

[54] **HEADBOX OF A PAPER MAKING MACHINE HAVING MULTIPLE, VERTICALLY INCLINED VANES**

[75] Inventors: **Jouni Koskimies; Kauko Heinanen**, both of Jyvaskyla, Finland

[73] Assignee: **Valmet Oy**, Helsinki, Finland

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[51] Int. Cl. .... **D21f 1/02, D21f 1/06**

[58] Field of Search ... **162/343, 336, 216, 380, 344, 162/342, 338**

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Primary Examiner—Robert L. Lindsay, Jr.

Assistant Examiner—Richard H. Tushin

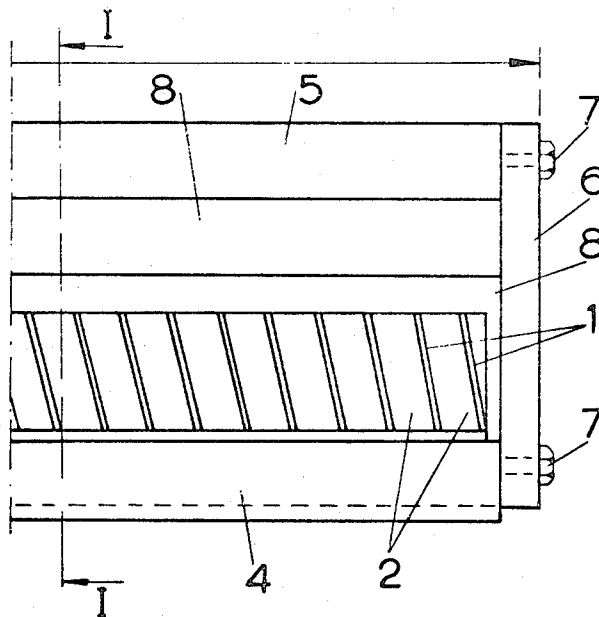
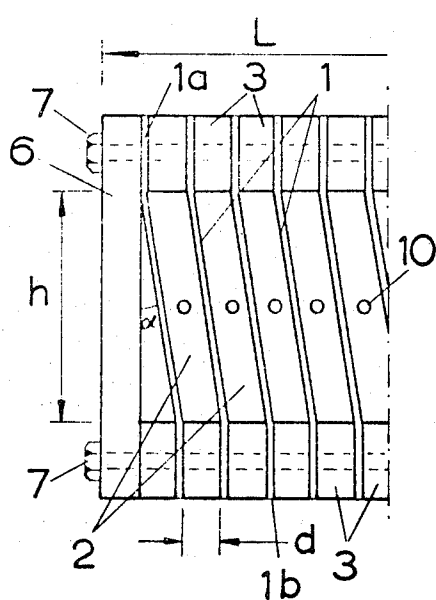
Attorney, Agent, or Firm—Richards & Geier

[57]

### ABSTRACT

In a headbox of a paper making machine flow resistance is used to provide a pressure drop required for rendering uniform the flow velocity profile and for homogenizing paper pulp slurry. The flow resistance is produced by employing vanes extending parallel to the flow and dividing the headbox into flow channels having a small cross sectional area and a large friction surface area. The invention is particularly characterized in that the vanes are inclined in relation to a vertical plane and have vertical extensions. The vanes are spaced apart a distance such that the height of each flow channel is substantially greater than the width.

