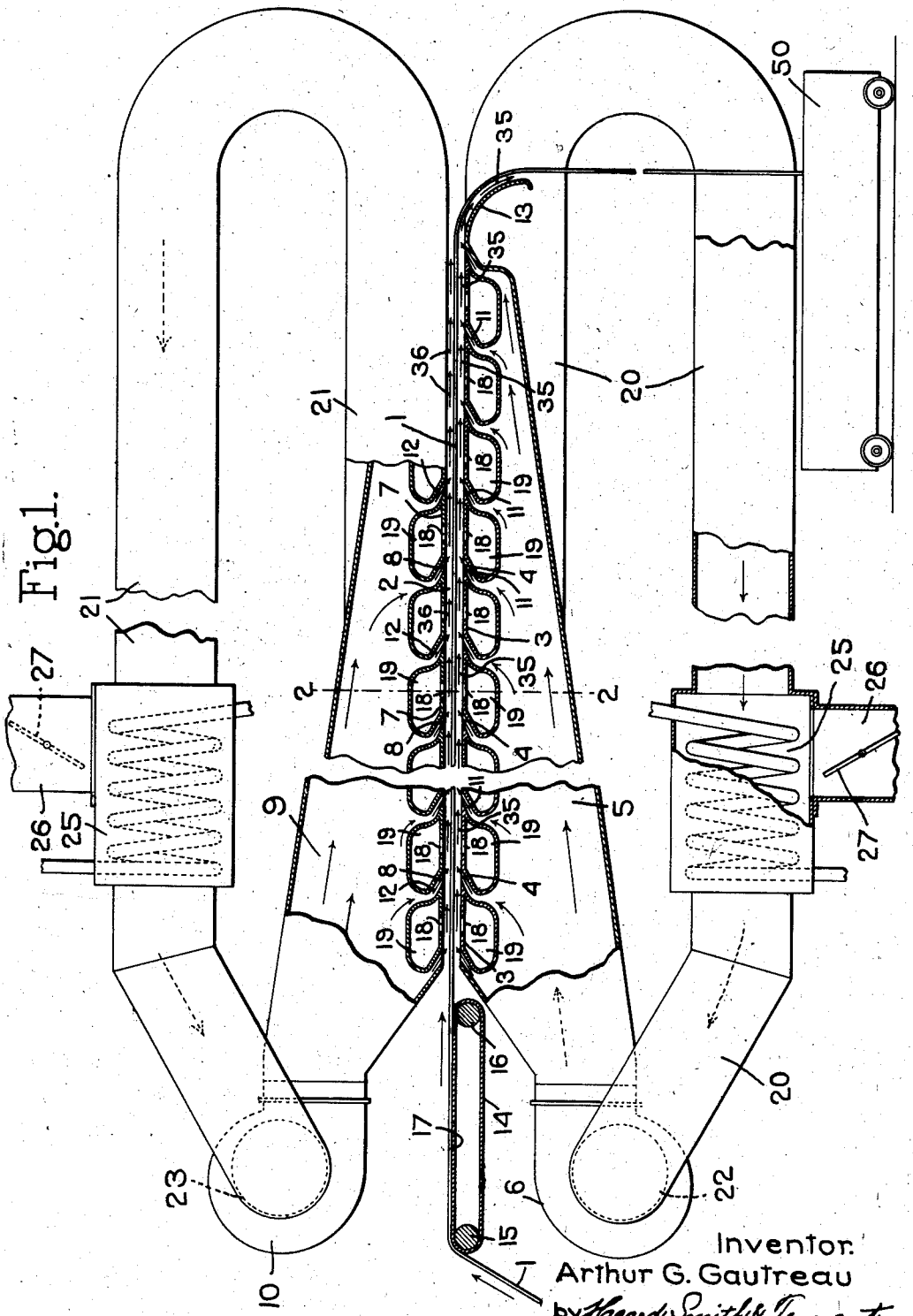
Jan. 24, 1939. A. G. GAUTREAU 2,144,919

APPARATUS FOR AND METHOD OF DRYING WEB MATERIAL

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Fig. 1.



