United States Patent

De Noyer

[15] **3,661,706**

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[54] AIR LOADED HEADBOX FOR A PAPERMAKING MACHINE HAVING VERTICALLY ALIGNED VANES THEREIN

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[52] **U.S. Cl.** **162/343,** 162/216, 162/340

[51] **Int. Cl.** **D21f 1/06**

[58] **Field of Search** 162/343, 339, 340, 336, 347, 162/216, 345

[56] **References Cited**

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3,216,892	11/1965	Wahlstrom et al.	162/343
3,532,598	10/1970	Lee et al.	162/343 X
1,909,150	5/1933	Bell-Irving et al.	162/343 X
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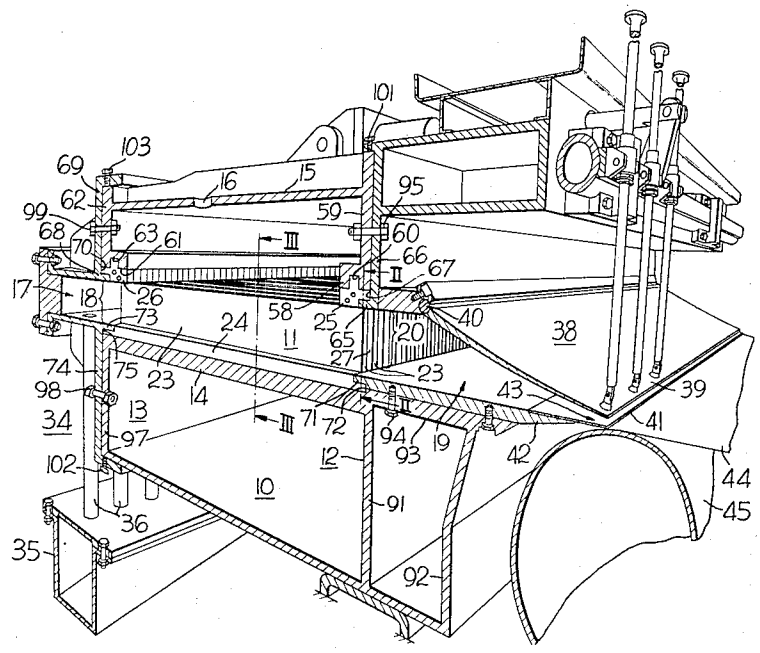
[57] **ABSTRACT**

An airloaded headbox for a papermaking machine having an air chamber above vertical rectangular guide vanes defining horizontally extending channels between adjacent vanes for the flow of dilute paper stock toward a slice opening over a Fourdrinier wire. The guide vanes are provided with keys projecting vertically upward from each of the upper corners of each vane and with keys projecting horizontally from each of the four corners of each vane. The keys project into keyways defined by lands and shelves projecting toward the guide vanes from vertical front and rear wall assemblies of the headbox. Three spacers are arranged between each pair of adjacent vanes, with a first of the spacers providing a channel floor and a second and third of the spacers horizontally spaced apart and adjacent the upper corners of each vane and defining therebetween a channel top open to the air chamber for air loading stock flowing horizontally through the channels. The first spacer has a horizontally extending key on each end. The second and third spacers each have a vertical key projecting upwardly and a horizontal key projecting toward the adjacent vertical end wall. Each of the keys of both the vanes and the spacers, in side abutting and alternating arrangement, project into keyways in register therewith. The keyways support the vanes and spacers, with the vanes and channel floor spacers between front and rear wall assemblies providing for cross-machine deflection of the floor of the flow passages, due pressure of pulp stock therein, which is both minimized and made independent of headbox width. The vertical keys of the vanes provide for the vanes to tie together the front and rear wall assemblies to minimize deflection of the front wall assembly and slice defining structure toward the slice opening.