**7 Claims, 3 Drawing Figures**



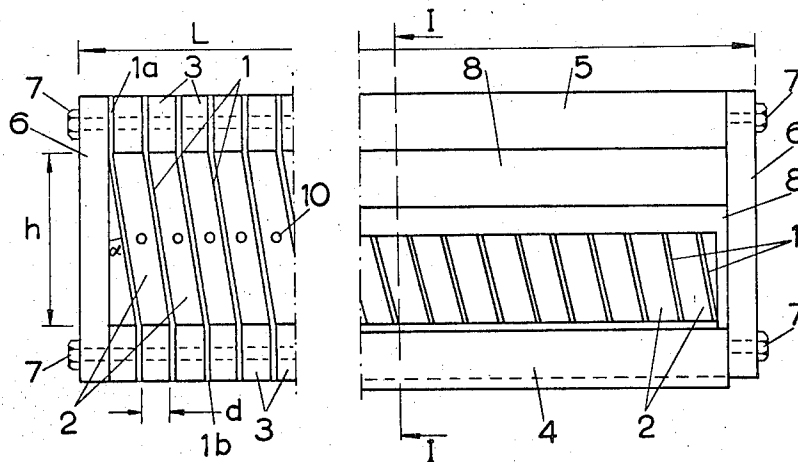


FIG. 1

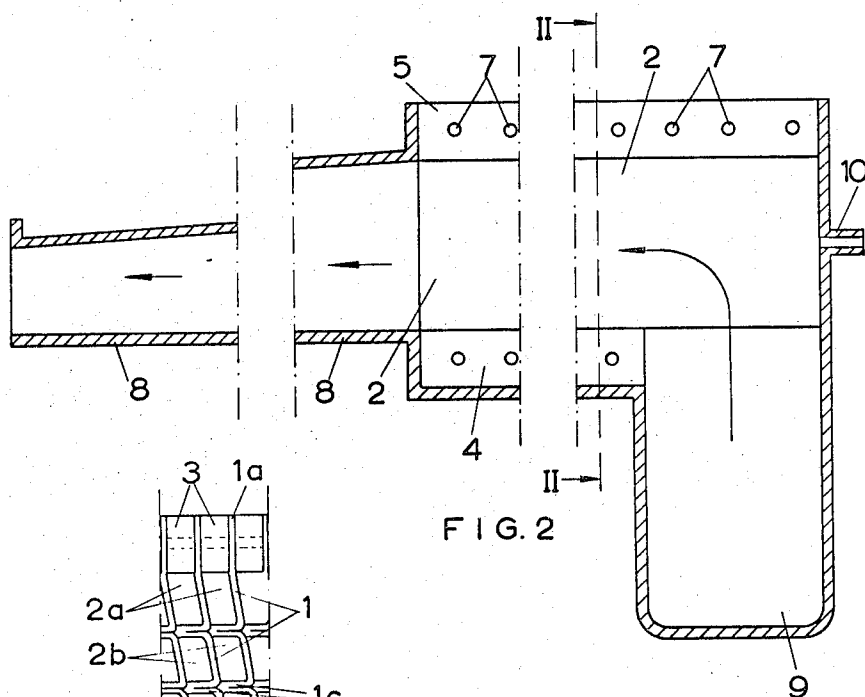


FIG. 2

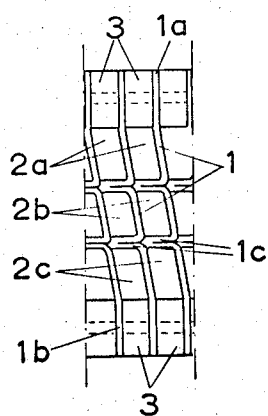


FIG. 3

# HEADBOX OF A PAPER MAKING MACHINE HAVING MULTIPLE, VERTICALLY INCLINED VANES

This invention relates to a headbox in a paper making machine, wherein the pressure drop required to equalize the velocity profile of the flow through the headbox and for homogenizing the paper slurry has been achieved by a resistance to flow which has been produced by dividing the headbox by partitions paralleling the flow into flow ducts having a small cross sectional area and a large friction area.

In prior art headboxes an attempt was made to equalize the flow velocity profile and to homogenize the pulp slurry by placing after the inlet pipe system one or several flow resistances causing a loss of pressure. The task of these resistances is to correct those faults which occur in the flow supplied by the input pipe system; such faults include, for example, differences in pressure and flow rate in the direction across the headbox and fiber accumulations in the pulp slurry itself. The usual solution is to place within the headbox one or several perforated rolls in such manner that the pulp slurry on its flow path from the input portion to the discharge portion, or the so-called slice aperture, is compelled to pass through these rotating rolls. These rolls cause in the pulp slurry flow a specific pressure drop and they produce turbulence on a small scale. The result is either partial or complete correction of the faults in the inlet part and dispersion of the fiber aggregations, or so-called flocks, if any, whereby the quality of the paper is improved.

Perforated rolls serve their purpose fairly well if they have been properly designed and if appropriate speeds of rotation and directions are chosen for them. However, these rolls involve such great difficulties of design and manufacture in the case of paper machines with a great width, and their operation is highly sensitive to errors in control, so that designers have been compelled to look for other devices constituting solutions by which the same aims might be attained. This has led to a headbox type wherein either all perforated rolls or a part of them have been replaced by a stationary bundle of pipe, appropriate choice of the diameter of an individual pipe and of the pipe length enabling pressure drops of desired magnitude to be obtained, whereby desired effects upon the pulp flow passing through the pipes are achieved.