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APPARATUS FOR AND METHOD OF DRYING WEB MATERIAL

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Fig.2.

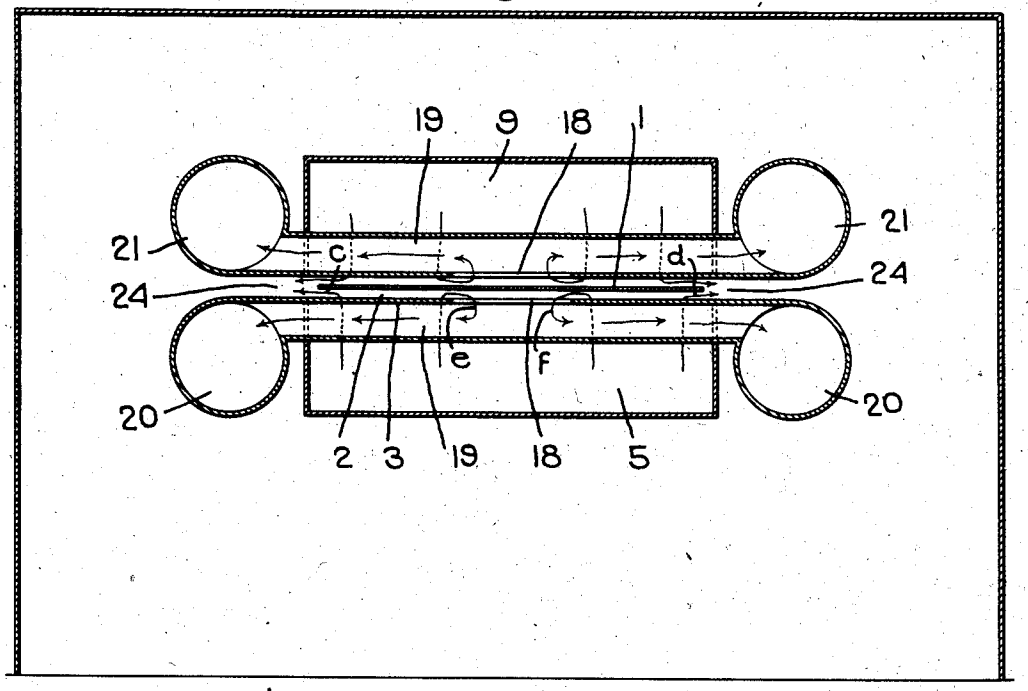
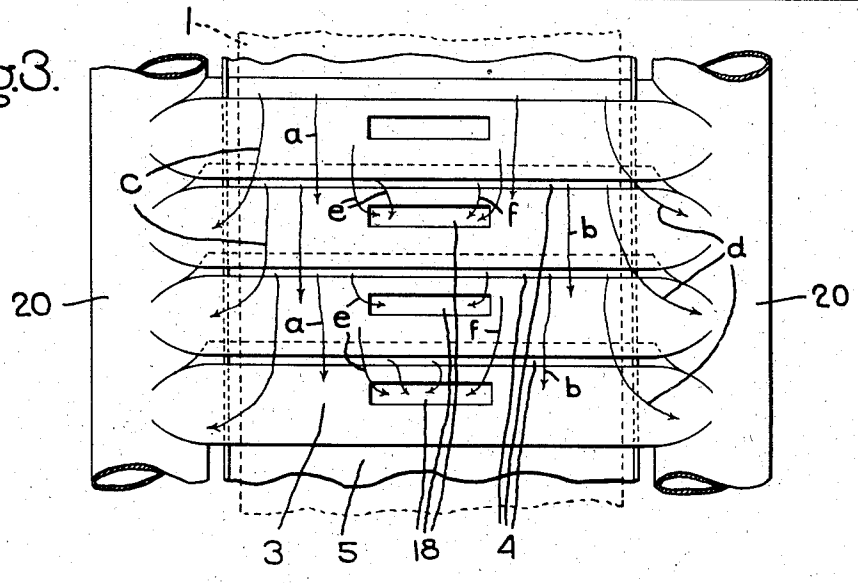


Fig.3.



