June 5, 1934. H. KRANTZ 1,961,881

TENTERING AND DRYING MACHINE

Original Filed Aug. 18, 1928

Fig. 1

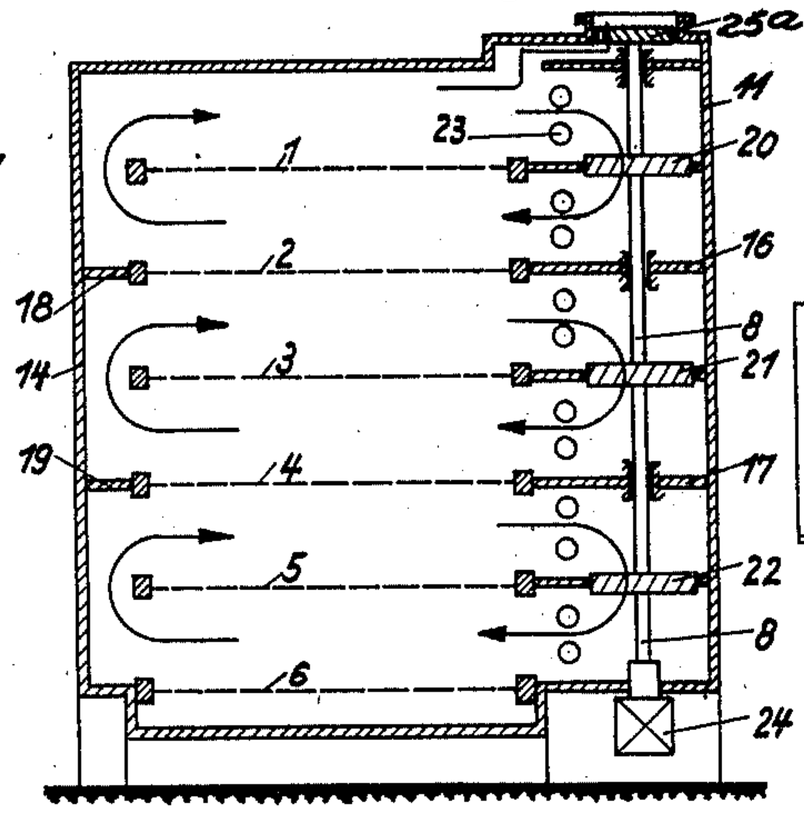


Fig. 3

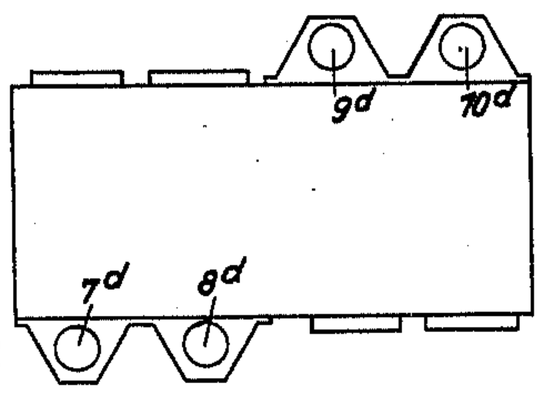


Fig. 2

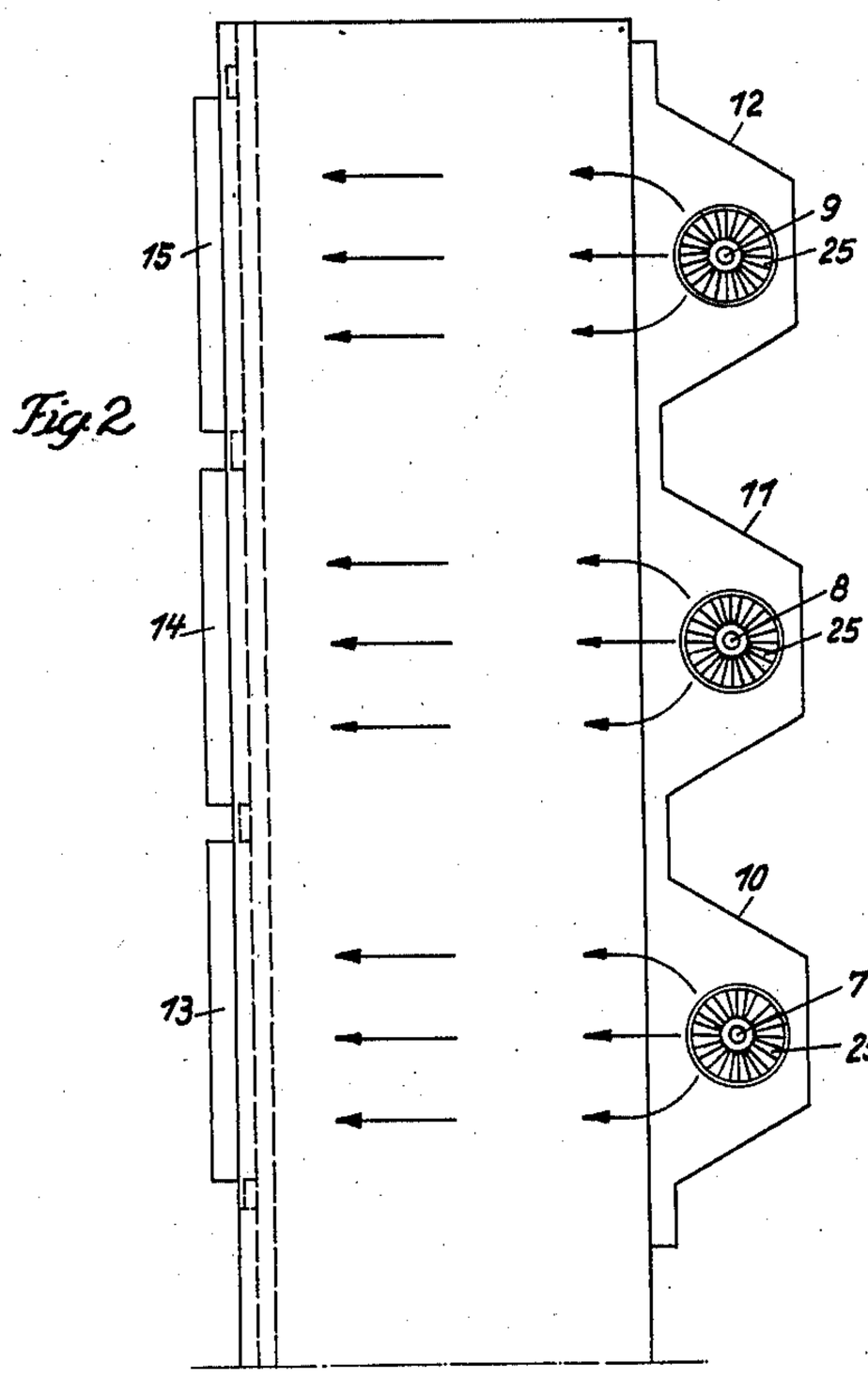
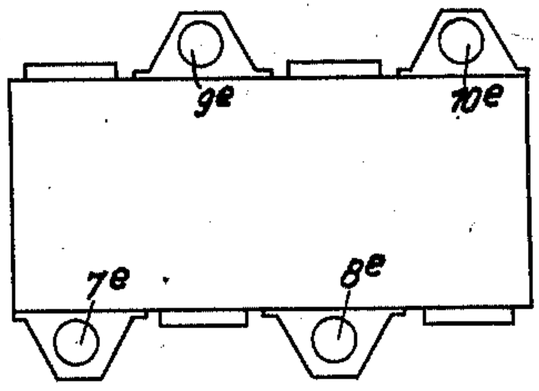


Fig. 4



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Patented June 5, 1934 1,961,881

UNITED STATES PATENT OFFICE

1,961,881

TENTERING AND DRYING MACHINE

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Application August 18, 1928, Serial No. 300,563. Renewed May 25, 1932. In Germany October 25, 1927

5 Claims. (Cl. 34—48)

This invention is directed to tentering and drying machines wherein the fabric while subjected to continuous and progressive travel through the machine is constantly subjected to particularly directed and controlled currents of heated air for drying purposes.

In tentering and drying machines, the fabric is designed for travel longitudinally to and fro through the machine on a circuitous path providing a plurality of vertically spaced layers which, for the purpose of this invention, may be said to form independent drying tiers or stages. In drying the fabric so passing through the machine, heated air is forced into more or less intimate contact with the surface of each layer of the fabric to thereby absorb moisture from the fabric during its progressive travel through the machine. The drying medium must, of course, be delivered to the fabric under pressure in order that it may flow over the surface of the fabric for the drying effect, and the commercially practical machine for the purpose must possess certain characteristics with respect to the drying medium for satisfactory service. In the first place, the medium must be so directed with respect to the moving fabric that every portion of the surface of a particular layer of the fabric must be effectively reached by the drying medium, as otherwise irregular drying would result, with a corresponding objectionable condition of the fabric. Furthermore, this complete searching of the fabric by the drying medium must be performed with a minimum of power, as otherwise the machine is costly to operate, which is a disadvantage.