As far as design is concerned, no difficulties are encountered in connection with such structures even in paper machines of great width, and they are not dependent on errors incurred by the persons operating the machine. As regards the manufacturing process, on the other hand, these pipe batteries are comparatively difficult to shape, which implies high manufacturing costs. Functionally, these designs have the drawback that the flow emerging from a round pipe, upon its discharge, is required to assume a rectangular cross section. This causes harmful turbulence and improprieties in the velocity profile immediately before the slice, and these disturbances are not followed by any equalizing elements.

In order to avoid these disturbances of flow, pipe bundles causing pressure drops have been built into headboxes of tubing having a rectangular cross section, but even greater difficulties than before have then been experienced with regard to the manufacturing of the pipes themselves and of achieving sufficient surface

smoothness, particularly at the seams, at reasonable cost.

Vertical partitions situated in the same plane, which are known in prior art, caused streaking of the paper because when the pulp slurry flows along such channels, water that is present in the pulp is separated to run closest to the walls of the channels. Since the areas poor in fibers are vertical and, moreover, in channels lying vertically over each other these areas coincide, this causes vertical streaks containing less fiber in the flow deposited on the wire and corresponding defects in the completed paper.

The same difficulties have also been encountered when the flow duct of the headbox has been divided by vertical partitions, parallel to the flow, into a number of channels lying side by side. Here the primary aim has been to prevent the establishment of a transversal flow within the headbox, and perforated rolls of the described type have been used in addition.

An object of the present invention is to provide a headbox design wherein the functional defects and process difficulties described above have been eliminated.

Other objects of the present invention will become apparent in the course of the following specification.

In carrying out the objectives of the present invention it was found desirable to provide a combination wherein partitions having a vertical extension equalling that of the flow channels are in a tilted position with reference to the vertical plane and wherein the ratio of adjacent sides in the cross section of the flow channels is substantially different from unity i.e., the partitions or vanes are spaced apart such that the flow channels therebetween have heights greater than their widths. This structural design solution avoids all functional, structural and manufacturing difficulties stated above. Since in the device according to the present invention channels with approximately rectangular cross section are used, the flow trouble associated with round pipes, which was described above, does not occur on their discharge side. Harmful, large vortices do not occur because the vortex size is restricted in practice by the smaller wall distance of the channel. On the other hand the pressure losses caused by the system of lamellae can be limited so as to be reasonable, while this may become difficult in the case of round or square channels. The pressure drop incurred in a channel having, according to the present invention, a side ratio appreciably differing from unity is only approximately half of the losses in a round or square pipe. Consequently the lamellated part may have almost the total length of the headbox, whereby it is highly rigid against deformations. On the other hand, when these rectangular channels having a small cross section area are formed by the aid of separate side walls placed beside each other, and the spacing of which is furthermore adjustable as desired by the aid of separate spacers, a headbox thus made is rather advantageous both as regards its construction and its manufacturing process. To this is added the fact that the flow resistance causing pressure loss requires no control measures to be carried out by the operator of the machine. Since the side walls have been placed obliquely with respect to the vertical plane, the above-described longitudinal streaks in the vertical plane at the side walls of the channels are eliminated, and any streaks poor in fiber which may still be

formed are distributed to overlap uniformly over the entire width of the web.

Some of the other advantages resulting from the device of the present invention are as follows:

Due to its fairly high flow channel losses, the headbox provides a uniform flow profile in spite of small, invariably present differences of pressure on the inlet side.

Nacro-turbulence in the headbox is eliminated, although it still ensures good mixing by means of micro-turbulence.

The headbox makes it possible to exercise control of the basis weight profile not only by means of the usual edge strip at the slice but also by means of consistency profile adjustment, if certain channels, as may be desired, are provided at their initial ends with water in adjustable quantity for dilution of the pulp slurry in them.

It is possible to divide the pulp slurry in vertical direction into several layers, for the purpose of feeding different kinds of pulp into different layers. Sufficiently close spacing of the side wall plates of the channels, together with the vertical angle of inclination, eliminates the streakiness of the completed paper.

As far as the design and manufacturing technique are concerned, the following advantages result from the present invention:

The structure is rigid and insensitive to deflections and bending caused by temperature differences and differential pressures.

The structure can be largely composed of elements, which can be assembled to form a box of desired width. In this box it is easy to achieve the desired kind of friction surface, in order to obtain a given, desired pressure loss.

The design is light, inexpensive and easy to assemble, as compared to prior art headboxes.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing showing by way of example only, preferred embodiments of the inventive idea.

In the drawing:

FIG. 1 shows a headbox of the present invention partly as a side view of its discharge end and partly as a section along the line I—I of FIG. 2.