9 Claims, No Drawings



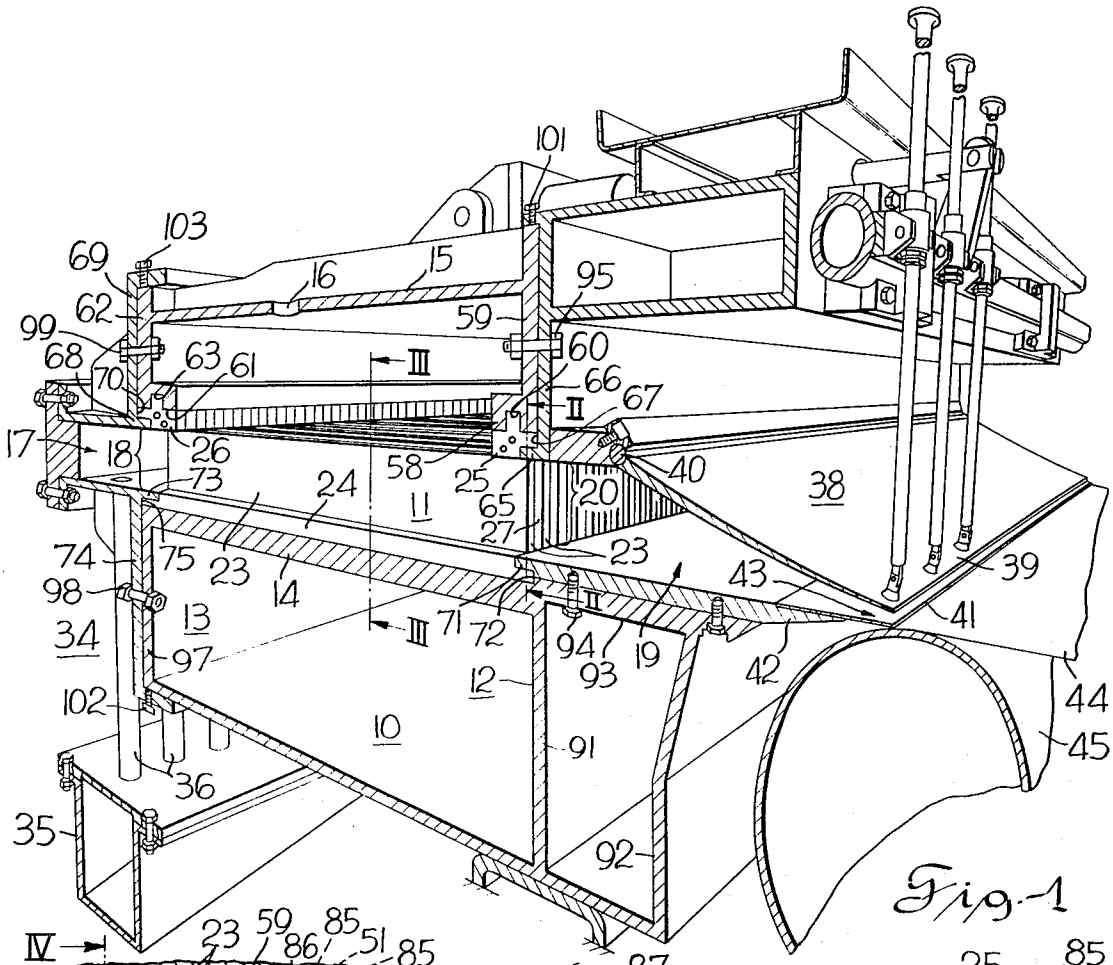


Fig. 1

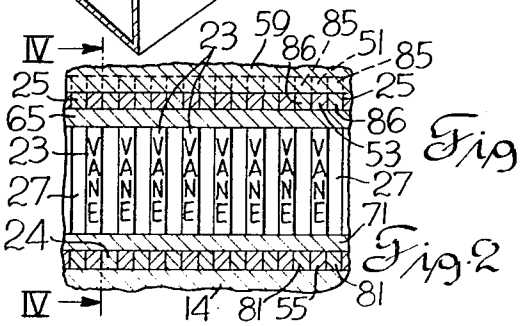


Fig. 2

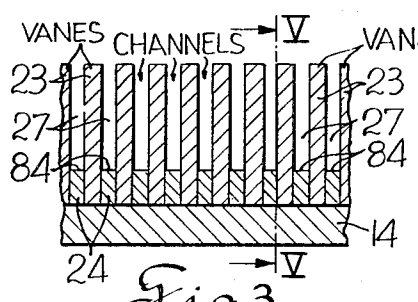


Fig. 3

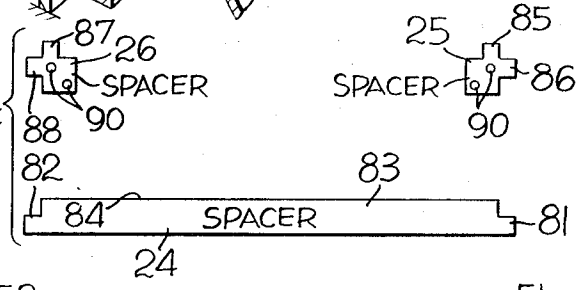


Fig. 4

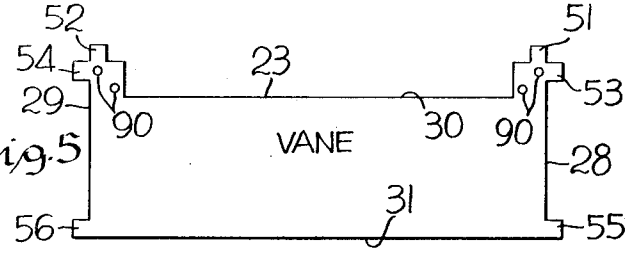


Fig. 5

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AIR LOADED HEADBOX FOR A PAPERMAKING MACHINE HAVING VERTICALLY ALIGNED VANES THEREIN

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This application discloses several keys and keyways certain of which, but not all, are the subject of my copending United States patent application entitled "Papermaking Machine Headbox Having Vertically Aligned Vanes Therein." Ser. No. 87,378, filed concurrently with this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the construction of a headbox for spreading dilute paper stock across the entire width of a paper web former and particularly to a construction that may be applied with particular advantage to a very wide headbox for high speed web formation and which may be air loaded.

2. Description of the Prior Art

As papermaking machines have been developed for increased web forming speeds and greater web widths, the deflection of parts of the headbox have become greater. At the same time that the desire for faster and wider machines was developing, an increased emphasis on paper quality created a need for a headbox with parts having less deflection. However, doubling the rate of flow of stock from the headbox results in a fourfold increase in pressure on the structures of the headbox containing the stock, and doubling the width of a headbox spanning a web former increases the deflection of the