Sept. 23, 1930. B. R. ANDREWS 1,776,609

DRYING APPARATUS

Filed Nov. 6, 1928 2 Sheets-Sheet 1

Fig. 1.

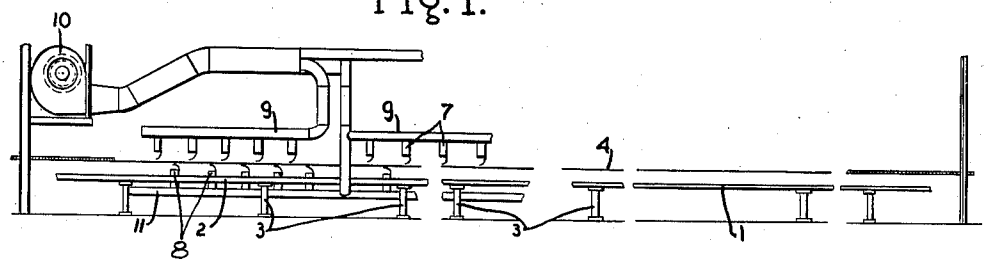


Fig. 2.

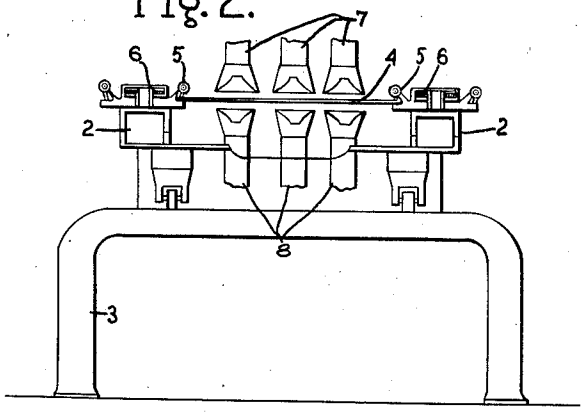


Fig. 3.

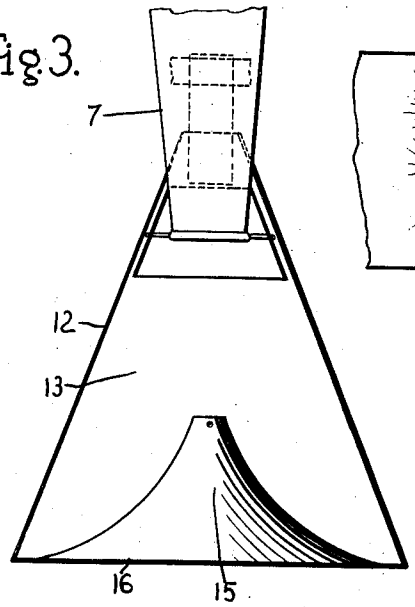
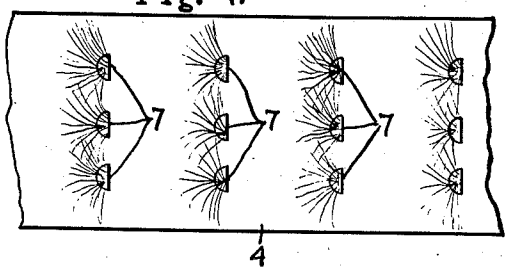


Fig. 4.



Inventor
Bernard R. Andrews
by Hard Smith & Tennant
Attys.

Sept. 23, 1930. B. R. ANDREWS 1,776,609

DRYING APPARATUS

Filed Nov. 6, 1928 2 Sheets-Sheet 2

Fig. 5.