FIG. 2 is a longitudinal section of the same headbox along the line II—II of FIG. 1.

FIG. 3 is a diagram illustrating an embodiment wherein the channels are divided into partial channels in the direction of their weight.

FIG. 1 shows a plurality of narrow flow channels 2 defined by side walls or vanes 1, which extend longitudinally to the machine and have a small cross section area, their width  $d$  being about 5 to 20 mm and their height  $h$  about 50 to 100 mm. The width of these flow channels is determined by spacers 3, which at the same time constitute the bottom 4 and top 5 of the headbox. The side walls 6 of the headbox are joined with the bottom 4 and top 5 by means of long tie bolts 7, which extend over the entire width  $L$  of the headbox, whereby the assembly of the body of the headbox is rendered quite easy. Associated with the body of the headbox are the pulp inlet part 9 and the pulp discharge part 8, which may be provided with known control elements of the slice portion. The inlet part 9 is also provided with

water supply connections 10, of which there is at least one for each flow channel 2. From these water connections it is possible to supply diluting water to such points as may be required, in order to control the consistency profile.

The flow channels 2 consist of spaces defined by the side walls 1. According to the present invention, the side walls 1 are arranged to have an oblique position with reference to the vertical plane. This oblique position is most appropriately obtained by making the angle of inclination  $\alpha$  of the side walls 1 with reference to the vertical plane at least so large that  $\tan \alpha = d/h$ , where  $d$ =width of the spacer 3 and of the flow channel 2, and  $h$ =height of the flow channel 2. This tilting of the side walls 1 provides that the effects of the streaking caused by the side walls 1 are eliminated in the finished paper.

The side walls 1 are preferably made of sheet metal which has been ground to have an appropriate surface smoothness, and on both edges of which planar fixing portions 1a and 1b have been provided, separated by bends and which have been angulated from the plane of the side walls 1 to the amount of the angle  $\alpha$ ; upon their fixing with the tie bolts 7, each wall is held between each two spacers 3.

In the embodiment shown in FIG. 3 the flow channel 2 has been divided by the use of partitions 1c substantially parallel to the horizontal plane and to the direction of flow into three partial channels 2a, 2b and 2c. The number of these partial channels 2a, 2b and 2c may be two or more. The use of partitions 1c renders the side walls 1 more rigid and also enables this type of headbox to be used for manufacturing a multi-layer web by introducing different kinds of pulp into the partial channels 2a, 2b and 2c. The partitions 1c are preferably produced from the same continuous sheet of which the side wall 1 is made by folding this sheet double to form the partitions 1c connected with the side wall in question.

What is claimed is:

1. In a paper making machine, a headbox having a top wall and a bottom wall and side walls, and including vanes extending from the top wall to the bottom wall and dividing the interior of the headbox into a plurality of flow channels, said vanes being inclined to a vertical plane, said vanes being spaced apart such that the height of each flow channel is substantially greater than its width.

2. A headbox in accordance with claim 1, comprising spacers, said vanes consisting of sheet material and having planar bends fixed in spaced relationship to said spacers to form said vanes, said spacers constituting the top wall and bottom wall of each flow channel extending parallel to a horizontal plane.

3. A headbox in accordance with claim 2, comprising tie bolts extending the entire width of the headbox through said side walls, said spacers and said planar bends, said spacers and said planar bends constituting the bottom wall and top wall of the headbox.

4. A headbox in accordance with claim 2, comprising inner partitions connected with said vanes and extending parallel to the horizontal plane, said partitions dividing said flow channels in the vertical direction into a plurality of additional flow channels.

5. A headbox in accordance with claim 4, wherein said inner partitions consist of folded bends constituting parts of the vane sheets.

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6. A headbox in accordance with claim 1, comprising an inlet portion and water supply connections communicating with said inlet portion.

7. A headbox in accordance with claim 1, wherein the angle of inclination  $\alpha$  of the vanes with reference

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to the vertical plane is such that  $\tan \alpha \geq d/h$ , wherein d is the width of a flow channel and h is the height of the flow channel.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,791,918 Dated February 12, 1974

Inventor(s) JOUNI KOSKIMIES, ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet, insert --[30] Foreign Application  
Priority Data      Finland      748/71      Mar. 16, 1971

Signed and sealed this 6th day of August 1974.

(SEAL)  
Attest:

McCOY M. GIBSON, JR.  
Attesting Officer

C. MARSHALL DANN  
Commissioner of Patents