United States Patent

De Noyer

[15] **3,661,705**

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[54] PAPERMAKING MACHINE HEADBOX HAVING VERTICALLY ALIGNED VANES THEREIN

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

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

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

[56] **References Cited**

UNITED STATES PATENTS

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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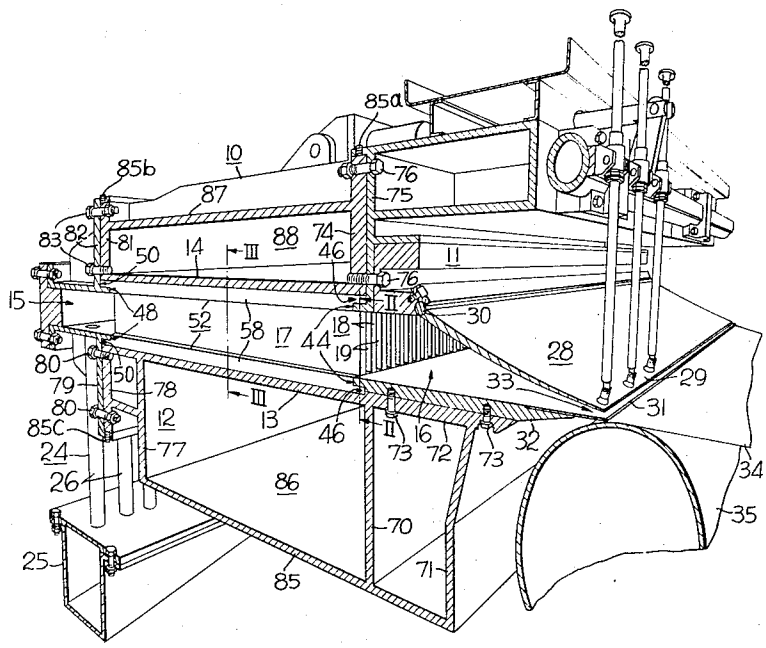
[57] **ABSTRACT**

A headbox for a papermaking machine having vertical rectangular guide vanes defining channels therebetween for the flow of dilute paper stock toward a slice opening over a Fourdrinier wire. The guide vanes are provided with keys projecting horizontally from the vanes and into keyways defined by shelves projecting toward the guide vanes from vertical front and rear wall assemblies of the headbox. A pair of spacers is arranged between each pair of adjacent vanes, with one spacer providing a channel floor and the other spacer providing a channel ceiling. Each spacer has a key on both ends thereof. The keys of both the vanes and the spacers, in side abutting and alternating arrangement, project into a keyway. The keyways support the vanes and spacers between front and rear wall assemblies with cross-machine deflection of the flow passages, due pressure of pulp stock therein, being both minimized and made independent of headbox width. Pressurized chambers below and above the channels load the vanes and spacers against deflection in vertical planes defined by the vanes and spacers.