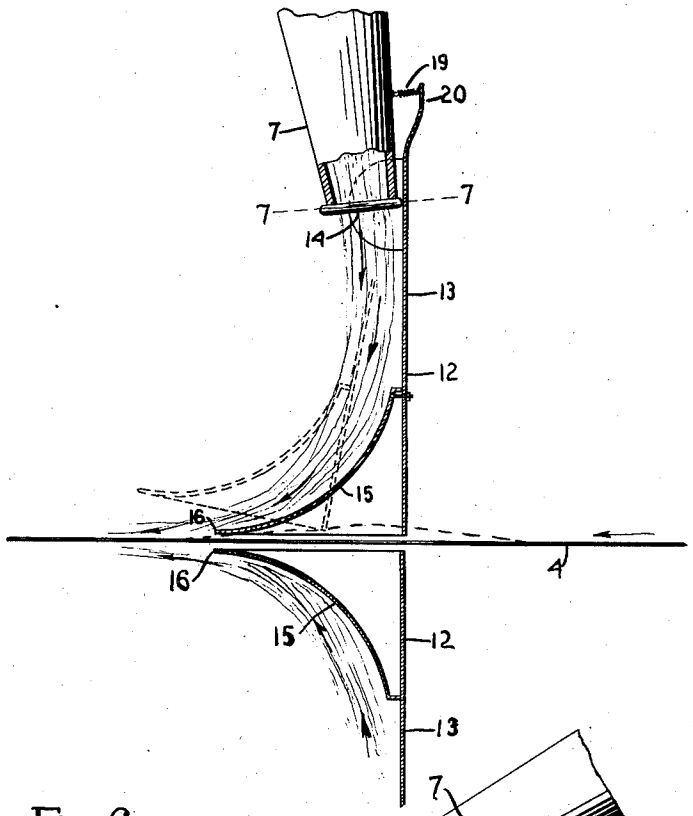


Fig. 6.

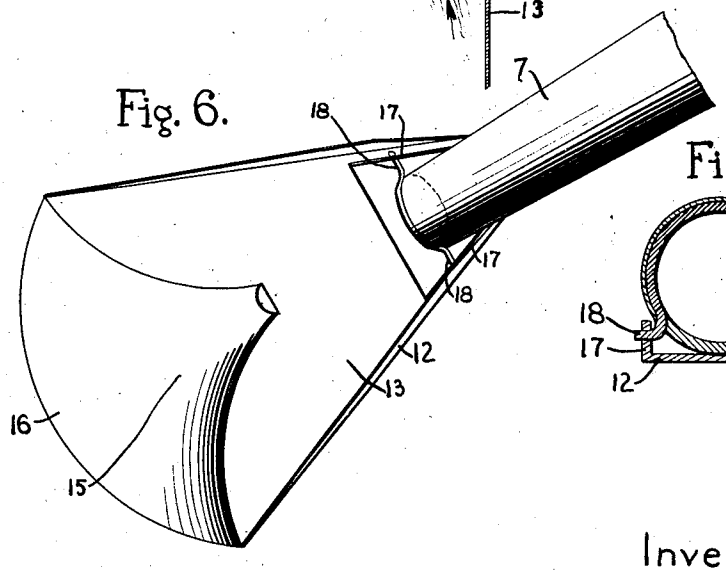
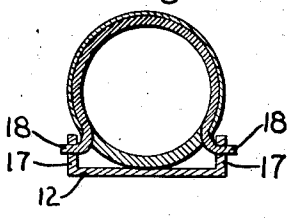


Fig. 7.



Inventor
Bernard R. Andrews
by Heard Smith & Kenyon
Attys.

Patented Sept. 23, 1930 1,776,609

UNITED STATES PATENT OFFICE

BERNARD R. ANDREWS, OF BRAINTREE, MASSACHUSETTS

DRYING APPARATUS

Application filed November 6, 1928. Serial No. 317,666.

This invention relates to drying apparatus for drying sheet or web material by directing jets of heated air against such material. In a drying apparatus of this type the drying or water-evaporating effect of the jet of heated air which is delivered onto the web material is directly proportional to the velocity of the air as it impinges on said web material and hence for rapid drying it is highly desirable that the air should be delivered to the air material at a relatively high velocity.