headbox floor sixteen times. Thus, by doubling speed and doubling width, the deflection of the headbox floor could increase by sixty-four times. Following the most common teaching of the prior art would lead one to reinforce the headbox with external beams having greater resistance of deflection, but this is both costly and cumbersome as the required beams may need to have a vertical dimension four times greater than the vertical dimension of such support beams required for slower speed and narrower width machines.

As will appear from the description to follow, the present invention involves generally rectangular stock flow channel defining vanes which are relatively thin, and arranged in a vertical position to present a greater horizontal length than vertical height. The vanes are parallel and closely spaced to define horizontally extending stock flow channels between adjacent vanes. Such vanes, without certain novel features which will appear as the description of the present invention proceeds, are known and disclosed in U.S. Pat Nos. 1,909,150 (see FIG. 4) and 3,216,892 (see FIG. 1).

SUMMARY OF THE INVENTION

The present invention applies to a headbox for a papermaking machine having a stock flow chamber defined by a vertical front wall assembly, and a vertical rear wall assembly. A structure defining a stock inlet chamber communicates through the rear wall assembly and a structure defining a stock outlet chamber with a slice opening communicates through the front wall assembly. A plurality of parallel and vertical guide vanes are arranged to define channels extending from the inlet chamber to the outlet chamber. Each of the vanes are generally rectangular.