8 Claims, 5 Drawing Figures



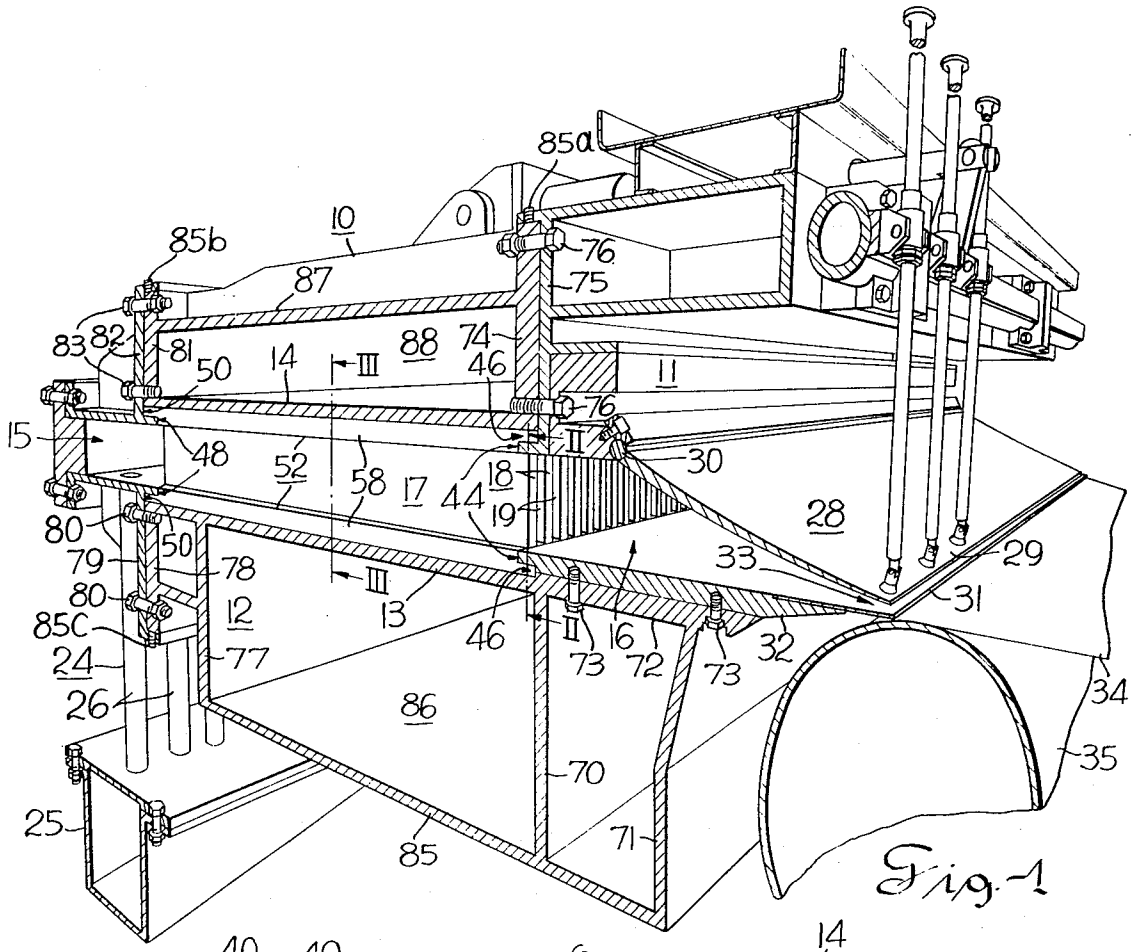


Fig. 1

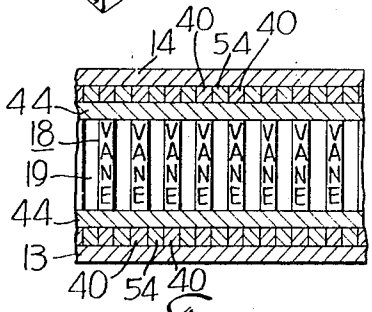


Fig. 2

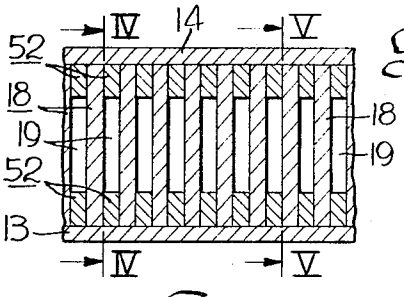


Fig. 3

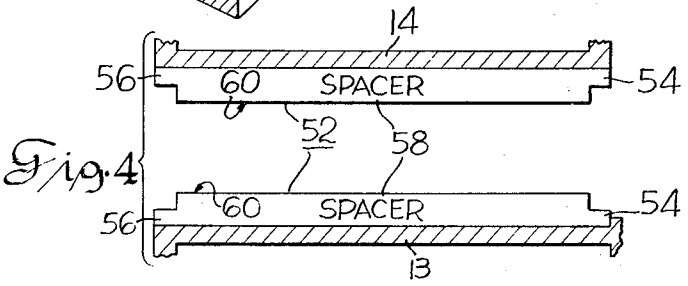


Fig. 4

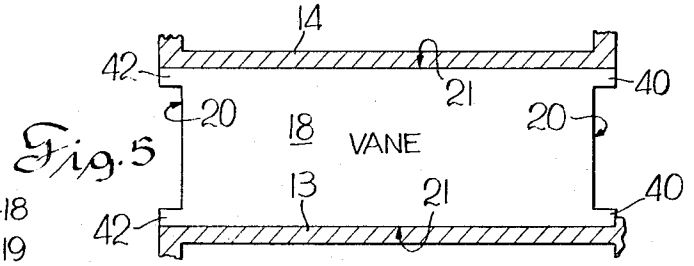


Fig. 5

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PAPERMAKING MACHINE HEADBOX HAVING VERTICALLY ALIGNED VANES THEREIN

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.