Inventor.
Arthur G. Gautreau
by Hecard Smith & Tennant.
Attys.

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Fig.4.

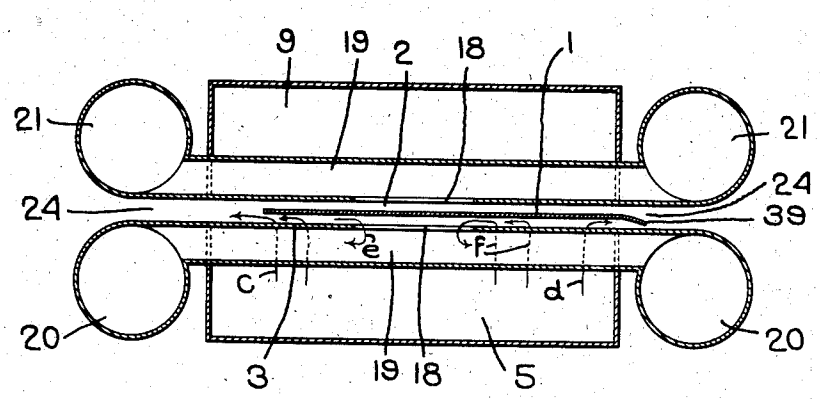
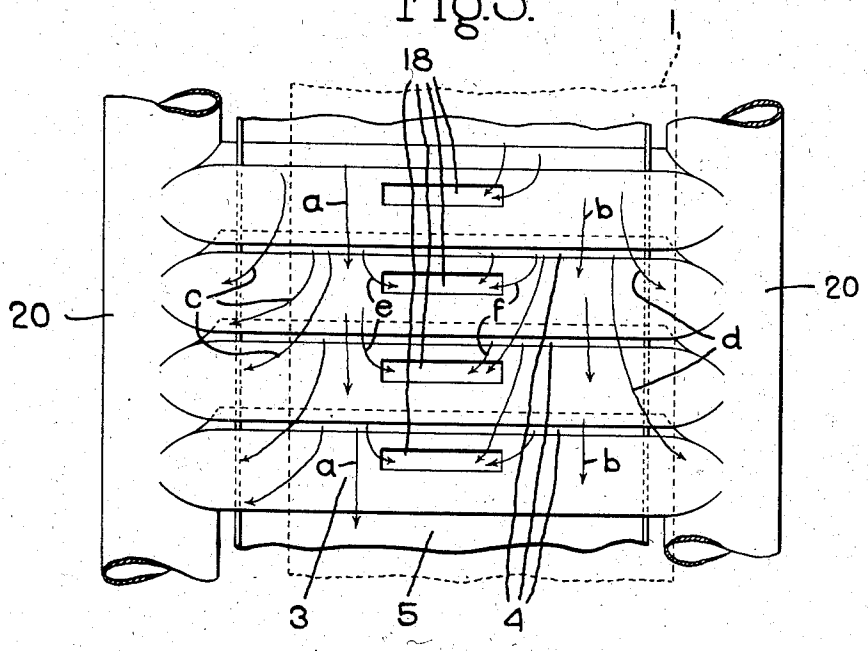


Fig.5.



Inventor.
Arthur G. Gautreau
by Heard Smith & Tennant.
Attys.