It is an object of the present invention to provide a new and improved headbox of the aforesaid type with provisions for minimizing deflection of the front wall assembly and slice defining structure.

It is another object of the present invention to provide a new and improved headbox of the aforesaid type in which the vanes tie together the front and rear vertical wall assemblies and the vanes are tensioned and minimize deflection of the front wall assembly and slice defining structure.

It is also an object of the present invention to provide a new and improved headbox of the aforesaid type in which transverse deflection, that is deflection across the span of the box width, is both minimized and independent of the dimension of the span of box width and/or machine speed.

It is another object of the present invention to provide a new and improved headbox adapted for changing open area of pulp stock flow channels without a need to rebuild the walls and structures defining the box.

The improvement according to the present invention comprises providing the vanes with keys projecting vertically and upwardly away from the guide vanes and into keyways defined by lands projecting vertically toward the guide vanes from the vertical front and rear wall assemblies. In a preferred embodiment each vane also has horizontal keys projecting from each of the four corners of each vane toward the front wall and rear wall respectively to project in keyways in register therewith, with both a vertical and horizontal key projecting from each of the two upper corners of the vertical and rectangular guide vanes. Three spacers are provided between adjacent vanes, with a first of the spacers providing a channel floor and the second and third of the spacers being horizontally spaced apart and adjacent the upper corners of each vane and defining therebetween a channel top open to the chamber above the vanes for air loading stock flowing horizontally through the channels. The first spacer has a horizontal key on both ends thereof. The second and third spacers each have a vertical key projecting upwardly and a horizontal key projecting toward the adjacent vertical end wall. The keys of both the vanes and the spacers, in side abutting and alternating arrangement project into their respective keyways. The keyways for the horizontal keys of the vanes and the channel floor spacer support the vanes and the channel floor spacer between the front and rear wall assemblies with cross-machine deflection of the channelized flow passage between the inlet and outlet chambers, due to the pressure of pulp stock therein, being both minimized and made independent of the dimension of the span of box width. The vertical keys of the vanes in their respective keyways provide for the vanes to tie together the front and rear wall assemblies to minimize deflection of the front wall assembly and slice defining structure. A preferred embodiment may further provide horizontal structure spaced above the vanes to enclose the chamber above the channelized flow passages, for air loading the stock in the open top channels with greater than atmospheric air pressure. The air pressure acts to apply outwardly directed forces upon the front and rear vertical wall assemblies but the vanes tie the front and rear walls together to resist deflection caused by such forces.

Other features and objects of the invention that have been attained will appear from the more detailed description to follow with reference to an embodiment of the present invention shown in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 of the accompanying drawing is a view in perspective and in section, showing a papermaking machine headbox according to the present invention;

FIGS. 2 and 3 are views taken along lines II—II and III—III, respectively, in FIG. 1 and viewing the structure in the direction indicated by arrows; and

FIGS. 4 and 5 are views taken along lines IV—IV AND V—V, respectively, in FIGS. 2 and 3 and viewing the vanes and spacers in the direction indicated by arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a headbox 10 is shown which comprises a stock flow chamber 11 defined by vertical front wall assembly 12, a vertical rear wall assembly 13, and a horizontal structure defining a floor 14. If it is desired to air load the chamber 11 with above atmospheric air pressure, a horizontal structure defining a box top 15 is also provided having a port 16 for devices (not shown) such as are disclosed in U.S. Pat. No. 2,736,246 or 3,515,635. A structure defining a stock inlet chamber 17 communicates with chamber 11 through an open-

ing 18 in the rear wall assembly 13, and a structure defining a stock outlet chamber 19 communicates with chamber 11 through an opening 20 in the front wall assembly 12. The stock flow chamber 11 is provided with a plurality of parallel and vertical guide vanes 23 which are spaced apart by a first spacer 24, a second spacer 25 and a third spacer 26 to define channels 27 therebetween extending from the inlet chamber 17 to the outlet chamber 19. Each of the vanes 23 are generally rectangular and (see FIG. 5) have a pair of vertical edge portions 28 and 29, and a pair of horizontal edge portions 30 and 31.