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 through 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 provide a cross beam beneath the headbox floor having greater resistance of deflection, but this is both costly and cumbersome as the beam required 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 vertical front wall assembly, a vertical rear wall assembly, a horizontal structure defining a box floor, and a horizontal structure defining a box top. A structure defining a stock inlet chamber communicates through the rear wall assembly and a structure defining a stock outlet chamber communicates through the front wall assembly. A central flow passage is defined between the horizontal structures from the rear wall assembly to the front wall assembly, and a plurality of parallel and vertical guide vanes are arranged in the flow passage to define channels extending from the inlet chamber to the outlet chamber. Each of the vanes are generally rectangular and have a pair of vertical edge portions and a pair of horizontal edge portions.

It is an object of the present invention to provide a new and improved headbox of the aforesaid type which can be constructed with the deflection of the box floor easily and inexpensively limited to 0.010 inches, and if desired to 0.001 inches or less.

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 keys projecting horizontally away from the guide vanes and into keyways defined by shelves projecting toward the guide vanes from the vertical front and rear wall assemblies. In a preferred embodiment such a key projects from each of the four corners of the vertical and rectangular guide vanes, and spacers are provided between adjacent vanes along the upper and lower edge portions of the vanes, with the spacers each having a key on both ends thereof. The keys of both the vanes and the spacers, in side abutting and alternating arrangement project into a keyway. The keyways support the vanes and spacers between the front and rear wall assemblies with cross-machine deflection of the flow passage due to the pressure of pulp stock therein, being both minimized and made independent of the dimension of the span of box width. A preferred embodiment may further provide that the horizontal structures which define the box floor and top, respectively, beneath and above the spacers, each further define a chamber below and above the channelized flow passage, for containing pressurized fluid for loading the spacers against bowing downwardly and upwardly in planes parallel to the vanes, due to pressure of pulp stock within the flow passage.

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 FIG. 3 and viewing the structure in the direction indicated by arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a pressurized headbox **10** is shown comprising a vertical front wall assembly **11**, a vertical rear wall assembly **12**, a horizontal structure defining a box floor **13**, and a horizontal structure defining a box top **14**. A structure defining a stock inlet chamber **15** communicates through the rear wall assembly **12** and a structure defining a stock outlet chamber **16** communicates through the front wall assembly **11**. A central flow passage **17** is defined between the floor **13** and top **14** from the rear wall assembly **12** to the front wall assembly **11**, and a plurality of parallel and vertical guide vanes **18** are arranged in the flow passage **17** to defined channels **19** therebetween extending from the inlet chamber **15** to the outlet chamber **16**. Each of the vanes **18** are generally rectangular and (see FIG. 5) have a pair of vertical edge portions **20** and a pair of horizontal edge portions **21**.

The headbox **10** is provided with a stock entrance assembly **24** which includes a manifold **25** with a plurality of tubes **26** connecting manifold **25** to the inlet chamber **15**. The headbox **10** is also provided with a stock discharge assembly **28** which includes a top slice lip **29** connected to the front wall assembly **11** by a pivotal connection **30** at the level of the top of flow passage **17**, and a bottom slice lip **31** connected to an apron board **32** which is part of the front wall assembly **11** at the level of the bottom of flow passage **17**. The top slice lip **29** and bottom slice lip **31** define a slice opening **33** for discharging dilute pulp stock onto a Fourdrinier web forming wire **34** looped over a breast roll **35**.

Referring to FIG. 5, each vane **18** is provided with a first pair of vertically spaced keys **40** each projecting horizontally outward and away from a corner of vane **18** defined by one of the horizontal edge portions **21** and one of the vertical edge portions **20**. Each vane **18** is provided with a second pair of vertically spaced keys **42** each projecting horizontally opposite but in register with the keys **40** of the first pair.