As the width of the fabric in its arrangement in the machine is necessarily less than the length of any one layer, it follows as a matter of course that if a drying medium is to be directed under pressure into contact with the surface of the fabric, materially less power will be required to force the drying medium directly transverse the fabric than to force the same medium lengthwise the fabric. Therefore, an essential characteristic feature of the present invention is the drying medium pressure means by which the medium is forced to travel directly transverse the fabric, that is, throughout the shortest dimension of the fabric. Under this development, and as it is highly important that the entire surface of any one layer of the fabric be reached by the drying medium, it follows that when the drying medium is directed transverse the fabric or throughout the shortest dimension of the fabric, a number of means for developing the requisite pressure in the drying medium must cooperate with each layer of the fabric.

Where, as in the present instance, fans of a more or less particular type are employed, a number of such fans will be employed with each drying stage or fabric layer, the initial function of each fan being to direct the air therefrom, generally speaking, in a direction transverse the fabric. As a number of fans will be employed, it is highly important that the air from any one fan be so related to the air from adjacent fans that the aggregate air from all fans will form a substantially unbroken layer of air commensurate with the length of the fabric layer and moving directly transverse the fabric for drying purposes.

This requisite involves the relation of adjacent fans and the control of the air therefrom in such manner that the air stream from one fan will be directed toward the air streams from adjacent fans and be intercepted thereby and compelled to move transverse the fabric. That is to say, the air from a particular fan will naturally spread on divergent lines from the fan over the fabric, and if the fans are so arranged that the relative side portions of the body of air from any one fan which is tending to move diagonally of the fabric is intercepted by the similar side portions of air stream from adjacent fans, these angularly meeting streams of air which would otherwise tend to cross each other are intercepted one by the other, with the effect that such margins of the air streams of each fan move in a component direction, which is directly transverse the fabric. If the fans are arranged so that the intercepting streams of air from adjacent fans will occur substantially at that edge of the fabric next the fan, it follows as a matter of course that the air from the fans flows substantially as an unbroken body directly transverse the fabric layer and throughout the full length of such layer. Here is the most effective drying by simultaneously subjecting all of the fabric layer to the drying medium at the same time, and furthermore the power necessary to so direct the medium is materially reduced as compared with the conventional machine because it is only compelled to travel transverse the fabric, that is, the shortest possible distance.

Thus, seeking at all times the most effective drying with the minimum of necessary power, I provide a plurality of relatively spaced air circulating means, with each of said means including a plurality of air circulating elements coop-

erating respectively with the separate tiers formed by the fabric layers. Through this arrangement, and for the reasons above stated, I am enabled to perform a more effective drying of the fabric in a much shorter time and with a materially less expenditure of power than has heretofore been accomplished, primarily because each of the air circulating elements, by reason of the particular arrangement described, provides a relatively short circulating path for the air from that element and thereby renders the drying more effective because the whole length of fabric in a particular layer is thus easily and effectively reached and the power to drive the air throughout this comparatively short path is materially reduced as compared with conventional structures.

In the use in a machine of this type of a series of vertically arranged fan shafts, on each of which there is a fan for cooperation with a particular drying stage, it is apparent that the air is circulated directly transverse the fabric of each layer in contact with one surface of the fabric and again transverse the fabric in contact with the other surface of the fabric, the latter air movement being incident to the suction effect of the particular fan or the next upper or lower fan on the fan shaft.

Again, with a machine constructed in accordance with the invention, the path to be taken by the air from the delivery port of a fan to its suction port or to the suction port of another fan mounted on the same or another vertical shaft is shortened to such an extent that large quantities of air can be passed through the machine at a low expenditure of power, thereby securing a high output.

The machine of the present invention is also superior to another known tentering and drying machine which includes a number of horizontal fan shafts, namely one fan shaft for each drying tier. The present machine possesses over this known machine the following advantages:—

First of all, it effects the production, in each drying stage above and below each fabric layer, of a current of drying air directly transverse the fabric and substantially uninterrupted through the full length of the drying stage. The diameter of the fan rotors is independent of the depth of the drying tier. It is, therefore, possible to use fans of any desired diameter without requiring any enlargement of the depth of a drying tier, which means that it is not necessary, with a given height of the room available, to reduce the number of superimposed drying tiers. The arrangement of as many superimposed drying tiers as possible is preferable because such arrangement allows a better gradation of the drying action to be obtained and space to be saved by correspondingly reducing the length of the machine.