The headbox 10 is provided with a stock entrance assembly 34 which includes a manifold 35 with a plurality of tubes 36 connecting manifold 35 to the inlet chamber 17. The headbox 10 is also provided with a stock discharge assembly 38 which includes a top slice lip 39 connected to the front wall assembly 12 by a pivotal connection 40 at the level of the top of opening 20 in the front wall assembly 12, and a bottom slice lip 41 connected to a lower front wall number 42 which is part of the front wall assembly 12 at the level of the bottom of the opening 20. The top slice lip 39 and bottom slice lip 41 define a slice opening 43 for discharging dilute paper stock onto a Fourdrinier web forming wire 44 looped over a breast roll 45.

Referring to FIG. 5, each vane 23 is provided with a first key 51 projecting vertically upward from the upper horizontal edge portion 30 of vane 23 in a vertical plane adjacent edge portion 28. Each vane 23 is also provided with a second key 52 projecting vertically upward from the upper horizontal edge portion 30 of vane 23 in a vertical plane adjacent the other vertical edge portion 29. Each vane 23 is provided with a third key 53 projecting horizontally outward and away from the upper end of the vertical edge portion 28. Each vane 23 is further provided with a fourth key 54 projecting horizontally opposite key 53 and in the same horizontal plane with key 53. Each vane 23 is also provided with a fifth key 55 and a sixth key 56 projecting horizontally outward of vane 23 in opposite directions along the lower horizontal edge 31.

Referring to FIG. 1, a first land 58 is connected to an upper member 59 of front wall assembly 12 on the same side of wall assembly 12 as the channels 27. The land 58 is spaced away from member 59 and projects downwardly a predetermined distance to define a first keyway 60 extending upwardly a predetermined distance away from the channels 27. A second land 61 is connected to an upper member 62 of the rear wall assembly 13, and on the same side of wall 13 as the channels 27. The land 61 is spaced away from member 62 and projects downwardly a predetermined distance to define a second keyway 63 extending upwardly a predetermined distance away from the channels 27. A first horizontal shelf 65 projects from another upper member 66 of the front wall assembly 12 inwardly and below the member 59 and toward the chamber 11 and defines a third keyway 67. A second horizontal shelf 68 projects from another upper member 69 of the rear wall assembly 13 inwardly below the member 62 and toward the chamber 11 and defines a fourth keyway 70 facing and in register with the keyway 67. A third horizontal shelf 71 projects from the lower front wall member 42 inwardly above the floor 14 and toward chamber 11 and defines a fifth keyway 72. A fourth horizontal shelf 73 projects from a lower member 74 of rear wall assembly 13 inwardly above the floor 14 and toward chamber 11 and defines a sixth keyway 75.

As shown in FIG. 1, spacers 24, 25 and 26 are arranged against an adjacent vane 23 to space therefrom another vane which engages the spacers 24, 25 and 26 in a manner shown in FIG. 2 and FIG. 3, to define the channels 27.

Referring to FIG. 4, the first spacer 24 is shown as having horizontal and oppositely projecting keys 81, 82 for projecting into 72 and 75 respectively, between vane keys 55, 56 respectively. The first spacer 24 has a midportion 83 between the keys 81, 82 that projects vertically upward a predetermined distance to define a floor 84 for a channel 27. The second spacer 25 is shown as having a vertical key 85 for projecting upward into the keyway 60 between vane keys 51, and a key 86 for projecting horizontally into the keyway 67 between vane keys 53. The third spacer 26 has a vertical key 87 for projecting upward into the keyway 63 between vane keys 52, and a key 88 for projecting horizontally into the keyway 70 between vane keys 54.

