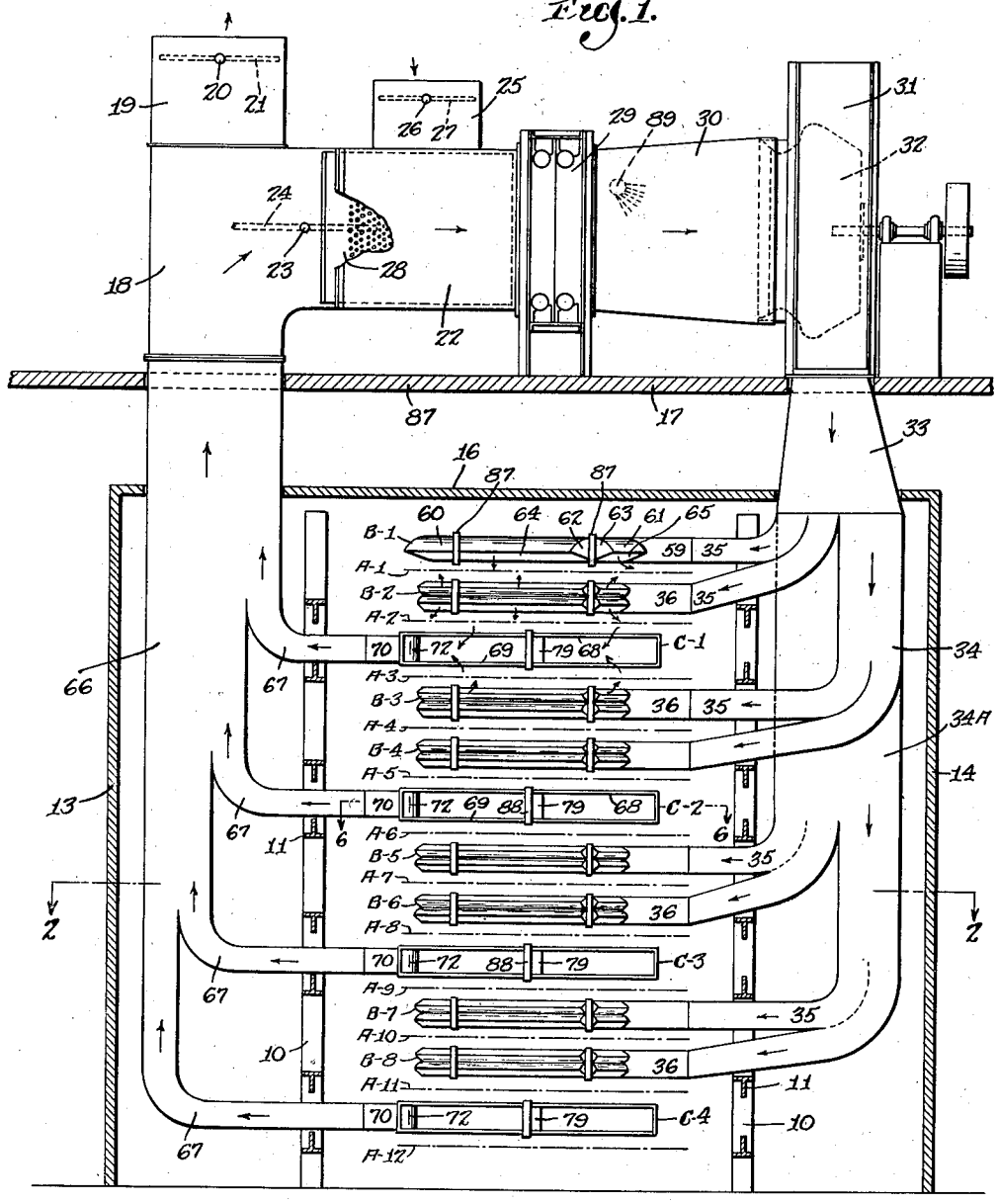
March 28, 1939. C. P. BRIDGES 2,152,238

MATERIAL TREATING APPARATUS

Filed Jan. 24, 1936 3 Sheets-Sheet 1

Fig. 1.



