June 8, 1937. L. BUCK 2,083,141

APPARATUS FOR CONDITIONING SHEET MATERIAL

Filed Sept. 21, 1934 4 Sheets-Sheet 1

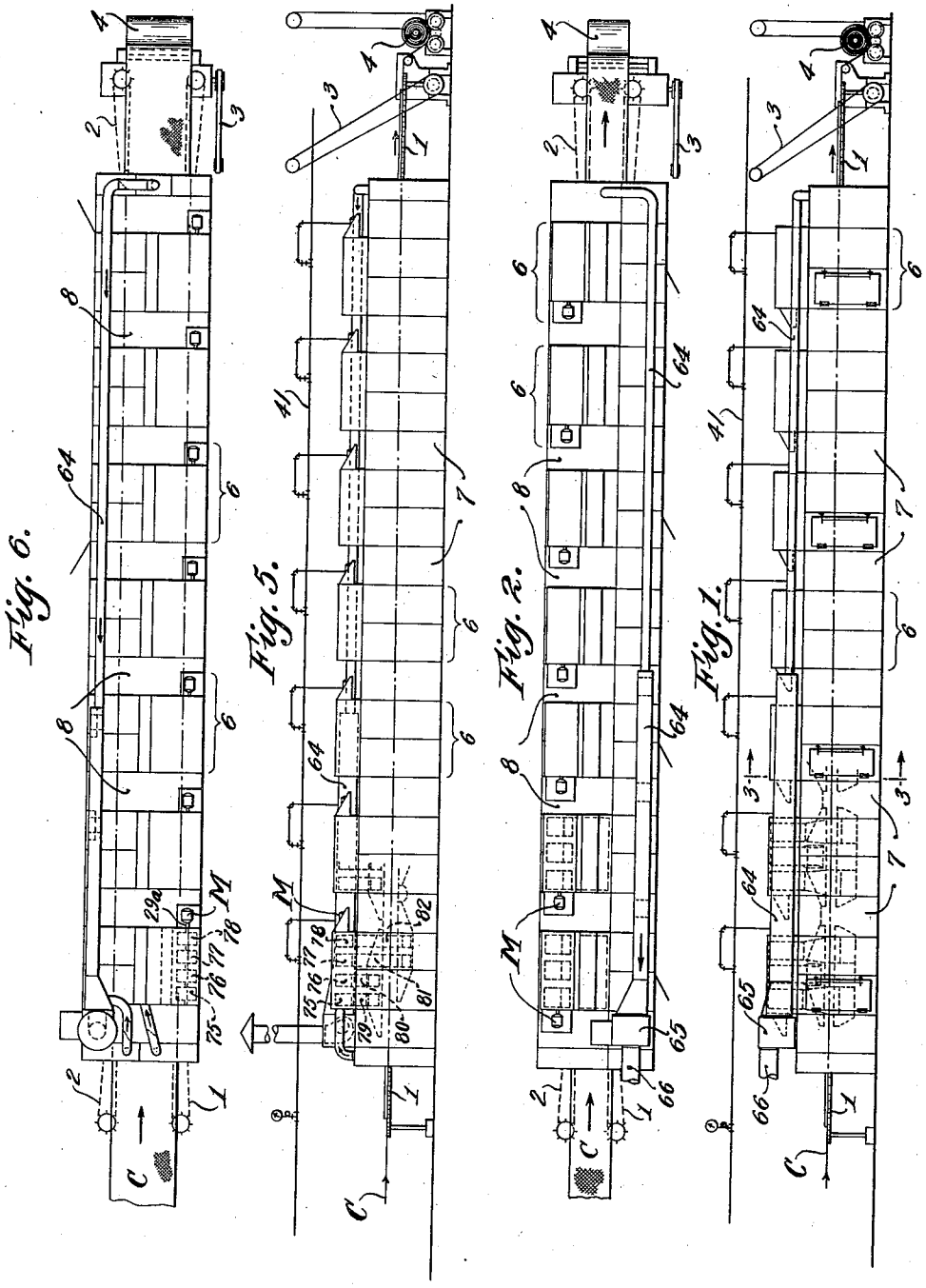

Fig. 6.

Fig. 5.

Fig. 2.

Fig. 1.

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Fig. 3.