As shown in FIG. 2, the vanes 23 define channels 27 with alternating and side abutting first vane keys 51 and spacer keys 85 (shown in broken lines) projecting upwardly, alternating and side abutting third vane keys 53 and spacer keys 86 shown between shelf 65 and upper front wall member 59, and alternating and side abutting fifth vane keys 55 and spacer keys 81 shown between the third shelf 71 and floor 14. Since the second and third spacers 25, 26 (as shown in FIG. 1) do not extend the entire distance between the front and rear walls 12, 13, the channels 27 are provided with open tops as shown in FIG. 3.

As shown in FIGS. 4 and 5 the vanes 23, second spacers 25 and third spacers 26, may be provided with holes 90 for aligning rods (not shown) which may be used to hold these elements in place during assembly and prior to securing them in the positions which have been described or each set of spacers may be doweled to a vane. All of the keys are tightly secured in keyways in a manner that will be described next.

Referring again to FIG. 1, the shelves 65 and 68 have been described as being connected to and part of the wall assemblies 12, 13, respectively. The lower part of the front wall assembly 12 also includes vertical members 91, 92. Member 91 is connected on its upper end to the forward part of the box floor 14, and a horizontal member 93 is also connected to the upper end of member 91 and to member 92. The lower front wall member 42, from which the shelf 71 projects, is carried on top of the member 93. The member 42 is connected to the member 93 by screws 94 which also serve to pull the shelf 71 downwardly to clamp the vane keys 55 and spacer keys 81 in keyway 72 between the shelf 71 and the box floor 14. The upper part of the front wall assembly 12 includes the vertical members 59, 66, with the member 59 carrying the box top 15 and defining the land 58 and the keyway 60. The shelf 65 is connected to the member 66 in a manner which has been described. Bolts 95 are provided to draw the members 59 and 66 together for holding the vane keys 53 and spacer keys 86 between the shelf 65 and the bottom of member 59. The lower part of the rear wall assembly 13 includes a vertical member 97 and the vertical member 74 which carry the rear end of the floor 14, and previously described the member 74 supports the shelf 73. Bolts 98 are provided to draw the members 97, 74 together for holding the lower vane keys 56 and spacer keys 82 in the keyway 75 between the shelf 73 and the box floor 14. The upper part of the rear wall assembly 13 includes the vertical member 62 which carries the rear end of the box top 15 and defines the land 61 and keyway 70, and the vertical member 69 which carries the shelf 68. Bolts 99 are provided to draw the members 62, 69 together for holding the vane keys 54 and spacer keys 88 in the keyway 70 between the shelf 68 and the bottom of the member 62. Jack screws 101, 102 and 103 are also provided to secure the assembly in a manner which will now be described. Jack screw 101 is threaded in a portion of the member 66 that projects over the top of the member 59. When the jack screw 101 is turned to move downwardly it engages the top of member 59 and the member 66 is drawn up-wardly an amount permitted by a loose fit of bolt 95 through the members 59, 66 and as member 66 moves upwardly the shelf 65 is pulled up to clamp the vane keys 53 and spacer keys 86 in the keyway 67 and the vanes are placed in vertical tension between keys 53 and 55 when the headbox is pressurized. Jack screw 102 is threaded in a portion of the member 74 that projects under member 97. When jack screw 102 is turned to move upwardly it engages the bottom of member 97 and the member 74 is pulled downwardly to seat shelf 73 onto vane keys 56 and spacer keys 82, which is permitted by a loose fit of bolts 98 through the members 74, 97. Similarly, jack screw 103 is threaded in a portion of the member 69 that projects over the top of the member 62.

When jack screw **103** is turned to move downwardly it engages the top of member **62** and the member **69** is drawn upwardly an amount permitted by a loose fit of bolts **99** through the members **62, 69** and as member **69** moves upwardly the shelf **68** is pulled up to clamp the vane keys **54** and the spacer keys **88** in the keyway **70** and the vanes are placed in vertical tension between keys **54** and **56** when the headbox is pressurized.

The members **59** and **62** below the box top **15** cooperate with end walls (not shown) and enclose the chamber **11** above the open top channels **27**. Pressurized air may be admitted to the chamber **11** through port **16** to load the stock in the open top channels **27** with above atmospheric air pressure.