In the drying of web material it is the common practice to move the web material past the egress end of stationary nozzles through which heated air is being delivered so that during the movement of the web material said heated air will impinge on the heated material and thus effect the drying. It is not practical, however, to place the stationary nozzles in close proximity to the web material, especially if the latter is cloth or some flexible material because such cloth or flexible material is likely to have more or less waving motion as it is moved past the nozzles with the result that the web material is likely to catch on one of the nozzles or to engage the nozzles and thus become more or less damaged. Consequently with the stationary nozzle it has been customary to place the egress end at a distance of a few inches from the web material to avoid any likelihood of said material engaging the nozzle. The spacing of the egress end of the nozzle from the web material is, however, a detriment as the velocity of an air current issuing from a nozzle decreases rapidly in proportion to the distance from the nozzle and hence when a jet of air is delivered at a relatively high velocity from a nozzle which is situated four or six inches from the web of material the velocity of air when it reaches the web material will be very greatly reduced.

Inasmuch as the drying effect of the air is directly proportional to its velocity as it impinges on the web material the drying effect of a nozzle placed several inches from such material will be very much less than would be the case if the air could be delivered against the material at substantially the same velocity at which it left the nozzle.

Furthermore, if in drying web material such as cloth which is filled or loaded with a filling material the jets are delivered against the cloth at substantially right angles thereto there is danger that the filling material will be blown out of the cloth somewhat thus affecting its quality, especially if the air jets are delivered against the cloth at a relatively high velocity.

It is one of the objects of my present invention to provide an apparatus for drying web material by which the air may be delivered onto the web material at a relatively high velocity without any danger that either the web material or nozzle will be injured by being brought into contact with each other and also without danger that the quality of a filled web material will be impaired by the high velocity jet of air.

In carrying out my invention I have provided a novel form of nozzle in which the end from which the air jet is delivered is movable so that in case it is engaged by the moving web material during the drying operation it will move out of the way and thus prevent injury to the web material, the delivery end of the nozzle automatically returning to its normal position again.

I have also provided a novel form of nozzle by which the drying air current will be delivered to the web material in the form of a sheet moving in the general plane of the web material. A drying current of air may be delivered in this way to the web material at a high velocity without deleteriously affecting the quality of the material.

In the drawings:

Fig. 1 is a side view of a drying apparatus embodying my invention;

Fig. 2 is an enlarged sectional view on the line 2—2, Fig. 1;

Fig. 3 is a front view of one of the nozzles;

Fig. 4 is a diagrammatic view illustrating the manner in which the nozzles deliver the air to the web;

Fig. 5 is an enlarged vertical section view showing two opposed nozzles on opposite sides of a web of cloth and illustrating the manner in which the air is delivered onto the cloth;

Fig. 6 is a perspective view of one of the nozzles;

Fig. 7 is an enlarged section on the line 7—7, Fig. 5.

My invention is adapted for the drying of various kinds of web material and merely as illustrating one use to which it may be put I have shown it as it might be used in drying cloth which is supported in a tenter-frame, the cloth representing the web material to be dried and the tenter-frame representing the means for supporting it and moving it past the nozzles.

In the drawings 1 indicates generally the tenter-frame which may have any suitable or usual construction, it being illustrated as having two longitudinally-extending members 2 which are supported at suitable intervals on supports 3. The web material 4 is supported at its edges by suitable grippers 5 that are carried by endless chains 6 that are guided in ways formed in the longitudinal members 2, this being the usual construction of a tenter-frame. I wish to state, however, that the tenter-frame has been referred to merely as illustrating one form of supporting means for the web material to be dried.

The drying of the web material 4 is accomplished by air jets which are delivered onto one or both sides thereof through suitable nozzles 7 and 8. The nozzles 7 are situated above the web material 4 and are connected to a conduit 9 which extends to a suitable air-forcing mechanism indicated generally at 10. The nozzles 8 beneath the web material are directed upwardly against the under side thereof and they are connected to a suitable conduit 11 which also has communication with the air-forcing mechanism 10 so that air under pressure will be delivered against both sides of the cloth from both nozzles.

