

A DEVICE FOR FEEDING FIBROUS AEROSUSPENSION ONTO FORMING WIRE OF PAPER-MAKING MACHINE

FIELD OF THE INVENTION

The present invention relates to devices for making various types of paper from fibrous materials by an aerodynamic method, and, more particularly, to a device useable in the papermaking industry for feeding a flow of fibrous aerosuspension onto a forming wire.

BACKGROUND OF THE INVENTION

The aerodynamic method of papermaking can be schematically divided into the following major stages: grinding the fibrous material, its dispersing (i.e., separating the ground material into separate fibers and forming an aerosuspension of the fibers), forming a layer of fibers on a forming wire, pressing, and drying. To make the paper web leaving a paper-making machine uniform in thickness and width, the uniformity of the fibers being laid onto the forming wire must meet high requirements. This is especially difficult to achieve when making a wide paper web. To maintain a high production rate of the process in this instance, several devices (i. e., dispersers) for separating fibrous material into separate fibers are used for feeding flows of aerosuspension to an apparatus that forms a single flow of aerosuspension with a uniform distribution of fibers across the width of the web being formed.

Devices for dry-forming of paper web from an aerosuspension of fibrous material are known. One such device comprises a chamber with a perforated bottom that houses a rotor with a shell and brushes. The chamber features inlet and outlet connections, and includes a concentrator

mounted on the inlet connection. See, for example, USSR Author's Certificate No. 1110845, 3 D 21 H 5/26, published 08/30/84, Information Bulletin No. 32. The body of the concentrator is radially bent in the feeding direction from the feeding side and is equipped with a waste-collecting
5 bunker mounted on its larger radius wall; the above body also features a partition dividing it into two sections used for transporting a flow of fibers and removing the air, said partition being erected on the side of fibers output. The air-removing section is equipped with a number of separating blades. The concentrator features an additional section mounted on the
10 side from which the fibrous aerosuspension is fed and equipped with a turning baffle.

When the aerosuspension flow enters the concentrator, the latter removes large particles into a waste collector and separates the aerosuspension flow into a concentrated fiber flow and an airflow. The air
15 is removed and the aerosuspension flow is fed to the rotor with brushes. An additional destruction of fiber flakes occurs, when the brushes interact with the perforated bottom. The separated fibers pass through perforations in the bottom and are deposited on the forming wire. However, since the dispersing body represented by the rotor with brushes is located directly
20 next to the forming wire, the structural uniformity of produced paper web is disturbed because the amount of fibrous aerosuspension passing through the openings in the chamber bottom in a unit of time cannot be accurately controlled. This device is also unable to produce a uniform aerosuspension flow for making a wide paper web at an increased rate of aerodynamic
25 forming process in general, i.e., to converge flows from several dispersers

into a single aerosuspension flow with a uniform distribution of fibers across the width of the formed web.

Another device for dry web forming comprises a cylindrical fiber feeding pipe with a longitudinal slot used for feeding dispersed fibers onto a continuous forming wire. See, for example, USSR Author's Certificate No. 1154400, 4 D 21 H 5/26, published 05/07/85, Information Bulletin No.17. The slotted section of pipe is tapered in the direction of wire motion. The pipe is set at an angle less than 90° relative to the wire axis, and its inclination angle is adjustable. The pipe is equipped with a means for uniform distribution of fibers across the wire width that is in the form of a set of slotted rings mounted along the pipe, with each ring featuring a catch. Suction boxes are placed beneath the wire to provide a controlled vacuum generation. A uniform deposition of fibers across the wire width requires deposition of the same number of fibers per unit of pipe length onto the wire at the beginning and the end of the slot. This condition is provided by the pipe tapering. The adjusting rings controlling the degree of opening of the slot at any spot along the pipe length are used for fine adjustment of the flow. The described device is simple in design, though a lot of labor is consumed in adjusting the device to different forming rates in each specific case. Moreover, the device is unable to provide a uniform flow of fibers from several dispersers.

A device for defibration of fibrous materials believed to be closest to the invention claimed is described in USSR Author's Certificate No. 746007, 2 D 21 D 1/34, published 07/07/80, Information Bulletin No.25. This device comprises a cylindrical body, a rotor, and a stator designed as

concentric nested pipes with disk-carrying partitions. The partitions and disks form ring-shaped channels extending along the body axis, through which a fibrous aerosuspension from individual dispersers is fed. Coaxial slotted rings are fixed on both sides of the disks. The rotor comprises two support disks resting on the outer pipe of the stator with their bearings. The support disks are interconnected with blades fixed along their periphery, thus forming a fan. The fan blades feature rotor disks attached to them. The disks carry concentric slotted rings on both of their sides. The concentric rings of the rotor are coaxial with the concentric rings of the stator. A sieve is mounted around the rotor at a certain distance therefrom.