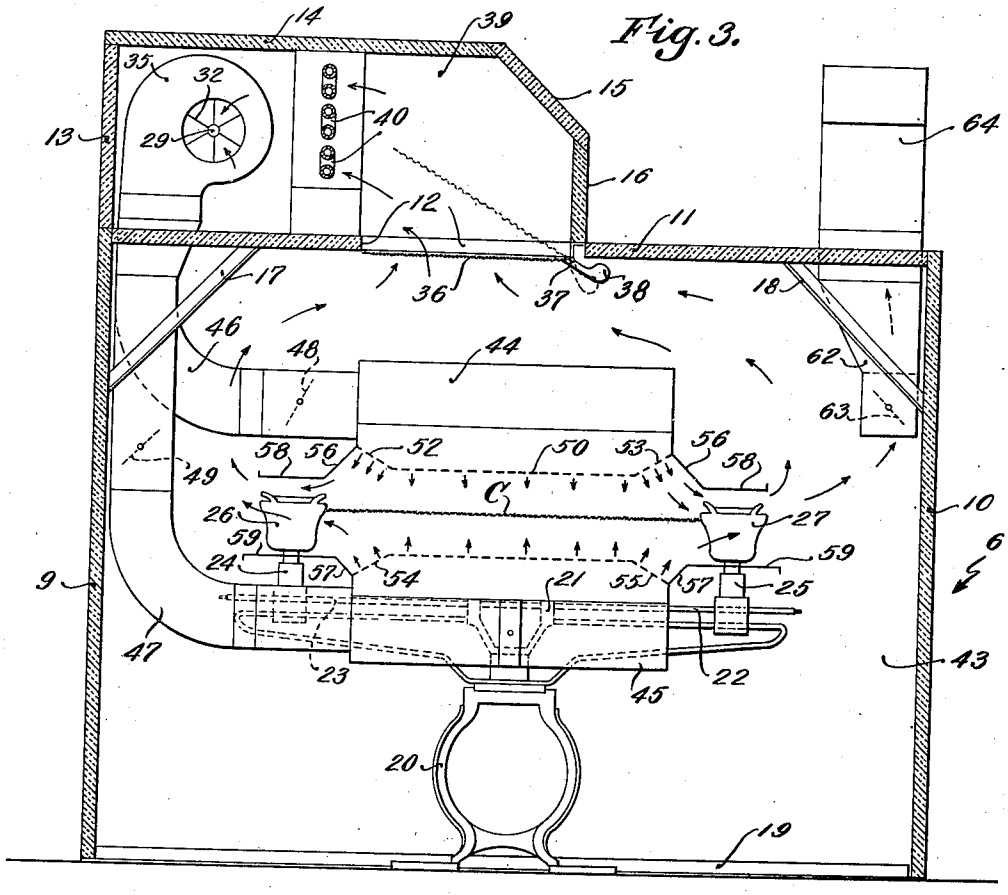


Fig. 4.

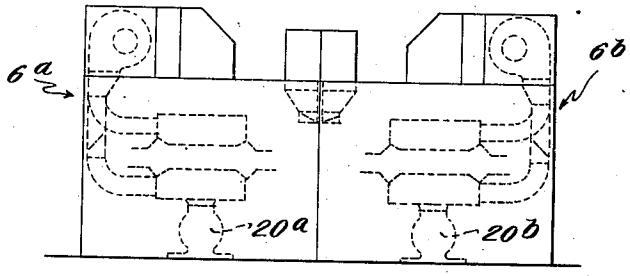
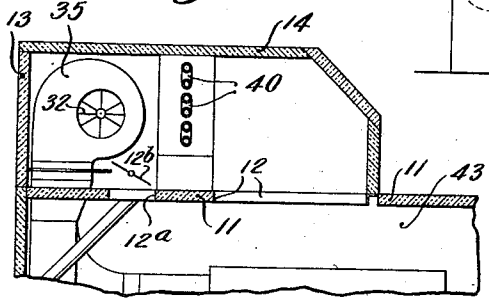


Fig. 3a.



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APPARATUS FOR CONDITIONING SHEET MATERIAL

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Fig. 7.