If the egress end of the nozzles 7 and 8 are fixedly secured in place it is not practical or feasible to have said ends close to the moving web material 4, especially if the latter is cloth or some other flexible material because as the cloth moves it is apt to have a more or less up and down or waving motion, especially at the leading edge when it is being introduced into the tenter-frame. If the eduction end of the nozzles is too close to the cloth there is danger that the cloth will catch on the nozzles or will engage them and thus be damaged thereby, but the placing of the egress end of the nozzles at a distance of four to six inches from the cloth has the disadvantage that the jet of air will suffer a very decided loss of velocity in traversing the distance from the end of the nozzle to the cloth and will thus lose much of its drying effect.

I have by my invention provided a novel means by which the drying jet of air may be delivered from the nozzle onto the cloth or other web material at a relatively high velocity, thus giving the maximum drying effect without danger of injuring the web material and may also be delivered in the form of a sheet extending substantially parallel to the face of the web material.

In securing these ends I propose to employ a nozzle having a movable eduction end which is constructed so that in case it is engaged by the moving web material being dried it will move out of the way to allow the web material to pass and will then automatically resume its normal position again.

By means of this construction it is possible to have the eduction end of the nozzle normally very close to the surface of the web material so that there will be no appreciable loss of velocity in the drying current of air between the time it leaves the nozzle and impinges on the web material. Furthermore, due to the special shape of the eduction end of the nozzle this drying current of air is delivered along the cloth in the form of a sheet and at a high velocity so that a maximum drying effect is produced. Moreover, since the drying current is delivered onto the web material in a direction substantially parallel to the surface thereof a high velocity of air current may be used without injuring the web material in any way as might occur if the jet of high velocity was delivered against the latter in a direction substantially perpendicular to the face thereof.

Each nozzle terminates at its eduction end in a deflector member 12, each member having a flat surface 13 extending beyond the eduction opening 14 of the nozzle, said flat surface merging into a concavely-curved fan-like deflecting surface 15. In the construction shown the body of each nozzle 7 and 8 is rigid but the deflector portion at the eduction end thereof is pivotally mounted to the fixed body so that it may swing in the general direction in which the web material is moving. The deflecting member 12 acts as a guiding member which extends from the eduction aperture 14 into close proximity to the cloth 4 and which guides the air current delivered through said eduction aperture onto the cloth.

The air current which is delivered through each nozzle will flow along the flat surface 13 and then will be deflected by the curved deflecting surface 15 in a fan-like sheet of air which is delivered over the delivery edge 16 of the nozzle in a sheet formation extend-

ing substantially parallel to the surface of the material being dried. By thus having the delivery end of the nozzle movably mounted it will easily swing out of the way in case it is engaged by the moving web material 4 as might occur if the web material was flexible material like cloth and which assumed a waving motion during its movement. Furthermore, the current of drying air will flow along the surfaces 13 and 15 and will be delivered over the edge 16 without any appreciable loss of velocity and as the surface 16 is very close to the web material 4 the air will be delivered onto the web material at substantially the velocity at which it left the nozzle.

The deflecting members 13 have been referred to as movably connected to the body of the nozzle. This may be conveniently done by pivoting them thereto and as illustrated in the drawings each deflector member is provided with ears 17 and the nozzle is provided with trunnions 18 extending through apertures in said ears.

Means are provided for normally holding each deflector member in its operative position while allowing it to swing about its pivot out of the way as shown by dotted lines Fig. 4 in case it is struck by the web material during the movement of the latter.

One convenient way would be to employ a light spring 19 for this purpose, the spring being shown in Fig. 4 as connecting the tail portion 20 of the deflector member with the body of the nozzle. While I have herein illustrated a construction in which the delivery end of the nozzle is movably mounted yet the invention is not necessarily limited to this particular construction, the essential thing being that the portion of the nozzle adjacent the web material should be movable in the direction of the length of the web material.

A device embodying my invention is not only highly advantageous for drying ordinary cloth or similar material but is of special advantage in drying web material in the form of cloth such as cloth for shades, which has been loaded with some filling material. In drying web material of this kind it is detrimental to deliver a current of air against the web material at high velocity in a direction at substantially right angles thereto because such high velocity air jets are apt to blow some of the filling material out of the cloth thus impairing its quality. With my invention, however, the high velocity air current can be used, thus speeding up the drying operation because the drying current is delivered onto the material in the form of a sheet extending parallel to the surface thereof and there is no tendency for an air current of this sort to blow the filling material out of the cloth.