In the operation of the described apparatus, dilute paper stock enters through manifold **35** and flows upwardly through the tubes **36** to the inlet chamber **17**. From the inlet chamber **17** the stock flows through the channels **27** defined within the flow chamber **11**. The weight and pressure of stock in such as the flow chamber **11** normally, in boxes constructed according to the prior art, exerts forces tending to cause the floor **14** to deflect downwardly across both the longitudinal and cross-machine spans of chamber **11**. Furthermore, the pressure of the stock and air loading in such as the flow chamber **11** normally, in boxes constructed according to the prior art, tends to deflect the front wall **12** and stock discharge assembly **38** outwardly toward the slice opening **43**. With the construction that has been described however, the vanes **23** are keyed and tensioned in keyways **67, 72, 70, 75** and the spacers **24** are keyed in keyways **72, 75** for support by the front and rear wall assemblies **12, 13** to divide the cross-machine span into a plurality of very narrow cross-machine spans that have much less tendency for cross-machine deflection as a result of the vanes being supported at each end and the resistance to deflection provided by vertical tension applied to the vanes when the headbox is pressurized. By providing the vertical vane keys **51** and **52** arranged as described, the vanes **23** tie together the front and rear wall assemblies **12, 13** and minimize outward deflection of the front wall **12** and stock discharge assembly **38** toward the slice opening **43** when the headbox is pressurized.

Thus it has been disclosed how downward deflection of the structures defining channels **27** and outward deflection of the front wall **12** and slice defining assembly **38** has been limited and made independent of the width of the box **10**. It should also be noted open area through the channels **27** can be changed without rebuilding the box **10**, by merely adding or taking away a number of vanes **23** and replacing the spacers **24, 25, 26** with new spacers of narrower or wider widths.

From the foregoing detailed description of the present invention it has been shown how the objects of the present invention have been attained in a preferred manner. However, modification and equivalents of the disclosed concepts such as readily occur to those skilled in the art are intended to be included in the scope of this invention. Thus, the scope of the invention is intended to be limited only by the scope of the claims such as are or may hereafter be, appended hereto.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an air loaded headbox for a papermaking machine having a stock flow chamber defined by a vertical front wall assembly, a vertical rear wall assembly, and a horizontal structure defining a floor between the front and rear wall assemblies; a structure defining a stock inlet chamber communicating through an opening defined in the rear wall assembly, structure defining a stock outlet chamber with a slice opening and communicating through an opening defined in the front wall assembly, and a plurality of parallel and vertical guide vanes projecting upwardly from the floor and means defining stock flow channels therebetween with each vane projecting on one end thereof to the opening in the rear wall assembly and on the other end thereof to the opening in the front wall assembly, each said vanes being generally rectangular and having an upper horizontal edge, with the upper horizontal edge of adjacent vanes providing the channels with top portions open upwardly thereof, the improvement comprising:

a. each vane having a first key projecting vertically upward from each vane and adjacent the end of the vane projecting to the front wall opening;

b. each vane having a second key projecting vertically upward from each vane and adjacent the end of the vane projecting to the rear wall opening;

c. a first land connected to the front wall assembly and projecting vertically downward and spaced from the front wall assembly on the channel side thereof and defining a first vertically extending keyway in the front wall assembly above the opening therethrough;

d. a second land connected to the rear wall assembly and projecting vertically downward and spaced from the rear wall assembly on the channel side thereof and defining a second vertically extending keyway in the rear wall assembly above the opening therethrough; and

e. the first key projecting into the first keyway and the second key projecting into the second keyway to thereby utilize the vanes to tie together the front and rear vertical wall assemblies above the openings therethrough and minimize deflection of the front vertical wall assembly and slice defining structure.

2. In a headbox according to claim **1**, wherein said means defining stock flow channels between said guide vanes includes three spacers between adjacent vanes, a first of the spacers being adjacent a lower horizontal edge of the vanes and extending horizontally between the front and rear wall openings and upwardly a predetermined distance to provide a stock flow channel floor, and a second and third of the spacers being horizontally spaced apart and adjacent the vane first and second keys respectively in side abutting relation therewith, the second and third of the spacers defining therebetween a channel top opening.