The invention in preferred and modified forms is illustrated in the accompanying drawing, in which:—

Figure 1 is a transverse section of a tentering and drying machine constructed in accordance with this invention, wherein the drying air is circulated transversely of the machine.

Figure 2 is a plan view of the same.

Figures 3 and 4 are diagrammatic views of other modified forms.

In the construction and arrangement shown more particularly in Figures 1 and 2, the fabric web is passed longitudinally to and fro through the machine on a circuitous path, presenting in the instance shown six vertically spaced layers, indicated by the dotted lines 1, 2, 3, 4, 5 and 6. The respective layers of the fabric thus moving longitudinally of the machine are spaced apart and define in such spacing wholly uninterrupted areas between the respective fabric layers open from side to side and from end to end.

Arranged at equal distances along one side of the machine are a plurality of vertically disposed fan shafts, three being shown in the present instance and indicated at 7, 8 and 9. These fan shafts are arranged immediately beyond one longitudinal edge of the fabric, and as the fan shafts extend vertically of the casing and as the respective fabric layers are moving in planes horizontally of the casing, it is apparent that the fan shafts are at right angles to the plane of movement of the fabric layers. Each fan shaft is provided with a plurality of fans 20, 21 and 22, each fan being horizontally aligned with successive alternate layers of the fabric, that is, as shown, fan 20 is in alignment with fabric layer 1, fan 21 in alignment with fabric layer 3, and fan 22 in alignment with fabric layer 5. Each fan shaft is mounted in a separate compartment offset from the casing proper, as illustrated more particularly in Figure 2, that is, the fan shaft 7 and the fans 20, 21 and 22 thereon is mounted in a compartment 10, the fan shaft 8 with the fans 20, 21 and 22 thereon is mounted in a compartment 11, while the fan shaft 9 with the fans 20, 21 and 22 thereon is mounted in a compartment 12. These respective compartments are fully open on the side next the casing and otherwise completely closed. The side walls of the compartments which serve to form deflector plates for the air from the fans diverge from the end of the compartment remote from the c. sing proper toward the casing. Horizontal partitions 16, 17 in alignment with alternate fabric layers, such as 2 and 4, aid in defining the several superimposed stages of the drying compartment.

On the side of the casing remote from the fan compartments, there is or are provided what may be termed one common reversing chest or a plurality of reversing chests 13, 14 and 15, as shown, through the medium of which the air from any one particular fan is caused to circulate above and below the particular fabric layer on the level of which that fan is located. Horizontal partitions 18 and 19 in the reversing chest or chests complete the formation of the drying stages.

The casing is provided with a power element 24 by which the fan shafts may be operated in any conventional desired electrical or mechanical manner, and the upper end of certain of the shafts, or all of them if found expedient, may be provided with fans 25a adjacent an outlet from the casing, with such fan or fans serving to expel the moisture-laden drying air from the machine. The admission of fresh air to the fans and the exhaust of spent air may take place in any well known manner through the use of adjustable flap valves (not shown). The flow of air through the drying tiers of the machine may take place in parallel order, as shown in Figure 1, or obviously through the provision of suitable by-pass channels may take place wholly or partly in serial order, and in the latter event one and the same air current may be circulated through some or all of the drying tiers in succession. Such air, of course, is aug-

mented both in temperature and force of circulation at each drying tier by the particular heater and fan cooperating therewith.

It has been stated that the fabric layers provide what may be termed drying tiers or stages between the successive layers and that these drying tiers or stages are uninterrupted throughout the full length and breadth of such tiers. It is a characteristic requisite of the drying of the fabric that the moisture be abstracted from the fabric by a heated medium flowing over the fabric and that this abstraction be substantially uniform and that the moisture-laden air be maintained in active circulation.

A not unimportant feature of a machine of this type is economy in operation without sacrifice of material results and obviously the shorter the effective path of the drying air and the circulatory effect on the fabric, the less the power required for the desired result and, therefore, the more economical the machine. The air from the fans is sent directly across the fabric, and as this is the shortest possible path of travel, the power incident to such air delivery is the possible minimum. It is an essential requisite, however, that this drying air have substantially uniform circulatory contact with the surface of the fabric in each fabric layer, and this means that there must be an uninterrupted body of air traveling directly across the fabric but having an area commensurate with that of the fabric surface. This result is incident to the arrangement of the fans and the walls of the fan compartments in such a manner that the relative side portions of the current of air from any one fan are intercepted by similar side portions of air streams from adjacent fans with the effect that such margins of the air streams of the fans move in a component direction, which is directly transverse the fabric, thereby forming a substantially unbroken body of air directly transverse the fabric layer and throughout the full length thereof.