I claim:

1. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward, of nozzles for delivering heated air onto the surface of the web material, each nozzle comprising a stationary body portion provided with an eduction aperture spaced from the web material, and a deflecting member pivotally connected to the body portion and extending from the eduction aperture into close proximity to the web material, the pivotal connections permitting said deflecting members to swing in the direction of travel of the web material upon engagement by the web.

2. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward, of nozzles for delivering heated air onto the surface of the web material, each nozzle having an eduction aperture spaced from the web material, and a deflecting member extending from the eduction aperture into close proximity to the web material, said deflecting surface being shaped to deliver the air onto the web material in a direction substantially parallel to the surface thereof, said deflecting portions being pivotally connected to the body of the nozzles so that the delivery end of the deflecting surface can yield in the general direction of the movement of the web material upon engagement by the web.

3. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward, of nozzles for delivering heated air onto the surface of said web material, each nozzle comprising a body portion provided with an eduction aperture spaced from the web material, and a deflecting member yieldingly connected to the nozzle body and extending from the eduction aperture into close proximity to the web material, said deflector member being shaped to deliver the air onto the web material in a direction substantially parallel to the surface thereof, and the yielding connection permitting the delivery end of the deflector member to yield in the general direction of the movement of the web material upon engagement by the web.

4. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward, of nozzles for delivering heated air onto the surface of the web material, each nozzle comprising a body portion provided with an eduction aperture spaced from the web material, and a deflecting member extending from said aperture to a point in close proximity to the web material, each deflector being shaped to deliver the heated air onto the web material in a direction substantially parallel to the surface thereof, and means for piv-

otally connecting each deflector to its nozzle body to permit the delivery end thereof to swing in the general direction in which the web material is moving upon engagement by the web.

5. In an apparatus for drying web material, the combination of means to move the web material forward, of nozzles for delivering heated air onto the surface of said web material, each nozzle comprising a body portion provided with an eduction aperture spaced from the web material and a deflecting member yieldingly connected to the nozzle body in the direction of movement of the web, and extending from the eduction aperture into close proximity to the web material, said deflector member having a flat surface merging into a concavely curved fan shaped deflecting surface, thereby to deliver a sheet of air onto the web material in a direction substantially parallel to the surface thereof.

6. In an apparatus for drying web material, the combination of means for holding said web material and moving it forward of nozzles for delivering heated air onto the surface of said web material, each nozzle comprising a body portion having an eduction aperture and a deflecting member, said deflecting member having a flat surface merging into a concavely curved fan shaped deflecting surface thereby to deliver a sheet of air onto the web material in a direction substantially parallel to the surface thereof.

7. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward of means for delivering onto said web material heated air in the form of a sheet extending substantially parallel to the surface of said material and moving at a high velocity relative to said material, comprising a nozzle having a flat surface merging into a concavely curved fan shaped deflecting surface.

8. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward, of nozzles for delivering heated air onto the surface of the web material, each nozzle comprising a body portion provided with an eduction aperture spaced from the web material, and a pivotally mounted guiding member extending from the eduction aperture into close proximity to the web material for guiding the air current from said aperture onto the web material, the pivotal mounting of each guiding member permitting it to swing relative to said body portion in the direction of travel of the web material upon engagement by the web.

9. In an apparatus for drying web material, the combination with means for holding said web material and moving it forward, of nozzles for delivering heated air onto the surface of the web material, each nozzle comprising a stationary body portion provided with an eduction aperture spaced from the web material, and a pivotally mounted deflecting member extending from the eduction aperture into close proximity to the web material, the pivotal mounting of each deflecting member permitting it to swing in the direction of travel of the web material upon engagement by the web.

In testimony whereof, I have signed my name to this specification.

BERNARD R. ANDREWS.