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MATERIAL TREATING APPARATUS

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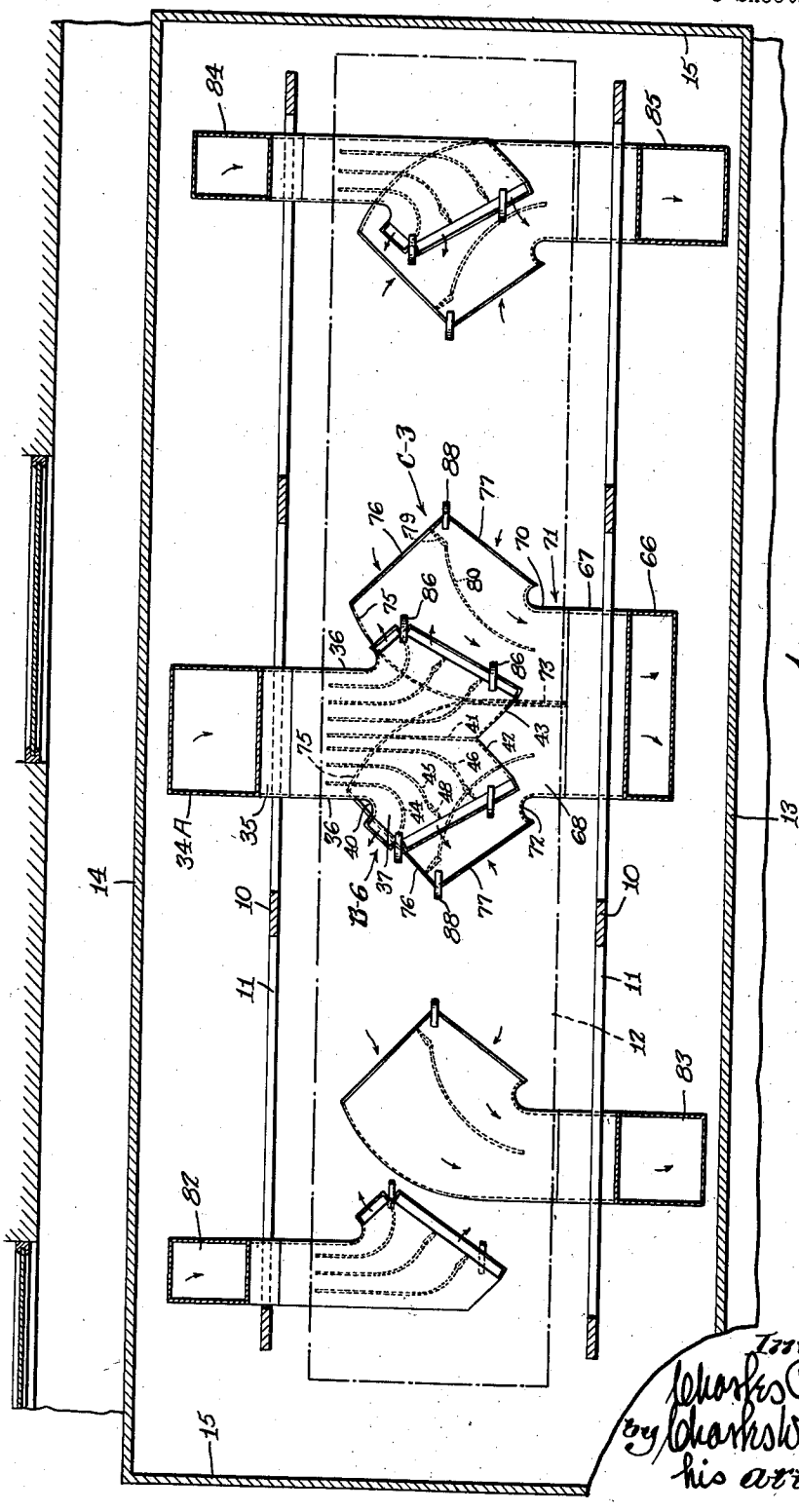


Fig. 2.

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March 28, 1939. C. P. BRIDGES 2,152,238

MATERIAL TREATING APPARATUS

Filed Jan. 24, 1936 3 Sheets-Sheet 3

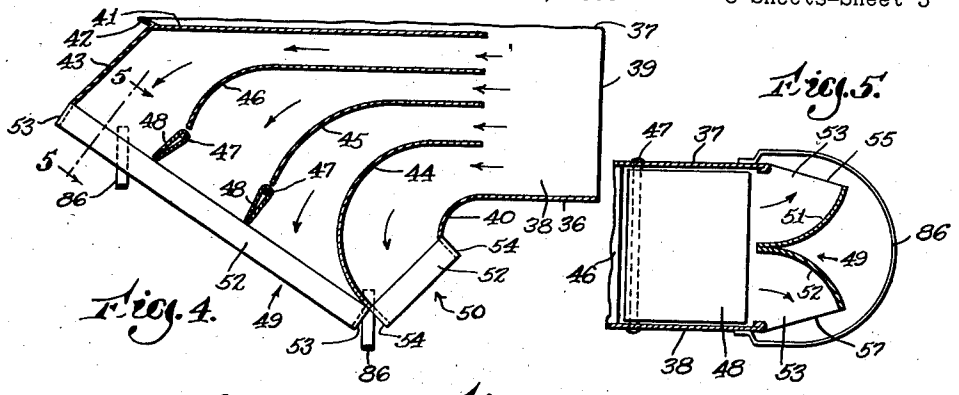


Fig. 4.

Fig. 5.

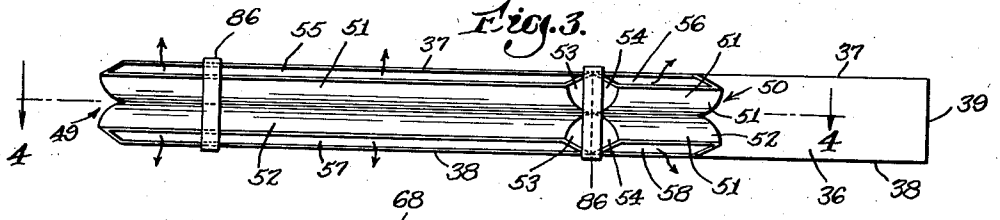


Fig. 3.

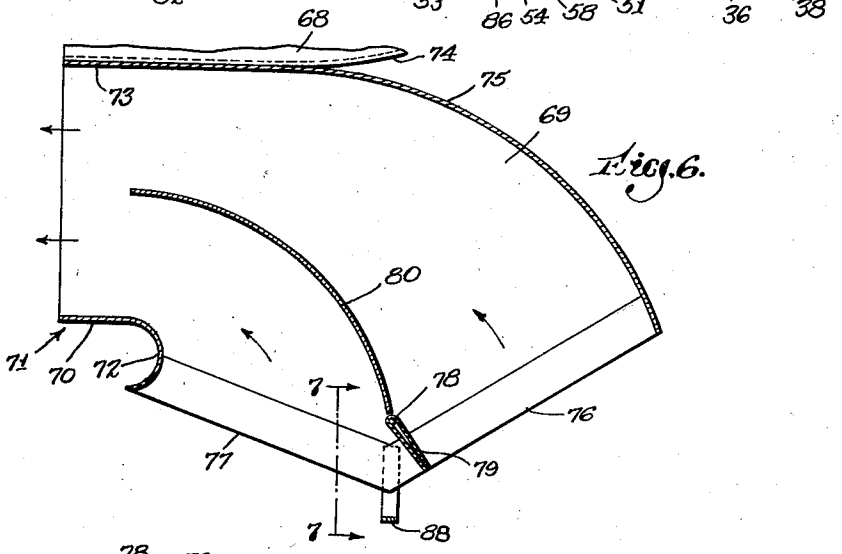


Fig. 6.

