging from said edge to define a space of generally triangular section, tube assembly means defining a plurality of separate and parallel passages of relatively small individual cross sectional flow area and directly connected at one end to said slice lip assembly for delivering stock directly into said triangular space, a chamber directly connected to the other end of said tube assembly means to supply stock thereto, inlet means for delivering stock to said chamber for distribution therefrom into said tube assembly means, a rotor mounted for rotation within said chamber on an axis perpendicular to said passages and having a discontinuous outer surface for creating turbulence in the stock within said chamber, the end of said tube assembly means which is connected to said chamber being cylindrically curved substantially concentrically with the axis of said rotor, and means supporting said rotor for rotation on said axis with said surface thereof in closely spaced relation with said cylindrically curved surface of said tube assembly means for creating multiple eddy currents of small magnitude in the stock immediately adjacent the inlet ends of said passages.

3. A headbox as defined in claim **2** wherein said inlet means to said chamber are located in angularly spaced relation around said chamber from said tube assembly means to provide for flow of stock through said rotor from said inlet means to said passages.

4. A headbox as defined in claim **2** wherein said chamber includes a top wall, and comprising means for supplying pressure air to the interior of said chamber to maintain a controlled air pressure within said chamber above the level of stock therein.

5. A headbox for delivering papermaking stock to the forming member of a papermaking machine, comprising a chamber having a concave bottom wall cylindrically curved about an axis located in said flow box and also having inlet means for receiving stock and an outlet therefrom for the stock, a slice lip assembly spaced from said chamber and including means defining a discharge outlet for the stock to the forming member, tube assembly means defining a plurality of separate and parallel passages of relatively small individual cross-sectional flow area connected between said chamber outlet and said slice lip assembly, the inlet end of said tube assembly means being curved to conform generally with a cylindrical surface forming a continuation of said concave bottom wall, and a roll mounted for rotation on said axis and having a discontinuous outer surface located in closely spaced relation with the inlet ends of said tubes to create turbulence in the stock adjacent said inlet end of said tube assembly means.

6. A headbox as defined in claim **5**, wherein the center plane through said plurality of passages substantially connects with said axis.

7. A headbox as defined in claim 5 comprising means forming an adjustable connection between said slice lip assembly and said tube assembly means providing for variation of the spacing between the inlet ends of said passages and said discharge outlet.

8. A headbox as defined in claim 5 wherein said chamber includes a top wall, and comprising means for supplying pressure air to the interior of said chamber to maintain a controlled air pressure within said chamber above the level of stock therein.

References Cited

UNITED STATES PATENTS

2,688,276	9/1954	Showers	162—343
2,688,905	9/1954	Hornbostel	162—343 X
3,255,074	6/1960	Salomon et al.	162—343 X

DONALL H. SYLVESTER, *Primary Examiner*

J. H. NEWSOME, *Assistant Examiner.*