The device is equipped with connectors for feeding and removing the fibrous aerosuspension. The device combines a dispersion function and generation of an aerosuspension flow with uniform distribution of fibers across the width of the formed web. Aerosuspension flows from individual dispersers are fed through the channels into the rotor. The flow driven by the rotor blades collides with the rotating rings of the rotor and stationary rings of the stator in an alternating manner, which determines the process of dispersion.

The fully dispersed fibers are fed through the sieve inside the device where they pass through an opening in the bottom section of the body onto the forming wire of a paper-making machine. Such a design provides for a uniform deposition of fibers across the wire width and thus allows one to manufacture paper-making equipment having practically any acceptable width required for papermaking. However, as stated above, combining the functions of dispersion and distribution of fibrous aerosuspension across

the width of the forming wire decreases the structural uniformity of the formed web and makes the design of the whole device much more complex. The presence of a sieve causes a substantial drop in the device's production capacity.

5 SUMMARY OF THE INVENTION

Accordingly, the present invention provides a device that can enhance the structural uniformity of the formed paper web, while being structurally simple.

According to the present invention, a device for feeding fibrous
10 aerosuspension flow onto a forming wire of a paper-making machine comprises a cylindrical body that includes a plurality of input channels for directing the aerosuspension flow out of the cylindrical body. A rotor having an external surface and an axial length is mounted within the cylindrical body. A plurality of rotor blades, each having an axial
15 dimension, are attached to the rotor in a radial disposition. Additionally, the input and output channels are located on the exterior of the cylindrical body and tangentially oriented with respect to the direction of rotation of the rotor.

According to one specific implementation of the present invention, the
20 input channels can be constructed in the form of diffusing-converging passages, that diffuse in the axial direction and converge in the radial direction, relative to the cylindrical body. Each diffusing-converging passage has a diffusion portion oriented in an axial direction relative to the cylindrical body and a converging portion oriented in a radial direction
25 relative to the cylindrical body. According to such an embodiment, the

aerosuspension flow can be substantially distributed in the axial direction prior to entering the cylindrical body.

According to another embodiment of the present invention, the output channel can feature a bend at the outlet of the cylindrical body. The bend
5 functions to turn the output channel around in a direction opposite to the rotation of the rotor.

The rotor blades can be made such that their dimension along the axial direction does not exceed half ($1/2$) of the rotor's length. In addition, the blades are placed on the rotor surface preferably in alternating order to
10 improve agitation of the aerosuspension.

The location of the input channels and the output channel on the exterior of the body and tangential to the direction of the rotation of the rotor provides for a free feed of aerosuspension flows from several dispersers into an active agitation zone generated in the cylindrical body by
15 the rotation of the rotor. The diffusing-converging shape of the input channels provides for an additional axial re-distribution of the aerosuspension flows entering the cylindrical body, thus accelerating the mixing process. Further, if a bend is provided at the outlet of the body, fiber clusters from the aerosuspension flow are prevented from reaching
20 the output channel and being deposited onto the forming wire. Specifically, the clusters are carried by re-circulating the flow of aerosuspension and mixed once again by the rotor. If the blades are less than half the length of the rotor and disposed in alternating order on the rotor surface, conditions for additional axial re-distribution of the aerosuspension flow are created
25 and better mixing of the aerosuspension flow is achieved. As a result, the

aerosuspension flow fed from the output channel onto the forming wire features a uniform distribution of fibers across the width of the web being formed.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Fig. 1 is a perspective view of a device for feeding fibrous aerosuspension according to an embodiment of the present invention.

Fig. 2 is a perspective view of the device for feeding fibrous aerosuspension according to another embodiment of the invention.

10 Fig. 3 is a perspective view of an embodiment of a rotor for use with the device for feeding fibrous aerosuspension.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1 and 2, the device of the present invention comprises a cylindrical body 1, input channels 2 extending tangentially in a direction of rotation of a rotor 3 having carrying blades 4 on its external surface, and an output channel 5. The rotor 3 has an axial length measured in a direction parallel to the rotor's axis of rotation. Each of the blades 5 has an axial dimension parallel to the axial length of the rotor 5. Preferably, the axial dimension of the blades 5 is not greater than half of the rotor's axial length. The input channels 2 can be shaped as diffusing-converging passages. Additionally, as illustrated in Fig. 2, the output channel 5 can be turned around in the direction opposite to the direction of rotation of the rotor 3 by means of a bend 6 at the outlet of the cylindrical body 1. Alternatively, the output channel 5, can be oriented in the same direction as the rotation of the rotor 3, as illustrated in Fig. 1.