In the embodiment illustrated, the diverging currents of air from the fans are directed by the diverging walls of the fan compartments 10, 11, 12 and by such direction are compelled to move in a certain diagnoal relation to the adjacent fabric layer. The relation of immediately neighboring walls of adjacent fan compartments are converging toward the edge of the fabric. Hence the currents of air from the adjacent fans controlled by these neighboring walls are caused to approach the adjacent edge of the fabric on converging lines. In other words, the parts of the air from the respective fans which do not flow directly across the fabric are intercepted by each other and compelled to travel directly across the fabric. Whenever I refer herein to walls disposed about the rotary fans directing and uniformly distributing the air impelled thereby across the fabric in weftwise moving sheets, I mean any arrangement of walls by which the air currents produced by the single fans are caused to move uniformly and crosswise through the machine. Thus, by the arrangement described, the fans contribute to a body of air which is commensurate with the surface area of the fabric layer and which is compelled by the arrangement to seek the shortest path of travel with respect to the fabric, that is, a bodily movement directly across the fabric.

The characteristic feature of the invention, therefore, is the delivery of the drying air from a plurality of fans cooperating with each drying stage in the shortest possible direction with respect to the path of such air, that is, directly transverse the fabric layer, and at the same time the control of the air currents from the respective fans so that there is an uninterrupted volume of air flowing throughout the length and breadth of the particular fabric layer, with this body of air moving directly transverse the fabric. The air delivered from the fans is maintained in circulation by the same or adjacent fans, as at the end of the fabric remote from the fans such body of air, by reason of the reversing chests, is caused to circulate relative to the opposite side of the fabric layer toward the suction side of the fans from which it was delivered, this order constituting the parallel drying circulation, though as contemplated and hereinbefore referred to, it is apparent that the air delivered across the fabric from any one series of fans may maintain a more or less series circulation, as such air delivered from one set of fans will be returned in part to the suction side of said fans and in part delivered to the suction side of the next upper or lower fans, this being a series circulation.

In some instances, it is preferred to have the parallel circulation and in other instances desirable to have the series circulation, and obviously the construction described clearly provides for and allows the operation of the device in either parallel or series circulation. If flap valves hereinbefore referred to are appropriately arranged and distributed, it is apparent that the series or parallel circulation may be selectively maintained at will and the air from any one series of fans may be caused to circulate with respect to that series of fans or with respect to that series of fans and additionally with respect to other fans. It is, of course, understood that the air in its delivery from the fans is subjected to the action of heating elements conventionally illustrated at 23 and any appropriate type of heaters are contemplated for use.

In addition to the very short air paths, the machine described has the particular advantage that, by virtue of the arrangement of several vertical fan shafts at one or both sides of the machine, it allows the whole length of the drying space and the distance between two successive fabric layers to be utilized as one uniform large section of passage for the flow of the drying air from and to the fans.

The machine shown in Figure 3 comprises two fan shafts 7^d and 8^d at one side and two fan shafts 9^d and 10^d at the opposite side of the machine, the shafts being arranged in pairs on different halves of the machine. The circulation of the drying air is similar to that shown in Figures 1 and 2, that is to say, it takes place in the direction of the weft of the fabric.

Figure 4 shows a machine with two vertical fan shafts 7^e, 8^e and 9^e, 10^e at both sides of the machine, the shafts at one side being arranged in staggered relation to the shafts at the opposite side of the machine. Also in this machine, the circulation of the air takes place in the direction of the weft of the fabric.

In all cases, the air current may be guided so that it passes from the delivery port of a fan to the suction port of the same fan or of another fan arranged on the same or another shaft. Moreover, the current may be caused to flow wholly or partly through the fabric layers instead of along the surfaces of the layers as shown.

It will also be within the scope of this invention to provide each shaft with two fans for each tier or to omit the fan or fans at one or more tiers of the machine. Further, instead of mounting each fan shaft in a separate compartment several fan shafts may be mounted in a common compartment.