Referring to FIG. 1, a first pair of vertically spaced horizontal shelves 44 project from the front wall assembly 11 inwardly toward the flow passage 17 and define a first pair of keyways 46, with one keyway 46 being between the lower one of the shelves 44 and the floor structure 13 and the other of the keyways 46 being between the higher of the shelves 44 and the top structure 14. A second pair of vertically spaced horizontal shelves 48 project from the rear wall assembly 12 inward toward the flow passage 17 and define a second pair of keyways 50 facing and in register with the keyways 46 of the first pair.

Referring to FIG. 3, spacers 52 are arranged between adjacent vanes 18 to space adjacent vanes apart and define between each such pair of vanes 18, one of the channels 19. A pair of spacers 52 is shown in FIG. 4 as having a first key 54 and a second key 56. Each of the spacers 52 has a midportion 58 between the spacer first key 54 and the spacer second key 56. The midportions 58 of a pair of spacers 52 between adjacent vanes 18, project vertically toward each other and provide a pair of facing horizontal surfaces 60 which cooperate with adjacent vanes 18 to define the channels 19 within the flow passage 17 and with such pair of the surfaces 60 providing a floor and ceiling for a channel 19.

As shown best in FIGS. 2 and 3, the vanes 18 and spacers 52 are arranged with two spacers 52 between each pair of adjacent vanes 18, with one spacer 52 along the upper of the horizontal edges 21, and with a second spacer 52 along the lower of the horizontal edges 21. A pair of facing horizontal surfaces 60 and a pair of adjacently spaced vanes 18 therefore cooperate as shown in FIG. 3 to define a channel 19 rectangular in cross section. The channels 19 extend the horizontal length of the vanes 18. The vanes 18 and spacers 52 are therefore also in an arrangement in which keys 40, 42 of vanes 18 and keys 54, 56 of spacers 52 are in side abutting and alternating arrangement and project into a keyway 46, 50. The keys 40, 42, 54 and 56 are tightly secured in the keyways 46, 50 in a manner that will be described next.

Referring again to FIG. 1, the shelves 44 and 48 are part of the wall assemblies 11, 12, respectively. The lower part of the front wall assembly 11 includes vertical members 70, 71 and a horizontal member 72. The apron board 32, from which one of the shelves 44 projects, is carried on top of the member 72 and the box floor 13 is also carried, on the forward end, by the member 70. The apron board 32 is connected to the member 72 by screws 73 which also serve to pull the lower of the shelf 44 downwardly to clamp the lower keys 40, 54 between the lower shelf 44 and the box floor 13. The upper part of the front wall assembly 11 includes first and second vertical members 74, 75, with the member 74 carrying the box top 14 and the member 75 carrying the upper of the shelves 44. Bolts 76 are provided to draw the members 74 and 75 together and hold the upper of the keys 40, 54 between the upper shelf 44 and the box top 14. The lower part of the rear wall assembly 12 includes vertical members 7, 78 which carry the rear end of the floor 13 and a vertical member 79 which carries the lower of the shelves 48. Bolts 80 are provided to draw the members 79, 78 together and hold the lower of the keys 42, 56 between the lower shelf 48 and the box floor 13. The upper part of the rear wall assembly 12 includes a first vertical member 81 which carries the rear end of the box top 14 and a second vertical member 82 which carries the upper of the shelves 48. Bolts 83 are provided to draw the members 81, 82 together and hold the upper of the keys 42, 56 between the upper shelf 48 and the box top 14. Jack screws 85*a*, 85*b* and 85*c* are also provided to secure the assembly in a manner which will now be described. Jack screw 85*a* is threaded in a portion of the member 75 that projects over the top of the member 74. When the jack screw 85*a* is turned to move downwardly it engages the top of member 74 and the member 75 is drawn upwardly an amount permitted by a loose fit of bolt 76 through the members 74, 75 and as member 75 moves upwardly the upper of the shelf 44 is pulled up to clamp the upper of the keys 40 and 54 in the upper keyway 46 and the vanes are placed in vertical tension between the keys 40 when the headbox is pressurized. Similarly, jack screw 85*b* is threaded in a portion of the member 82 that projects over the top of the member 81. When jack screw 85*b* is turned to move downwardly it engages the top of member 81 and the member 82 is drawn upwardly an amount permitted by a loose fit of bolts 83 through the members 81, 82 and as member 82 moves upwardly the upper of the shelves 48 is pulled up to clamp the upper of the keys 42 and 56 in the upper keyway 50 and the vanes are placed in vertical tension between the keys 42 when the headbox is pressurized. Jack screw 85*c* is threaded in a portion of the member 79 that projects under member 78. When jack screw 85*c* is turned to move upwardly it engages the bottom of member 78 and the member 78 is pushed upwardly an amount permitted by a loose fit of bolts 80 through the members 78, 79 and as member 78 moves upwardly the top of member 78 is pushed upwardly against the lower of the keys 42 and 56 in the lower of the keyways 50. The screws 73 similarly provide for pulling down on apron board 32 to tightly clamp the lower keys 40, 54 in the lower keyway 46.