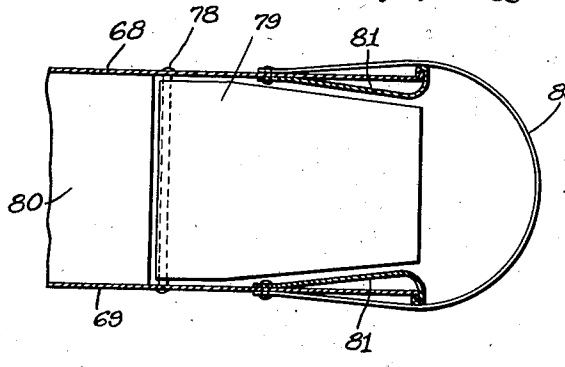


Fig. 7.

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Patented Mar. 28, 1939 2,152,238

UNITED STATES PATENT OFFICE

2,152,238

MATERIAL TREATING APPARATUS

Charles P. Bridges, Dedham, Mass.

Application January 24, 1936, Serial No. 60,611

4 Claims. (Cl. 34—48)

The present invention relates to the treatment of material, and more particularly to the absorption of moisture from, or the addition of moisture to, web material.

In producing web material, of which textile fabrics are one example, there are a number of treating operations to which the web is subjected. One of these operations is that of drying the wet web as it is conveyed along a tentering frame. The web travels along the tentering frame in one or a plurality of passes, and is subjected to the action of conditioned air during its travel. In one form of apparatus for conditioning the web, heated air is transferred directly through the web from one face thereof to the other by the establishment of a condition of unbalanced air pressure on the opposite faces of the web. The air transferred through the web is then collected and is conveyed away, either to the atmosphere or back to the web again or partially to both, depending upon the amount of moisture the air absorbs.

It will be apparent that such apparatus is suitable for use only with those fabric materials, such as cotton, rayon, silk, or the like, through which air can be transferred. With many woolens, however, and with finely woven fabrics of various types, it is practically impossible to drive air through the fabric, thereby requiring some other apparatus which will effect the desired conditioning. The same is true of conditioning web material which is not woven, such as leather, veneer, linoleum, or the like.

It is the principal object of the present invention to devise a method by which heavy or closely woven web material through which air cannot be transferred may be conditioned quickly and at a low cost. To the accomplishment of this object the present invention contemplates the formation of a plurality of passes in the web, the discharge of conditioned air between two or more passes, the collecting of air from between two or more passes, and the conveyance of the air away from the web.

The idea of discharging conditioned air into an enclosure containing the web material so as to dry it, for example, is broadly old. But with the conventional forms of apparatus for doing this there is a waste of heat and power, and the rate of drying is relatively slow. Moreover, the drying accomplished by apparatus now in use tends to be uneven, particularly for heavy materials, causing undesirable "shading" effects in webs of delicate coloration.

It is therefore a further object of the present invention to provide an apparatus which insures a rapid, uniform, and even conditioning throughout the web, thereby eliminating "shading" effects. To the accomplishment of this object, the present invention contemplates the even and regulated distribution of air over the full width of the web so that the web is conditioned as desired in a uniform manner.

To the accomplishment of these objects and such others as may hereafter appear, the various features of the present invention reside in certain methods, constructions, combinations, and arrangements of parts, all described hereinafter and then set forth broadly and in detail in the appended claims.

The various features of the present invention will be readily understood from an inspection of the accompanying drawings illustrating the best form of the invention at present known to the inventor, in which,

Figure 1 is a view in sectional elevation looking along a tentering frame equipped with an embodiment of the present invention;

Fig. 2 is a view in plan taken along the line 2—2 of Fig. 1;

Fig. 3 is a view in elevation of a diffuser;

Fig. 4 is a detail view in sectional plan of a diffuser, taken along the line 4—4 of Fig. 3;

Fig. 5 is a detail view in sectional elevation of a diffuser taken along the line 5—5 of Fig. 4;

Fig. 6 is a detail view in sectional plan of a collector, taken along the line 6—6 of Fig. 1; and

Fig. 7 is a detail view in sectional elevation of a collector taken along the line 7—7 of Fig. 6.

The present invention is illustrated in the drawings as being embodied in a standard tentering frame along which the web of material travels in 12 passes. It will be understood, however, that such a tentering frame is selected only for the purpose of illustrating one use of the present invention. The present invention is adapted for use with tentering frames having any desired number of web passes, and of the vertical type as well as the horizontal. Moreover, a tentering frame is only one of numerous types of web conveyors with which an embodiment of the present invention may be used.

In the drawings the tentering frame is shown more or less diagrammatically since it forms no part of the present invention. Referring to Figs. 1 and 2, the tentering frame comprises uprights 10 along which extend horizontal runs 11 to which are secured the lines of tenterhooks or clips (not shown) for catching the side edges

of the passes of the web of material 12 (Fig. 2). This general construction is well known.

The web of material 12 is formed by the tentering frame into twelve folds or passes which may conveniently be designated A—1, A—2, A—3, A—4, A—5, A—6, A—7, A—8, A—9, A—10, A—11, and A—12, respectively, as shown in Fig. 1. In the particular tentering frame shown, the pass A—1 is the first pass formed in the web upon its entrance into the frame and the pass A—12 is the last pass formed in the web prior to its exit from the frame in a dry condition.