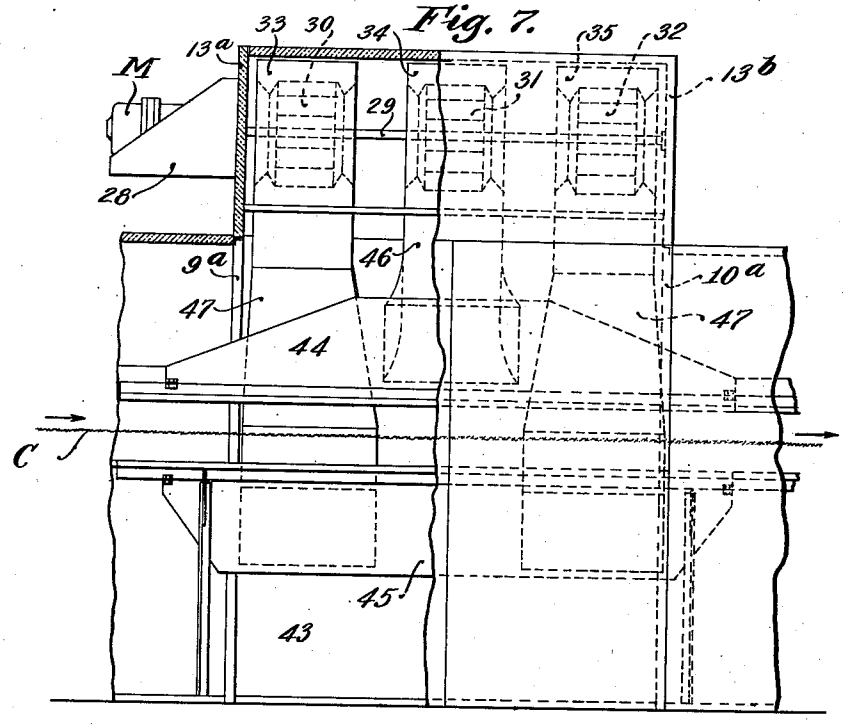
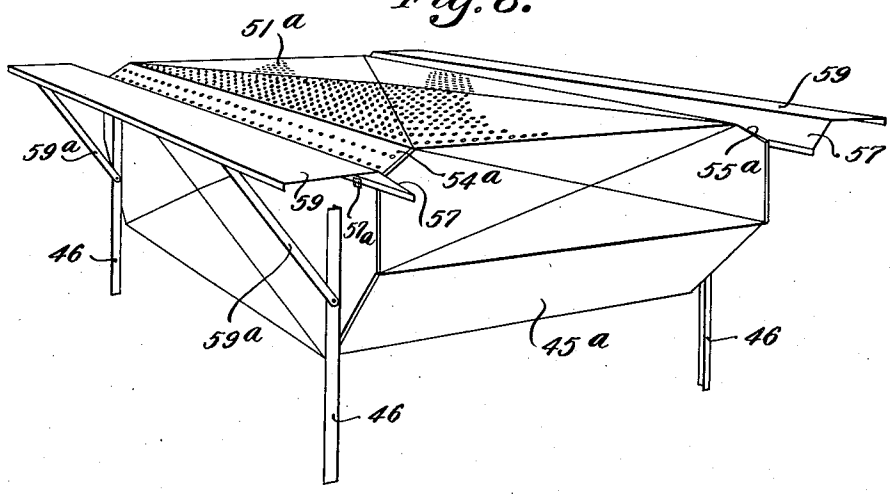


Fig. 8.



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APPARATUS FOR CONDITIONING SHEET MATERIAL

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Fig. 9.

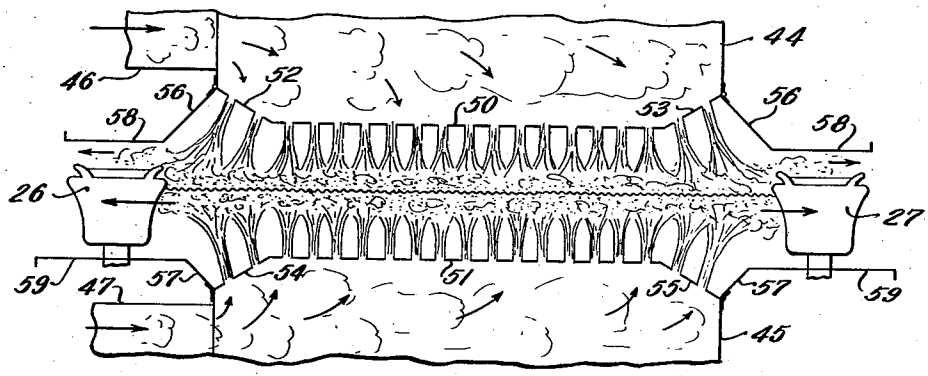


Fig. 10.