The members 70 and 77 beneath the box floor 13, are joined by a sub-floor 85, to cooperate with end walls (not shown) and define a chamber 86 beneath box floor 13. The members 74 and 81 above the box top 14, are joined by a second top 87, to cooperate with end walls (not shown) and define a chamber 88 above the top 14. A pressurized fluid may be admitted to the chambers 86, 88 through inlets (not shown) to apply a load to the floor 13 and top 14 to counter the loading applied within flow chamber 17.

In the operation of the described apparatus, dilute pulp stock enters through manifold 25 and flows upwardly through the tubes 26 to the inlet chamber 15. From the inlet chamber 15 the stock flows through the channels 19 defined within the flow passage 17. The weight and pressure of stock in such as the flow passage 17 normally, in boxes constructed according to the prior art, exerts forces tending to cause the box floor 13 to deflect downwardly across both the longitudinal and cross-machine spans of floor 13. Similarly, the pressure of the stock in such as the flow passage 17 normally, in boxes constructed according to the prior art, tends to deflect the box top 14 upwardly across both the longitudinally and cross-machine spans of top 14. With the construction that has been described however, the vanes 18 and spacers 52 are keyed in keyways 46, 50 and supported by the front and rear wall assemblies 11, 12 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 tying the box top 14 to the box floor 13 and resistance to deflection provided by vertical tension applied to the vanes when the headbox is pressurized. Further, the vanes 18 inherently have little tendency to deflect in the vertical plane defined by each vane since the unit force per vane is small compared to the cross sectional area of the vane while regarding the spacers 52, the load applied to the floor 13 and top 14 by pressure in chambers 86, 88, act against any tendency for the spacers to deflect in the vertical plane defined by each spacer 52.

Thus it has been disclosed how deflection of the horizontal structures above and beneath the flow chamber 17 and channels 19, has been limited and made independent of the width of the box 10. It should also be noted open area through the flow chamber 17 within the channels 19 can be changed without rebuilding the box 10, by merely adding or taking away a number of vanes 18 and replacing the spacers 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 a headbox for a papermaking machine having a vertical front wall assembly, a vertical rear wall assembly, a structure defining a stock inlet chamber communicating through the rear wall assembly, structure defining a stock outlet chamber communicating through the front wall assembly, means defining a central flow passage between the horizontal structures from the rear wall assembly to the front wall assembly, and a plurality of parallel and vertical guide vanes in the flow passage and means defining channels therebetween extending from the inlet chamber to the outlet chamber, each said vanes being generally rectangular and having a pair of vertical edge portions and a pair of horizontal edge portions, the improvement comprising:

a. each vane having a first key projecting horizontally outward and away from one of the vertical edge portions of each vane;

b. each vane having a second key projecting horizontally outward and away from the other of vertical edge portions of each vane;

c. a first horizontal shelf projecting from one of the vertical wall assemblies toward the central flow passage and defining a first keyway between the first shelf and one of the horizontal structures;

d. a second horizontal shelf projecting from the other of the vertical wall assemblies toward the first shelf and defining a second keyway between the second shelf and one of the horizontal structures; and

e. the first key projecting into the first keyway and the second key projecting into the second keyway to support each vane of the plurality of vanes between the front and rear wall assemblies to thereby provide support for the horizontal flow passage defining vanes between the front and rear vertical wall assemblies.