Operation of the device will now be described with reference to Figs. 1-3. Fans (not shown) feed aerosuspension flows from dispersers (not shown) into input channels 2 of the device. If the input channels 2 are shaped as diffusing-converging passages, as shown in Fig. 2, the aerosuspension flows being fed converge in the direction radial to the cylindrical body 1, while expanding in its axial direction. As a result of such re-distribution, the aerosuspension flow is substantially distributed in the axial direction, and fed into the space between the body 1 and the rotor 3.

As the aerosuspension flow travels within the cylindrical body 1, it reaches an active agitation zone generated by the blades 4 disposed on the rotor 3. (See Fig. 3). The blades 4 draw a part of the entire flow into a rotating (or circulating) flow around the rotor 3. A static pressure drop created by the blades 4 generates additional circulating flows represented by inter-blade vortexes that intensify agitation of air-suspended fibers. If the output channel 5 features a bend 6, as illustrated in Fig. 2, then a turn of aerosuspension flow in the bend 6 caused by a centrifugal force prevents possible clusters of fibers from entering the output channel 5. The clusters are carried away by the circulating flow, disintegrated by the blades 4 of the rotor 3 and are mixed again.

Thus, an aerosuspension flow with a uniform distribution of fibers across the entire width of the forming wire is produced by relatively simple means. Such flow permits formation of a wide paper web of enhanced uniformity.

While this invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various
5 modifications and equivalent arrangements included within the spirit and scope of the appended claims.

**WHAT IS CLAIMED IS:**

1. A device for feeding a fibrous aerosuspension flow onto a forming wire of a paper-making machine, the device comprising:
 - a cylindrical body including a plurality of input channels for receiving the fibrous aerosuspension flow, and an output channel for directing the received aerosuspension flow out of said cylindrical body;
 - a rotor mounted within said cylindrical body, said rotor having an external surface and an axial length; and
 - a plurality of rotor blades attached to said rotor in a radial disposition, said rotor blades having an axial dimension,wherein said plurality of input channels and said output channel are located on the exterior of the cylindrical body and tangentially oriented with respect to a direction of rotation of said rotor.
2. The device of claim 1, wherein said input channels are shaped as diffusing-converging passages having a diffusing portion oriented in an axial direction relative to said cylindrical body and a converging portion oriented in a radial direction relative to said cylindrical body.
3. The device of claim 1, wherein said output channel includes a bend at an outlet of said cylindrical body, said bend turning said output channel around in a direction opposite to the direction of rotation of said rotor.



4. The device of claim 1, wherein said output channel is oriented in a direction of rotation of said rotor.
5. The device of claim 1, wherein said rotor blades are fixed in an alternating order.
6. The device of claim 1, wherein the axial dimension of said rotor blades does not exceed half of the axial length of the rotor.
7. The device of claim 1, wherein said plurality of input channels comprises two input channels.
8. A method of feeding a fibrous aerosuspension flow onto a forming wire of a paper-making machine comprising the steps:
 - receiving the aerosuspension flow from a plurality of dispersers into a feeding device;
 - 5 agitating the aerosuspension flow within the feeding device; and
 - depositing the agitated aerosuspension flow onto the forming wire.
9. The method of claim 8, wherein the step of receiving comprises a step of receiving the aerosuspension flow from a plurality of dispersers into a feeding device through a corresponding plurality of input channels of the feeding device.



10. The method of claim 9, wherein at least one input channel of the plurality of input channels includes a diffusing-converging passages having a diffusing portion in an axial direction relative to the feeding device and a converging portion in a radial direction relative to the feeding device.
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11. The method of claim 8, wherein the step of agitating comprises a step of agitating the aerosuspension flow using a rotor mounted within the feeding device, the rotor including a plurality of radially disposed rotor blades.
12. The method of claim 8, wherein the step of depositing further includes a step of passing the aerosuspension flow through an output channel of the feeding device prior to the step of depositing.
13. A device for feeding fibrous aerosuspension onto a paper-making machine forming wire comprising a cylindrical body with axially extending internal input channels for feeding the fibrous aerosuspension flows, an output channel for aerosuspension flow,
- 5 and a rotor mounted inside the body, said rotor being designed as a cylinder with blades, wherein the input and output channels are located on the exterior of the body tangentially to the rotation direction of rotor, and wherein said rotor blades are fixed radially on the rotor is external surface.