Patented Jan. 24, 1939

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APPARATUS FOR AND METHOD OF DRYING WEB MATERIAL

Arthur G. Gautreau, Quincy, Mass., assignor to Andrews and Goodrich, Inc., Dorchester, Mass., a corporation of Massachusetts

Application June 24, 1937, Serial No. 150,085

7 Claims. (Cl. 34—48)

This invention relates to drying web material and particularly to that system of drying web material according to which the material is floated on a stream or current of drying medium, the latter serving not only to dry the web material but to support it during the drying operation.

One of the advantages inherent in this system of drying is that since the web material is supported on the drying medium during the drying operation it will be held out of contact with any rigid supporting surfaces and thus the drying will be done without producing any marks on the web material such as might be produced if the web material were supported on hard surfaces while it was being dried.

In drying web material by the above-mentioned method the drying medium is usually delivered against the under side of the web material through nozzles in the form of slots extending transversely to the length of said material, and if the space in which the web material is floating on the stream of drying medium is open at the sides, then although there is a current of drying medium moving lengthwise of the web and on which it is supported, yet a part of the drying medium which is delivered through the slots is flowing out laterally through said open sides, and such outwardly flowing portions of drying medium apply a force to the web tending to move it transversely.

So long as the web is correctly centered the force tending to shift it transversely in one direction which is applied thereto by the portions of the drying medium flowing outwardly on one side of the drying space is balanced by the force applied to the web tending to shift it transversely in the other direction by the portions of the drying medium which flow outwardly through the other open side of the drying space. If, however, the web moves slightly off center then these two opposing forces become unbalanced, and the force tending to move the web laterally in one direction will be greater than that tending to move it in the opposite direction with the result that the web will be carried further off center.

It is one of the objects of my present invention to provide an improved drying apparatus for, and an improved method of, drying web material by which the web is floatingly conveyed through the drying space by a stream of gaseous drying medium which flows through said space from one end to the other, and by which currents are established in said stream of drying medium that apply to the web a corrective force in a lateral direction whenever the web tends to move sideways in said space as it is being floatingly conveyed by the stream. With this invention, therefore, the web of material will be automatically maintained in its central or normal position during its traveling movement through the drying space and any tendency of the web to slue sideways will be immediately corrected by the corrective force of the currents which are thus established in the flowing stream of drying medium.

Another object of my present invention is to provide an improved method of and apparatus for drying web material using the principle of floating the web material on a current of drying medium, according to which improvements the web of material will be practically tension-free both longitudinally and transversely while it is being dried and will also be delivered from the drying chamber in this tension-free condition.

In order to give an understanding of my invention I have illustrated one embodiment of the invention in the accompanying drawings which will now be described after which the novel features will be pointed out in the appended claims.

In the drawings:

Fig. 1 is a somewhat diagrammatic view partly in section illustrating one embodiment of the invention;

Fig. 2 is a section on the line 2—2, Fig. 1;

Fig. 3 is a top plan view of one set of nozzles and suction ports;

Figs. 4 and 5 are views similar to Figs. 2 and 3 but showing the manner in which the web is restored to normal position when it tends to slue sideways.

In the drawings 1 indicates the web of material which is to be dried and this web material may be either cloth, paper or any other similar material. As stated above the method involves that known principle of drying the web by floating it in or through the drying space or chamber 2 on the drying medium. For this purpose the bottom wall 3 of the drying space or chamber 2 is formed with a plurality of nozzles 4 through which drying medium is delivered against the under side of the web 1 at sufficient velocity and in sufficient volume to float the web in or through said drying space. These nozzles may be arranged to deliver jets of drying medium against the web at right angles thereto or at any other desired angle, and if the web is to be given a traveling movement through the drying space as it is floated on the drying medium then it will be desirable to have the jets directed against the underside of the web at an angle. I find excellent results are secured where the nozzles are arranged

to deliver the jets of drying medium against the web material at an angle from twenty to thirty degrees.