The tentering frame is suitably housed in an enclosure provided with side walls 13 and 14, end walls 15, and a top 16. This enclosure is located in a room of the mill or fractory and provides that the heated air to which the web is subjected is not directed into the room, with resulting discomfort to room occupants and heat and air current losses from the frame and the web.

Referring now to Fig. 1, conveniently mounted on a horizontal support 17 above the enclosure top 16 and at a point near the enclosure wall 13 is an upwardly extending casing forming a chamber 18. Connected to the top of the chamber 18 is a conduit 19 for connection to a stack (not shown) which leads to the atmosphere. Extending through the conduit 19 is a shaft 20 on which is mounted a damper 21 for regulating the flow of air through the conduit and stack.

The chamber 18, in addition to extending upwardly from the support 17, also extends over the support towards the enclosure wall 14 to form a mixing chamber 22. Extending through the side walls of the mixing chamber 22 is a shaft 23 on which is mounted a damper 24 of such size that it may close off the mixing chamber 22 from the chamber 18. The top of the mixing chamber is provided with a conduit 25, having a damper shaft 26 and damper 27, for the introduction into the mixing chamber 22 of fresh air from the room in which the apparatus is located. Extending across the mixing chamber 22 from the rear end thereof at one side to the forward end at the opposite side is a perforated plate 28 through which all the air received by the mixing chamber from the chamber 18 must travel, as will be taken up infra. It will be understood that the shape of the perforated plate is such as not to interfere with the operation of the damper 24.

The dampers 21, 24, and 27 are preferably connected by suitable and well known mechanism whereby they may all be operated simultaneously. One example of such mechanism is shown in my copending application, Serial No. 19,505, filed May 2, 1935. By reason of this or similar mechanism the dampers are so connected that when the damper 24 is open, the dampers 21 and 27 are closed and when the damper 24 is closed the dampers 21 and 27 are open.

Connected to the front end of the mixing chamber 22 is a heat exchange element 29 shown herein for purposes of disclosure only as comprising a radiator unit having two sections. The radiator may be heated in any suitable manner.

Connected to the heat exchange element 29 by means of a duct 30 is a housing 31 containing a blower 32 having a downwardly directed mouth for discharge into a duct 33 the lower end of which passes through a suitable opening in the enclosure top 16. The blower 32 is mounted upon a shaft provided with a pulley as shown in Fig. 1 so that the shaft may be rotated by a belt and power connection (not shown), as is well understood.

In order to utilize and control the path of the air discharged by the blower 32 into the duct 33 and therefrom into the enclosure for the tentering frame, leading downwardly from the discharge mouth of the duct 33 are two laterally juxtaposed main conduits 34 and 34A from which extend branch conduits 35 into a horizontal position. As shown in Fig. 1, these branch conduits 35 are eight in number and extend through suitable openings in the tentering frame structure. The upper four branch conduits 35 lead from the main conduit 34 and the lower four branch conduits 35 lead from the main conduit 34A. These last named branch conduits may extend directly at a right angle from the main conduit 34A, but the branch conduits leading from the main conduit 34 extend obliquely thereto so that their discharge mouths are aligned with those of the branch conduits leading from the main conduit 34A. As shown in Fig. 1 all the branch conduits 35 terminate in vertical spaced relationship adjacent one side of the passes of web material.

Connected to each of the branch conduits 35 is a diffuser for discharging against an associated pass or passes of the web air heated by the radiator 29 and impelled by the blower 32. These diffusers are of two kinds, one of which, indicated at B—1 (Fig. 1) discharges air in one direction (downwardly) and the others of which, indicated at B—2, B—3, B—4, B—5, B—6, B—7, and B—8, discharge air in opposite directions (upwardly as well as downwardly). As shown in Fig. 1, the diffuser B—1 is located above the end pass A—1, so as to discharge air against its upper or outer face. The diffuser B—2 is located between the passes A—1 and A—2, so as to discharge air against the inner or under face of the pass A—1 and the adjacent face of the pass A—2. It will also be seen that the diffuser B—3 is located between the passes A—3 and A—4, the diffuser B—4 is located between the passes A—4 and A—5, the diffuser B—5 is located between the passes A—6 and A—7, the diffuser B—6 is located between the passes A—7 and A—8, the diffuser B—7 is located between the passes A—9 and A—10, and the diffuser B—8 is located between the passes A—10 and A—11. No diffuser of either type is located between the passes A—11 and A—12. With this construction there are diffusers adjacent the opposite faces of the passes A—1, A—4, A—7, and A—10; there are diffusers adjacent only one face of the passes A—2, A—3, A—5, A—6, A—8, A—9, and A—11; and there is no diffuser adjacent either side of the end pass A—12.

Considering now the diffusers in detail, it has been stated above that each of the diffusers B—2 through B—8 is adapted to discharge air both upwardly and downwardly. Viewing Fig. 2, it should also be stated that these diffusers, taking B—6 as an example, are each adapted to discharge air both to the right and to the left, that is, in opposite directions laterally. These diffusers are located more or less centrally of the web passes along their length, thereby providing that the air discharged will travel generally lengthwise of the passes toward their opposite ends.

Referring now to Figs. 2, 3, 4, and 5, each of the diffusers B—2 through B—8 is very roughly Y-shaped, and is provided with side walls 36, a flat top 37, and a flat bottom 38 parallel to the top. The top 37 and the bottom 38 are of the

same shape and extend three quarters or more of the way across the web material, branching out beyond the midway point into right and left hand portions, as shown in Fig. 2. The side walls 36 extend only a short distance over the web material and with the top 37 and bottom 38 form a neck 39 for connection with an associated branch air conduit 35. At their outer ends the side walls 36 are curved outwardly as shown at 40. Extending centrally between the side walls 36 and connected to the top 37 and the bottom 38 is a vertical partition 41 which extends along the top and bottom of the diffuser to the point where they branch off into right and left hand portions, at which point the partition 41 is joined to vertical walls 42 and 43 which form a V and are joined to the edges of the top and bottom of the diffuser. As shown in Fig. 2 the apex of the V formed by the walls 42 and 43 is directed inwardly.