I claim:—

1. A machine for drying and tentering textile fabrics comprising: a casing, means for conveying the fabric to be processed warpwise through said casing in a sinuous path providing spaced layers of fabric extending the length of the casing and defining therein successive drying stages open at their sides, and means for inducing drying air to travel in sheet form transversely through said stages from one open side to the other thereof uniformly sweeping the entire fabric surface of each stage, said means comprising a plurality of air-impelling rotary fans parallel to the fabric layers and arranged in spaced relation lengthwise along one side of said drying stages, and walls disposed about said rotary fans directing and uniformly distributing the air impelled thereby across the fabric in weftwise moving sheets coextensive with the fabric surfaces of said stages.

2. A machine for drying and tentering textile fabrics comprising: a casing, means for conveying the fabric to be processed warpwise through said casing in a sinuous path providing spaced layers of fabric extending the length of the casing and defining therein successive drying stages open at their sides, and means for inducing drying air to travel in sheet form transversely through said stages from one open side to the other thereof uniformly sweeping the entire fabric surface of each stage, said means comprising a plurality of air-impelling rotary fans parallel to the fabric layers and arranged in spaced relation lengthwise along one side of said drying stages, walls disposed about said rotary fans, and walls along the other side of said drying stages constituting reversing chests, said two groups of walls directing and uniformly distributing the air circulated by said fans across the fabric in weftwise moving sheets coextentive with the fabric surfaces of said stages.

3. A machine for drying and tentering textile fabrics comprising: a casing, means for conveying the fabric to be processed warpwise through said casing in a sinuous path providing taut spaced layers of fabric extending the length of the casing and defining therein successive superposed drying stages open at their sides, and means for inducing drying air to travel in sheet form transversely through said stages from one open side to the other thereof uniformly sweeping and extracting moisture from the entire fabric surface of each stage, said means comprising a plurality of air-impelling rotary fans for each stage, the fans of each stage being journaled for rotation in a common horizontal plane parallel to the fabric surfaces of said stage and arranged in uniformly spaced relation along a side of the drying stage, and air-confining walls enclosing the open sides of said stages, said air-confining walls being associated with said fabric layers and said rotary fans, directing and uniformly distributing the air impelled by said fans back and forth across the fabric in weftwise moving sheets coextensive with the fabric surfaces of said stages.

4. A machine for drying and tentering textile fabrics comprising: a casing, means for conveying the fabric to be processed warpwise through said casing in a sinuous path providing taut spaced layers of fabric extending the length of the casing and defining therein successive superposed drying stages open at their sides, and means for inducing drying air to travel in sheet form transversely through said stages from one open side to the other thereof uniformly sweeping and extracting moisture from the entire fabric surface of each stage, said means comprising a plurality of air-impelling rotary fans for each stage, the fans of each stage being journaled for rotation in a common horizontal plane parallel to the fabric layers of said stage and arranged in uniformly spaced relation along a side of the drying stage, and air-confining walls for enclosing the open sides of said stages and directing the impelled air therethrough, the walls at one side of said casing constituting reversing chests, and the walls at the other side of said casing encircling said fans and diverging therefrom toward said fabric, directing and uniformly distributing the air impelled by said fans across the fabric in weftwise moving sheets coextensive with the length of the casing.

5. A tentering and drying machine for textile fabrics comprising: a casing, means for directing the fabric to be processed warpwise through said casing in a sinuous path providing spaced horizontal layers of fabric substantially longitudinally coextensive with said casing, said casing being of greater width than said fabric and said directing means maintaining the edges of said fabric in spaced relation with the sidewalls of said casing, horizontal partitions extending inwardly from one side wall of said casing to the adjacent edges of alternate layers of fabric, said partitions extending for the full length of said associated alternate layers, horizontal partitions extending inwardly from the opposite side wall of said casing to the adjacent edges of said alternate layers of fabric for the full length thereof, said two sets of horizontal partitions defining, with said associated alternate fabric layers and said casing, full length horizontal air compartments each of which is partially divided by an intermediate horizontal layer of fabric spaced along one edge from the adjacent side wall of said casing for its full length, horizontal partitions extending from one of said casing side walls to the other edges of said intermediate fabric layer for the full length thereof, each of said last mentioned partitions having a plurality of uniformly spaced ports therethrough, and air circulating means for circulating the air in each compartment through said ports, weftwise between an alternate layer and the intermediate layer of a compartment, through substantially the full length space between one side wall and the spaced edge of the intermediate layer, weftwise between the intermediate layer and the other alternate layer, and back to said ports. said air circulating means comprising vertical fan shafts each extending concentrically through a port in each of said last-mentioned partitions. and a plurality of horizontal disc fans, one in each port and driven by said fan shafts.

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