These nozzles 4 are shown as in the form of slots extending across the bottom wall 3 of the space and with nozzles of this construction the jet of drying medium issuing from each nozzle will have a sheet-like formation. These nozzles or slots 4 communicate with a trunk or duct 5 which is connected to the discharge end of a fan or blower 6, the latter delivering the drying medium under the desired pressure. For performing a rapid drying operation it is advantageous to have the jets delivered at a high velocity since the speed of drying of a web has a direct relation to the velocity of the drying medium flowing over or against the web.

If, however, the drying medium is issued from the nozzles at high velocity it is desirable to provide means acting on the top of the web to hold it in place and to prevent it from being blown or forced too far away from the wall 3 by the jets of drying medium issuing from the nozzle 4. One means for accomplishing this end is to provide means for directing jets of drying medium against the upper face of the web at sufficient velocity and in such volume as to hold the web in its desired relation to the lower wall 3 of the drying space 2. In the construction herein illustrated there is provided an upper wall or roof 7 for the drying space 2 which is formed with nozzles 8 similar to the nozzles 4 and through which jets of drying medium may be delivered against the upper face of the web. These nozzles 8 communicate with a duct 9 connected to the discharge end of a fan or blower 10.

The blower 6 thus delivers jets 11 of drying medium through the nozzles 4, which jets impinge against the under fact of the web 1 and merge together to produce a stream 35 of drying medium flowing over the wall 3 and on which the web is floated and by which it is conveyed through the drying space 2.

The blower 10 produces through the nozzles 8 jets 12 of drying medium which impact against the upper face of the web to merge to form a stream 36 of drying medium flowing along the roof or upper wall 7 of the drying space, and which serves to prevent the web material from contacting with said upper wall.

The blowers 6 and 10 will be so operated that the velocity and pressure of the jets 11 impinging against the lower face of the web will have such a relation to the velocity and the pressure of the jets 12 impinging against the upper face of the web that said web will be held centrally in the drying space 2 and will be floated along on and by the stream of drying medium, said stream constituting the means by which the web is moved or conveyed through the drying space.

At the delivery end of the drying chamber there is provided a curved delivery surface 13 which forms a continuation of the wall 3 and over which the stream 35 of drying medium flows as indicated by the arrows in Fig. 1. The stream of drying medium flowing over this curved surface 13 supports the web and holds it out of contact with said surface so that as the web is delivered from the drying chamber it will, as it were, ride on the stream of drying medium over but out of contact with the surface 13.

Means are provided for feeding the web 1 to the drying chamber and regulating the feed thereof, and while any appropriate means for this purpose may be employed I have herein shown a feed apron 14 which is positively driven and which is carried by two rollers 15 and 16. The web 1, which may be taken from any suitable source, passes onto the upper arm 17 of this feed apron and is carried thereby and is delivered from the feed apron into the drying space 2. The friction of the web on the feed apron is sufficient to feed the web forward, and the portion of the web which is within the drying chamber 2 is fed forward by the streams of drying medium flowing along either side of the web and produced from the jets 11 and 12. As stated above, as the web leaves the drying chamber it is carried by the stream of air flowing over the delivery apron 13. The cloth is thus fed through and delivered from the drying chamber without being subjected to any tension induced by a mechanical feeding means, and will be substantially tension-free not only during the entire drying operation but as it is delivered from the drying chamber.

As stated above, one of the difficulties encountered in the operation of drying machines of this type is the tendency of the web to slue sideways during its passage through the drying chamber especially if the drying chamber is open at the sides. My present invention provides a novel construction and novel method by which any tendency of the web to slue sideways will be counteracted by currents set up in the stream of drying medium by which the web is floatingly conveyed through the drying chamber. For this purpose the lower and upper walls 3 and 7 of the drying space 2 are provided with suction ports 18 which are situated centrally of the web, said ports being connected to a suction apparatus so that part of the currents of drying medium delivered through the nozzles 4 and 8 will be returned through the suction ports. Each suction port leads into a chamber 19 extending transversely of the web and the chambers 19 for the ports 18 in the floor 3 of the drying space 2 are connected at their ends to two ducts 20 which lead to a suitable suction apparatus, while the suction chambers 19 with which the ports in the upper wall 7 of the drying space 2 communicate are connected to other ducts 21 which also lead to a suitable suction apparatus. Any suitable suction apparatus may be employed for this purpose, but as there is some advantage in re-circulating the current of drying medium I have shown the ducts 20 as connected to the inlet ports 22 of the blower 6 and the ducts 21 as connected to the inlet ports 23 of the blower 10.