In the construction just described, it will be seen that each of the diffusers B—2 through B—8 comprises a conduit extending part way across the web material and provided with branches disposed away from each other and in the general direction of the opposite ends of the web passes. By reason of this construction, air driven by the blower 32 into the branch conduits 35 and from there into the diffusers is guided by the side walls 36, the top 37, the bottom 38, the partition 41, and the walls 42 and 43 into currents directed generally in opposite directions.

Viewing Figs. 2 and 4, particularly the latter, it will be seen that if the partition 41 were the only deflector intermediate the side walls 36 and if the walls 42 and 43 were alone relied upon to direct the air over the web material, the air in the neck 39 would tend to pursue a straight course through the diffusers until deflected by the walls 42 and 43. This would obviously result in an uneven distribution of air over the web material, the portions thereof adjacent the walls 42 and 43 receiving the greater part of the air, and the portions of the material adjacent the side walls 36 receiving the least air. This uneven distribution of air would cause uneven drying of the web materiai.

To offset this tendency for uneven air distribution, the diffusers are provided interiorly at each side of the partition 41 with vertical vanes or baffles 44, 45, and 46, best shown in Fig. 4. The ends of these vanes adjacent the neck 39 are aligned with the end of the partition 41, and the vanes are spaced from each other and from the partition 41 and the side wall 36. The vane 44 has a curvature corresponding generally to that of the curved portion 40 of the wall 36 and extends throughout slightly more than 90 degrees so that air passing between it and the wall curve 40 is directed slightly rearwardly towards the edge of the associated pass of material, rather than directly longitudinally thereof. The vanes 45 and 46 control the path of the air between the vane 44 and the walls 42 and 43 and function to change the path of portions of the air at points ahead of the walls 42 and 43.

Preferably the vanes 45 and 46 terminate short of the edges of the diffuser top 37 and bottom 38, so that pivoted deflectors may be associated with these vanes. Referring to Figs. 4 and 5, adjacent the front ends of the vanes 45 and 46 the diffusers are provided with vertical pins 47 on which are rotatably mounted vertical deflectors 48 forming, in effect, adjustable continuations of the vanes 45 and 46. With this construction the deflectors 48 serve to regulate the paths of the air emitting from between the vanes 44 and 45, 45 and 46, and 46 and the partition 41 and the wall 42 (or 43), and so make it possible to have a more even discharge of air from the diffusers than if merely stationary vanes were used. Stated in another way, the deflectors 48 form partitions or dividers, as it were, for the opening bounded by the top 37, the bottom 38, the side wall 42 (or 43), and the vane 44. Since the deflectors 48 are pivoted, they may be turned to vary the size of the discharge ends of the passages between the wall 42 (or 43) and the vane 46, between the vane 46 and the vane 45, and between the vane 45 and the vane 44.

The construction so far described provides for a uniform distribution of conditioned air across the passes of material from one side thereof to the other and in opposite directions longitudinally thereof. It will be apparent, however, that without further air guiding means than those above described, the air would be discharged from the diffusers in a direction parallel to the passes of material of the web material. Such a mode of operation would have a low efficiency because a considerable quantity of the air would not come into contact with the passes, and hence would not absorb moisture. In order to provide for the greatest efficiency, the present invention contemplates that the air, in addition to being divided into two oppositely disposed currents by means of the partitions 41 and the walls, vanes, and deflectors associated therewith, shall also be further divided into currents directed upwardly and downwardly so that all the air strikes against the passes, and not just a portion of the air.

For this purpose the discharge ends of each diffuser are partially closed off between the top 37 and the bottom 38 by V-shaped deflectors 49 and 50 (Figs. 4 and 5). The walls 51 and 52 forming the V's are preferably curvilinear in cross section, with the apex of the V's directed inwardly of the diffuser. The deflector 49 extends between the wall 43 (or 42) and the outer end of the vane 44 as shown in Fig. 4, while the deflector 50, which is shorter than the deflector 49, extends between the outer end of the vane 44 and the end of the curved portion 40 of the side wall 36. The deflectors 49 and 50 are disposed to each other at an angle of slightly more than 90 degrees (Fig. 4) and are provided with ends 53 and 54, respectively. Referring to Figs. 3 and 5, particularly the latter, the curved walls 51 extend upwardly to a point slightly below the plane of the diffuser top 37, thereby, with the ends 53 and the top 37, defining for the deflector 49 a rectangular opening 55 and for the deflector 50 a rectangular opening 56 both of which openings are located adjacent a pass of the web material, and through which air is discharged against the pass. Similarly, the curved walls 52 extend downwardly to a point slightly above the plane of the diffuser bottom 38, thereby, with the ends 54 and the bottom 38, defining for the deflector 49 a rectangular opening 57 and for the deflector 50 a rectangular opening 58 both of which openings are located adjacent the next succeeding lower pass of the material and through which air is discharged against the pass. It will be seen that with the above described construction, the curved walls 51 and 52 guide the air in the diffuser upwardly and downwardly, respectively, and that the plane of the rectangular openings 55, 56, 57, and 58 are all inclined to the

planes of the passes of web material, thereby causing the air discharged from the openings to strike the passes of material obliquely.