3. In a headbox according to claim **2**, the second and third spacers each having a key projecting upwardly and into one of the keyways and between keys of adjacent vanes.

4 In a headbox according to claim **2**, horizontal structure spaced above the vanes and the second and third spacers defining an enclosed chamber for containing pressurized air for loading paper stock flowing through the open top channels.

5. In a headbox according to claim **1**,

a. a third keyway defined by a first horizontal shelf connected to the front wall assembly above the front wall opening and projecting toward the stock flow channels to define the third keyway below the first keyway and on the stock outlet chamber side of the first keyway;

b. a fourth keyway defined by a second horizontal shelf connected to the rear wall assembly above the rear wall opening and projecting toward the first shelf to define the fourth keyway below the second keyway and on the stock inlet chamber side of the second keyway; and

c. each vane having a third key projecting into the third keyway and a fourth key projecting into the fourth keyway to support each vane of the vanes between the front and rear vertical wall assemblies.

6. In a headbox according to claim **5**,

a. a fifth keyway defined by a third horizontal shelf connected to the front wall assembly below the front wall opening and projecting toward the stock flow channels to define the fifth keyway above the floor of the stock flow chamber;

b. a sixth keyway defined by a fourth horizontal shelf connected to the rear wall assembly below the rear wall opening and projecting toward the stock floor channels to define the sixth keyway above the floor of the stock flow chamber; and

c. each vane having a fifth key projecting into the fifth keyway and a sixth key projecting into the sixth keyway to support each vane between the front and rear vertical wall assemblies.

7. In a headbox according to claim 6, the first shelf being connected to the front wall by an upper front wall member movable upwardly relative to the first land and first keyway, a first screw operatively connected to the movable upper front wall member for raising the first shelf to clamp the third key in the third keyway and place the vanes in vertical tension between the third and fifth vane keys when the headbox is pressurized, the second shelf being connected to the rear wall by an upper rear wall member movable upwardly relative to the second land and second keyway, and a second screw operatively connected to the movable upper rear wall member for raising the second shelf to clamp the fourth key in the fourth keyway and place the vanes in vertical tension between the fourth and sixth vane keys when the headbox is pressurized.

8. In a headbox according to claim 7, the third shelf being connected to the front wall by a lower front wall member movable downwardly relative to the stock flow chamber floor and fifth keyway, a third screw operatively connected to the movable lower front wall member for lowering the third shelf to clamp the fifth key in the fifth keyway to hold the vanes in vertical tension between the third and fifth keys when the headbox is pressurized, the fourth shelf being connected to the rear wall by a lower rear wall member movable downwardly relative to the stock flow chamber floor and sixth keyway, and a fourth screw operatively connected to the lower movable rear wall member for lowering the fourth shelf to clamp the sixth key in the sixth keyway to hold the vanes in vertical tension between the fourth and sixth keys when the headbox is pressurized.

9. In a headbox according to claim 6, three spacers between adjacent vanes, a first of the spacers being adjacent a lower horizontal edge of the vanes and extending horizontally between the front and rear wall openings and upwardly a predetermined distance to provide a stock flow channel floor, and a second and third of the spacers being horizontally spaced apart and adjacent the vane first and second keys respectively in side abutting relation therewith, the second and third of the spacers defining therebetween a channel top opening, the first spacer having a key on the front wall end thereof projecting into the fifth keyway between adjacent fifth keys of adjacent vanes and the first spacer having a key on the rear wall end thereof projecting into the sixth keyway between adjacent sixth keys of adjacent vanes, the second spacer having a key projecting into the first keyway and a key projecting into the third keyway between first and third keys respectively of adjacent vanes, and the third spacer having a key projecting into the second keyway and a key projecting into the fourth keyway between second and fourth keys respectively of adjacent vanes.

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