The provision of the suction ports 18 interspersed with the nozzles 4 and 8 through which the high velocity jets are delivered produces a movement of the drying medium indicated by the arrows in Figs. 2 and 3. A portion of the drying medium flows longitudinally of the drying space 2 as indicated by the arrows *a*, *b*, and since the drying space 2 is open and unobstructed at the edges as shown at 24 there will be a constant drift of a portion of the drying medium outwardly through these open sides 24 as indicated by the arrows *c*, *d*. The suction produced at the ports 18 will draw portions of the drying medium downwardly through said ports into the suction chambers 19 and this will establish currents in the drying medium indicated by the arrows *e*, *f*. The portion of the drying medium represented by the arrows *a*, *b* and which flows longitudinally of the drying space forms a stream on which the web is floatingly conveyed through the apparatus. Under normal conditions when the web

1 is situated centrally in the drying space 2 there will be approximately an equal outward drift of current of the drying medium through each of the open sides 24 of the drying space as indicated by the arrows *c*, *d*, and the currents flowing outwardly through the open space beneath the web at each side serve to support the edges of the web. The currents which are established in the drying medium due to the suction at the suction ports 18, and which are indicated by the arrows *e*, *f* apply forces to the web which normally balance each other, the currents indicated by the arrows *f* tending to move the web toward the left in Fig. 2 and the currents represented by the arrows *e* tending to move the web to the right.

So long as the web remains centrally in the space these currents indicated by the arrows *c*, *d*, *e*, *f* are balanced. If, however, the web tends to move sidewise into the position shown in Fig. 4, for instance, then the extra weight of the edge 39 of the web will not be properly supported and will tend to sag, thus choking the space through which the drying medium drifts outwardly as indicated by the arrows *d*. The drying medium will always tend to flow in the direction of least resistance and any sagging of the edge 39 of the web will increase the current of drying medium represented by the arrows *f* which flow into the suction ports 18, and also result in a freer outward drifting flow of the drying medium at the left-hand open edge 24 as indicated by the arrows *c*. The currents of the drying medium indicated by the arrows *f* and *c* are, therefore, increased and the increasing of these currents tends to float the web back toward its central position.

If the web should be carried beyond its central position toward the left or should slue sideways toward the left for any cause, then the volume of the currents represented by the arrows *e* and *d* will be increased in the manner above described which will result in applying a corrective force to the web tending to float it back into central position again.

In accordance with this method, therefore, there are established in the stream of drying medium by which the web is floatingly conveyed through the drying space currents which tend to hold the web from sidewise movement and which apply to the web a corrective force in a lateral direction whenever the web tends to move sideways in the drying space.

Where the re-circulation feature is employed it is desirable that the current which is re-circulated should be heated after it has been withdrawn from the drying chamber and before it is returned thereto, and for this purpose I propose to employ heaters 25 in the return ducts 20, 21. Each heater is provided with an intake 26 open to the atmosphere which is controlled by a suitable valve 27. By manipulating these valves 27 the degree of suction produced by the fan may be regulated to secure the desired result.