2. In a headbox according to claim 1, wherein said means defining channels between said guide vanes includes spacers between adjacent vanes of said plurality of vanes with each spacer having a first key projecting into the first keyway between a pair of vane first keys, each spacer having a second key projecting into the second keyway between a pair of vane second keys, and each spacer having a midportion between its first and second key with said spacer midportion projecting vertically a predetermined distance into the flow passage and providing a horizontal surface cooperating with adjacent vanes to define the channel between the vanes.

3. In a headbox according to claim 2, horizontal structure above and below the vanes and spacers defining a chamber for containing pressurized fluid for loading the spacers against bowing away from the flow passage due to pressure of pulp stock within the flow passage.

4. In a headbox for a papermaking machine having a vertical front wall assembly, a vertical rear wall assembly, a structure defining a stock inlet chamber communicating through the rear wall assembly, structure defining a stock outlet chamber communicating through the front wall assembly, means defining a central flow passage between the horizontal structures from the rear wall assembly to the front wall assembly, and a plurality of parallel and vertical guide vanes in the flow passage and means defining channels therebetween extending from the inlet chamber to the outlet chamber, each said vanes being generally rectangular and having a pair of vertical edge portions and a pair of horizontal edge portions, the improvement comprising:

a. each vane having a first pair of vertically spaced keys each projecting horizontally outward and away from one of the horizontal edge portions and one of the vertical edge portions of each vane;

b. each vane having a second pair of vertically spaced keys each projecting horizontally outward and away from one of the horizontal edge portions and the other of the vertical edge portions of each vane;

c. a first pair of vertically spaced horizontal shelves projecting from one of the vertical wall assemblies toward the central flow passage and defining a first pair of keyways between each of the first pair of shelves and an adjacent one of the horizontal structures;

d. a second pair of vertically spaced horizontal shelves projecting from the other of the vertical wall assemblies toward the first pair of shelves and defining a second pair of keyways between each of the second shelves and an adjacent one of the horizontal structures; and

e. each of the first pair of keys projecting into one of the first keyways and each of the second pair of keys projecting into one of the second keyways to support each vane of the plurality of vanes between the front and rear wall assemblies to thereby provide support for the horizontal vanes between the front and rear wall assemblies.

5. In a headbox according to claim 4, wherein said means defining channels between said guide vanes includes spacers between adjacent vanes of said plurality of vanes along both horizontal edge portions thereof with each spacer having a first key projecting into one of the first keyways between a pair of vane first keys, each spacer having a second key projecting into one of the second keyways between a pair of vane second keys, and each spacer having a midportion between its first and second key with said spacer midportion projecting vertically a predetermined distance into the flow passage and providing a pair of facing horizontal surfaces between adjacent vanes, with the facing horizontal surfaces providing a channel floor and channel ceiling cooperating with adjacent vanes to define a channel therebetween of rectangular cross section extending horizontally the length of the vanes and spacers.

6. In a headbox according to claim 5, horizontal structures defining the box floor and top each further defining a chamber below and above, respectively, the flow passage for containing pressurized fluid for loading the spacers against bowing downwardly and upwardly away from the flow passage due to pressure of pulp stock within the flow passage.

7. In a headbox according to claim 4, the front wall assembly comprising a first member and a second member on the stock outlet side of the first member with the second front wall member being movable vertically relative to the first front wall member, one shelf of the first pair of shelves being connected to the second front wall member and movable therewith, a screw operatively connected to the first and second front wall members for moving the second front wall member and the shelf connected thereto vertically away from the vanes to eliminate clearance between the shelf and the upper key of the first pair of vertically spaced keys so that when the headbox is pressurized vertical tension is applied to the vanes between the first pair of vertically spaced vane keys.

8. In a headbox according to claim 4, the rear wall assembly comprising a first member and a second member on the stock inlet side of the first member with the second rear wall member being movable vertically relative to the first rear wall member, one shelf of the second pair of shelves being connected to the second rear wall member and movable therewith, a screw operatively connected to the first and second rear wall members for moving the second rear wall member and the shelf connected thereto vertically away from the vanes to eliminate clearance between the shelf and the upper key of the second pair of vertically spaced keys so that when the headbox is pressurized vertical tension is applied to the vanes between the second pair of vertically spaced vane keys.

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