The diffusers B—2 through B—8 are each interposed between two adjacent passes of the web material, respectively, and are therefore constructed to discharge air both upwardly and downwardly. The diffuser B—1, however, is located above the end pass A—1, which is the first pass, and therefore is constructed to discharge air only downwardly. The diffuser B—1 is similar to the other diffusers, being provided with a neck 59 like the necks 36, and with side walls, a top, bottom, and V-walls, partition, vanes, and deflectors between the top and bottom all of which correspond to the same parts in the diffusers B—2 through B—8. However, instead of being provided with V-shaped deflectors like the deflectors 49 and 50, the diffuser B—1 is provided with deflectors 60 and 61 (Fig. 1) similar to the walls 52, i. e., of a single curvature, extending downwardly and outwardly from the top of the diffuser to a point slightly above the plane of the bottom of the diffuser. The deflectors 60 and 61 are provided at their opposite ends with walls 62 and 63, respectively, similar to the ends 53 and 54 of the deflectors 49 and 50. The deflector 60 is longer than the deflector 61, and is angularly disposed thereto, and the two deflectors define, with the diffuser bottom and the ends 62 and 63, rectangular openings 64 and 65, respectively, through which air is discharged against the upper or outer face of the web pass A—1. Preferably the diffuser B—1 is slightly larger than the diffusers B—2 through B—8, extending outwardly slightly beyond the side edges of the passes as shown in Fig. 1.

The above described construction provides two kinds of guides for the air impelled by the blower 32 into the duct 33 and then against the passes of web material. The obliqueness of the planes of the rectangular diffuser openings to the planes of the passes insures that all the air discharged strikes the passes and does not issue from the diffusers in a path parallel to the passes. The curved walls 36, the V-walls 42 and 43, the vanes 44, 45, and 46, the deflectors 48, and the disposition of the rectangular diffuser openings angularly to each other insure by their cooperation that the air admitted into the necks 36 and 59 is spread evenly across the width of the passes of material. Upon issuing from the diffusers, the impelled air strikes the adjacent faces of the passes and spreads therealong, both along their length and also from one side edge thereof to the other. In effect, the discharged air forms a constantly moving blanket covering the entire faces of the passes and absorbing moisture therefrom as the air moves. As regards the passes A—1, A—4, A—7, and A—10, the air travelling laterally along one face of the passes meets at the side edges thereof the air travelling laterally along the opposite face of these same passes. As regards the passes A—2, A—3, A—5, A—6, A—8, A—9, and A—11, i. e., those passes against only one face of which air is discharged, the air travelling laterally therealong reaches the side edges thereof where it mingles with the air at the side edges of adjacent passes including A—1, A—4, A—7, and A—10, as the case may be, and is then drawn away by air collecting means which will now be described.

Referring to Fig. 1, the bottom of the chamber 18, adjacent the enclosure wall 13, is connected to a vertical main conduit 66 the upper end of which extends through the support 17 to a point of junction with the chamber 18. Branch conduits 67, herein shown in Fig. 1 as four in number, extend from the main conduit 66 into a horizontal position through the tentering frame structure, and terminate with their mouths aligned in vertical spaced relationship adjacent the side of the passes of material opposite the side thereof at which the branch conduits 35 terminate.

Connected to each of the branch conduits 67 is a collector for collecting the air discharged by the various diffusers B—1 through B—8. These collectors are all alike, and are indicated in Fig. 1 at C—1, C—2, C—3, and C—4. The collector C—1 is located between the passes A—2 and A—3, so as to collect air discharged against the passes A—1 and A—2 by the diffusers B—1 and B—2 and air discharged against the under surface of the pass A—3 by the diffuser B—3. The collector C—2 is located between the passes A—5 and A—6 so as to collect air discharged against the pass A—5 by the diffusers B—4 and against the pass A—6 by the diffuser B—5. The air discharged against the opposite faces of the pass A—4 by the diffusers B—3 and B—4 is collected partly by the collector C—1 and partly by the collector C—2. The collector C—3 is located between the passes A—8 and A—9 so as to collect air discharged against the pass A—8 by the diffuser B—6 and against the pass A—9 by the diffuser B—7. The air discharged against the pass A—7 by the diffusers B—5 and B—6 is collected partly by the collector C—2 and partly by the collector C—3. The collector C—4 is located between the passes A—11 and A—12 so as to collect air discharged against the pass A—11 by the diffuser B—8. The air discharged against the pass A—10 is collected partly by the collector C—3 and partly by the collector C—4. As stated above, the under face of the pass A—11 and the opposite faces of the pass A—12 do not have a diffuser adjacent thereto, the reason being that as the travelling web reaches the eleventh and twelfth pass stages its moisture content is practically that which the tentering operation seeks to achieve. However, the collector C—4 is located between the passes A—11 and A—12 to insure that there be a circulation of air about these passes as a finishing step to the drying operation.

Considering now the collectors in detail, each of the collectors C—1 through C—4 is roughly Y-shaped, as shown in Fig. 2, and is provided with a flat top 68, a flat bottom 69 parallel to the top, and side walls 70. The top 68 and the bottom 69 are of the same shape and extend three quarters or more of the way across the web material, branching out into right and left hand portions (Fig. 2) from a point substantially midway of the ends of the passes of the web. The side walls 70 extend only a short distance across the web and with the top 68 and the bottom 69 form a neck 71 for connection with an associated branch conduit 67. At their outer ends the side walls 70 are outwardly curved as shown at 72. Extending centrally between the side walls 70 from the plane of their juncture with the branch conduit 67 and connected to the top 68 and the bottom 69 is a vertical double partition 73. As shown in Figs. 2 and 6, the double partition 73 extends along the top and bottom of the collector to the point where they branch off, the partition 73 from this point branching out in a V to form vertical walls 74 and 75 joining the

edges of the top 68 and the bottom 69. As shown in Fig. 2 the apex of the V formed by the walls 74 and 75 is directed inwardly of the collector and the walls are concaved inwardly of the collector also.