I claim:

1. An apparatus for drying web material having a wall forming the bottom of a drying space which is open at its sides and through which the web may pass in the direction of its length, said wall having a plurality of nozzles for delivering the drying medium against the under face of the web, each nozzle extending from one side to the opposite side of said space and being so shaped and disposed as to deliver its jet of drying medium against the web at an acute angle and in a direction in which the web is moving, said wall also having suction ports interspersed with the nozzles and situated in a row along the center line of said drying space, suction ports being relatively short as compared with the nozzles in a direction transversely of the direction of movement of the web means to produce suction at said suction ports, and means to deliver jets of drying medium through said nozzles thereby forming a stream of drying medium flowing through said space on which the web is floated and conveyed through said space in the direction of its length, portions of said stream being drawn downwardly through the suction ports and portions flowing outwardly through said open sides whereby there is set up within said stream currents of drying medium which apply to the web a corrective force in a lateral direction whenever said web tends to move sideways in said space.

2. An apparatus for drying web material having a wall forming the bottom of a drying space which is open at its sides and through which the web may pass in the direction of its length, said wall having a plurality of nozzles for delivering the drying medium against the under face of the web, each nozzle extending from one side to the oposite side of said space and being so shaped and disposed as to deliver its jet of drying medium against the web at an acute angle and in a direction in which the web is moving, said wall also having suction ports interspersed with the nozzles and situated in a row along the center line of said drying space, the dimension of the suction ports in a direction transversely of the web being only a fraction of the transverse dimension of said space, a curved delivery section at the delivery end of said wall and forming a continuation thereof, means to produce suction at said suction ports, and means to deliver jets of drying medium through said nozzles thereby forming a stream of drying medium which flows over said wall longitudinally of the web and over said delivery section and on which the web is floatingly conveyed through said space and over the delivery section, portions of said stream being drawn downwardly through the suction ports and portions flowing outwardly through said open sides whereby there is set up within said stream currents of drying medium which apply to the web a corrective force in a lateral direction whenever said web tends to move sideways in said space.

3. An apparatus for drying web material comprising a wall forming the bottom of a drying space which is open at its delivery end and through which space the web material may pass, said wall having a curved delivery section connected thereto at the delivery end of said space and forming a continuation thereof, and means to deliver jets of drying medium through said wall thereby to form a stream of drying medium which flows over the wall and over the delivery section, said stream supporting the web while passing through the drying space and also while flowing over the delivery section.

4. An apparatus for drying web material having a wall forming the bottom of an elongated drying space which is open and unobstructed at its longitudinal sides and through which the web may pass, said wall having a plurality of nozzles for delivering the drying medium against the under face of the web, which nozzles extend from one side to the other of said spaces and also having suction ports interspersed with the nozzles and situated in a row along the center line of said

drying space, the dimension of the suction ports in a direction transversely of the web being only a fraction of the corresponding dimension of the nozzles, means to produce suction at said suction ports, means to deliver jets of drying medium through said nozzles thereby forming a stream of drying medium flowing through said space in the direction of the length of the web on which the web is floatingly conveyed, and means for directing drying medium against the upper face of the web to maintain it in proper spaced relation with said bottom wall, portions of said stream of drying medium being drawn downwardly through the suction ports and portions flowing outwardly through said open sides whereby there is set up within said stream currents of drying medium which apply to the web a corrective force in a lateral direction whenever the web tends to move sideways in said space.

5. The method of drying web material by means of gaseous drying medium which consists in floatingly conveying the web material through a drying space by a stream of gaseous drying medium flowing through said space from one end to the other, and establishing in said stream of drying medium currents which tend to hold the web from sideways movement.

6. The method of drying web material by means of gaseous drying medium which consists in floatingly conveying the web material through a drying space by a stream of gaseous drying medium flowing through said space from one end to the other, and establishing in said stream of drying medium currents which apply to the web a corrective force in a lateral direction whenever the web tends to move sideways in said space.

7. The method of drying web material which consists in conveying the web material through a drying space solely by floating it on a stream of gaseous drying medium which is flowing through said space from one end to the other, and establishing in said stream currents which apply to the web a corrective force in a lateral direction whenever the web tends to move sideways in said space.

ARTHUR G. GAUTREAU.