In the construction just described, it will be seen that each of the collectors C—1 through C—4 comprises a conduit extending part way across the web of material and provided with intake mouths disposed away from each other and in the general direction of the opposite ends of the passes. By reason of this construction air travelling to the side edges of the passes of material enters the collectors and is guided in two currents by the V-walls 74 and 75, the top 68, the bottom 69, the partition 73 and the side walls 70 into the necks 71 and from there to the branch conduits 67 and the main conduit 66. The two currents merge at the branch conduits 67.

It was pointed out above that with the diffusers B—1 through B—8, vane and deflector constructions are provided to insure an even discharge of air across the width of the web. A similar construction is provided in the collectors C—1 through C—4 to provide for the even collection of air. Viewing Figs. 2 and 6, it will be seen that the top 68 and the bottom 69 do not terminate in an edge extending in a straight line between the curve 72 of the side walls 70 and the free ends of the walls 74 and 75. Instead the top 68 and the bottom 69 extend a short distance lengthwise of the web in both directions along converging edges 76 and 77. Near the point of convergence of these edges, the top 68 and the bottom 69 on each side of the collectors support a vertical pin 78 on which is rotatably mounted a vertical deflector 79 of such length as to extend substantially to the edges 76 or 77, as shown in Fig. 6. Extending from the pins 78 rearwardly into the neck 71 are curved vanes or baffles 80, one on each side of the collector, supported by the top 68 and the bottom 69, and spaced from the partition 73 and the side walls 70. The curvature of the vanes 80 corresponds roughly with that of the walls 74 and 75, and provides that air entering the passage between the wall 75 and the deflector 79 is not met by a cross current of air entering the passage between the deflector 79 and the curved portions 72 of the side walls 70. Stated in another way, the vanes 79 function to deliver substantially parallel currents of air into the necks 71.

In order to regulate the quantity of air flowing into the collectors on each side of the vanes 80, the deflectors 79 may be swung as conditions require. Stated in another way, since the curved portion 72 of the side walls 70, the top 68, the bottom 69, and the deflector 79 form an entrance on one side of each vane 80, and since the wall 74 (or 75), the top and bottom, and the deflector 79 form an entrance on the other side of each vane 80, a swinging of a deflector 79 varies the size of these two entrances and so varies the amount of air that may flow into each. Preferably the marginal portions of the top 68 and the bottom 69 along the converging edges 76 and 77 are provided with braces 81 positioned interiorly of the collectors.

The various collectors C—1 through C—4 may directly underlie and overlie the respective diffusers B—1 through B—8 or may be placed slightly to one side thereof, as shown in Fig. 2. In either event the air discharged against the passes of material by the diffusers must travel along the passes to and over their side edges in order to find an outlet in the collectors. The air collected by the collectors passes into the branch conduits 67 and from there into the main conduit 66 after which it enters the chamber 18. The air in the chamber 18 may travel into the stack duct 19 or into the mixing chamber 22 or partly into each, as will be explained infra.

The diffusers B—1 through B—8 and the collectors C—1 through C—4 above described are located intermediate the ends of the passes of material, and so are constructed to discharge and collect air, respectively, in opposite directions. It is advisable, however, that the ends of the passes as well as their mid portions be provided with diffusers and collectors so that the passes can be subjected throughout their length to the influence of heated air and so that this influence will be substantially uniform throughout the entire surfaces of the passes. For this purpose at the left hand end of the passes, viewing Fig. 2, there is provided a collector and diffuser system, and a similar provision is made at the right hand end of the passes. These two systems are identical in all respects with the diffusers B—1 through B—8 and the collectors C—1 through C—4 with the one exception that they are single as opposed to the diffusers B—1 through B—8 and the collectors C—1 through C—4 which are double. Stated in another way, the single diffuser at the left in Fig. 2 has the same shape as the right hand portion of the double diffuser shown in Fig. 2 and the right hand single diffuser in Fig. 2 has the same shape as the left hand portion of the double diffuser shown in Fig. 2. Likewise the left and right single collectors in Fig. 2 have the same shape as the right and left hand portions, respectively, of the double collector shown in Fig. 2.

These single diffusers and collectors are located vertically with respect to each other and to the passes of material in the same manner as the double collectors and diffusers are located, and function the same way. The left hand diffusers receive air from a main conduit 82 which may be connected to the duct 33 (Fig. 1) or which may lead from a duct (not shown) corresponding to the duct 33 and connected to a duplicate of the heating, etc. arrangement shown above the support 17 in Fig. 1. The left hand collectors convey air into a main conduit 83 which may be connected to the main conduit 66 or which may lead to a chamber (not shown) corresponding to the chamber 18 (Fig. 1) but which forms a part of a duplicate of the heating, etc. arrangement shown above the support 17. The right hand diffusers in Fig. 2 are connected to a main conduit 84 which receives air in the same manner that the main conduit 82 does, and the right hand collectors in Fig. 2 are connected to a main conduit 85 for conveying away the collected air in the same manner as done by the main conduit 83. In a similar manner, there may be more than one of the double diffuser and collector systems in addition to the two systems of single diffusers and collectors shown or only two systems of single diffusers and collectors may be used, depending upon mill arrangements. The underlying idea is to subject the entire surfaces of the passes of material evenly and uniformly to the influence of conditioned air discharged between passes and to convey the air away in such manner that this can be achieved—and this can be brought about by other arrangements than the specific one shown in Fig. 2.

The passes of web material are relatively long

and sag to a certain extent between their points of support in the tentering frame. As the diffusers and collectors, both single and double type, are positioned closely adjacent the passes, it is advisable to provide the diffusers and collectors with suitable guides so that the web does not catch on projecting points or edges. Referring to Figs. 3, 4, and 5, these guides comprise curved bands 86 the free ends of which are connected to the top 37 and the bottom 38 of the diffusers B—2 through B—8, so that the curved portion of the band extends outwardly from the diffuser. As shown in Fig. 3, one band is located near the V-wall 43 and the other band is located so as to extend between the adjacent ends 53 and 54 of the deflectors 49 and 50. It will be understood that both the right and left hand portions of the double diffusers are provided with guides 86. The diffuser B—1 is provided with a pair of guides 87 identical in construction and position with the bands 86. Only one guide is necessary for each of the single type collectors and for each side of the double type collectors. These guides are formed by bands 88 (Figs. 6 and 7) like the bands 86 and 87, and are positioned so as to project in front of the apices formed by the converging edges 76 and 77 of the collector tops 68 and bottoms 69. With these guide constructions, the passes of the web material cannot contact sharp corners or edges and are thus protected from injury during their travel through the tentering frame.

In order to utilize the present invention to treat a web of material by restoring to the web a quantity of moisture to compensate for that driven out by some operation carried on under heat, a suitable humidifying element such as a water spray nozzle 89, conventionally shown in Fig. 1, may be provided in the duct 30 so as to be located between the heat exchange element 29 and the blower 32. The nozzle 89 when not in use does not interfere with the operation of the illustrated embodiment as a dryer. Since it is desirable to control the humidity of the air a humidostat (not shown) may be employed.

In view of the foregoing, it is believed that the operation of the illustrated embodiment of the present invention will be readily understood. Air which is conditioned by the heat exchange element 29 is impelled by the blower 32 into the main conduits leading to the diffusers, from which it is discharged evenly and uniformly against the adjacent passes of web material. The portion of the material which dries slowest determines the rate at which the web is run through the machine, and since the discharged air spread uniformly over the passes, there is no opportunity for uneven drying and "shading" effects. Since the air does not travel through the material because of the texture thereof, the air travels over the material to its side edges, insuring their drying as completely as that of the interior portion of the material away from its side edges. After travelling over the side edges of the material the air is collected by the various collectors and is conveyed away to the chamber, or chambers, 18.

What happens to the air conveyed to the chamber 18 depends upon the position of the dampers 21, 24, and 27, which in turn depends upon the humidity of the air within the tentering frame enclosure. This humidity may be determined by any suitable hygrometer (not shown). Depending upon the humidity conditions in the enclosure, the air conveyed to the chamber 18 may be entirely discharged to the atmosphere through the stack duct 19 or any desired portion of the air may be admitted to the mixing chamber 22 for re-circulation through the diffusers and collectors. During the admission of any re-circulated air into the mixing chamber 22, the perforated plate 28 functions to filter from the re-circulated air any lint that may have been received and entrained by the air during a previous discharge against the web material.

Nothing herein explained is to be interpreted as limiting the present invention in the scope of it application to use in connection with the particular apparatus or particular mode of operation or both selected for purposes of illustration and explanation. It will be apparent that the present invention is capable of use with web conveyors other than tentering frames, and with web materials other than textile fabrics. While the particular construction herein set forth is well suited to one mechanical form of the invention, it is not limited to these details of construction, nor to the conjoint use of all its features, nor is it to be understood that these particulars are essential since they and the steps of the methods disclosed may be variously modified within the skill of the artisan without departing from the true scope of the actual invention, characterizing features of which are set forth in the following claims by the intentional use of generic terms and expressions inclusive of various modifications.

What is claimed as new is:

1. An apparatus for treating a web of material provided with a plurality of passes having, in combination, a conduit, a blower for causing air to flow into the conduit, means connected to the conduit for discharging air, impelled by the blower, vertically against the opposite faces of one of the passes and against the non-adjacent faces of two other adjacent passes in opposite directions across the web from one side thereof to the other and lengthwise of the web towards its opposite ends, at least one collector located between the adjacent faces of said two other passes for collecting the discharged air, and means for conveying away the air collected.

2. An apparatus for treating a web of material provided with a plurality of passes having, in combination, a conduit, a blower for causing air to flow into the conduit, means connected to the conduit for discharging air, impelled by the blower, vertically against the opposite faces of one of said passes, against the non-adjacent faces of the next succeeding two passes, and against at least one face of the pass next succeeding said two passes in opposite directions across the web from one side thereof to the other and lengthwise of the web towards its opposite ends, at least one collector located between said two passes for collecting the discharged air, and means for conveying away the collected air.

3. An apparatus for treating a web of material provided with twelve passes having, in combination, a conduit, a blower for causing air to flow into the conduit, means connected to the conduit for discharging air, impelled by the blower, against the outer face of the first pass and also against the adjacent faces of the first and second, third and fourth, fourth and fifth, sixth and seventh, seventh and eighth, ninth and tenth, and tenth and eleventh passes, at least one collector located between the adjacent faces, respectively, of the second and third, fifth and sixth, eighth and ninth, and eleventh and twelfth passes

for collecting the discharged air, and means for conveying away the air collected.

4. An apparatus for treating a web of material provided with a plurality of substantially parallel passes having, in combination, a conduit, a blower for causing air to flow into the conduit, means connected to the conduit for discharging air, impelled by the blower, against the opposite faces of less than all the passes, means connected to the conduit for discharging air impelled by the blower against only one face of passes other than those receiving impelled air against their opposite faces, the number of passes receiving air against only one face being twice as many, less one, as the number of passes receiving impelled air against their opposite faces, means for collecting the discharged air, said fourth-named means being located between passes against the opposite faces of which air is not discharged and means for conveying away the air collected.

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