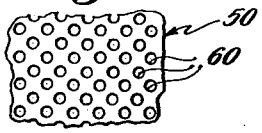


Fig. 9a

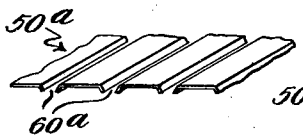


Fig. 11.

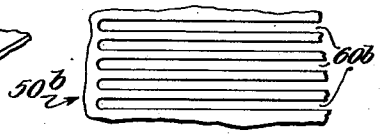


Fig. 12.

Fig. 13.

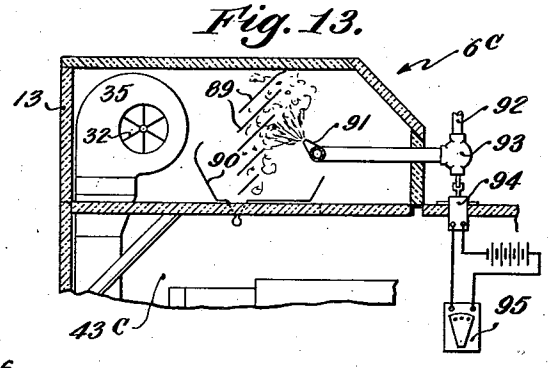
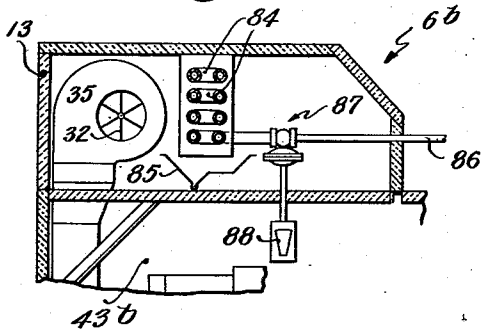


Fig. 14.



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UNITED STATES PATENT OFFICE

2,083,141

APPARATUS FOR CONDITIONING SHEET MATERIAL

Lucien Buck, Manchester, Conn.

Application September 21, 1934, Serial No. 744,883

6 Claims. (Cl. 34—48)

This invention pertains to apparatus for stretching and conditioning web-like material such, for example, as textile fabric, and relates more particularly to conditioning apparatus associated with a tentering frame or similar device. As a step in the process of finishing textile fabric it is customary to stretch the material by passing it through a tenter frame, the goods usually entering the frame in a moist, or at least damp condition, and preferably emerging from the frame substantially dry so as to retain the stretch imparted in tentering.

Efficiency of operation may require a linear speed of the fabric of the order of one hundred yards per minute in passing through the tentering frame, and in order to obtain proper drying during the relatively short period in which the material is undergoing the tentering operation, various expedients have been employed to hasten the drying operation. Among these may be mentioned the use of radiant heat, as by the provision of steam heating coils directly beneath the goods in the tenter frame (a method which is very wasteful of heat and which, without very careful supervision, may cause injury to the material); the use of a tunnel-like housing for the tenter frame through which air, usually preheated, is delivered at high velocity, such air flowing longitudinally of the goods so as to take up the moisture either by surface contact or by uncontrolled filtration through the goods; or by the use of nozzles so arranged as to deliver air under pressure and at high velocity directly against one or both surfaces of the goods so as actually to drive out the moisture by the force of the air jets. Each of these latter methods demands the expenditure of a great deal of power in producing the high velocity air used (recent practice sometimes requiring the delivery of air at the rate of from twenty thousand to thirty thousand cubic feet per minute), and since in such arrangements the air must travel through ducts from central fan-and-heater installation, there is a large loss of efficiency through friction, particularly when the air is eventually discharged through restricted nozzles at high velocity. Moreover, in these prior systems there is little provision for accurately regulating the amount of air, heat or power consumed, although some types of goods require far less heat or air than others in order to ensure proper drying, while in that type of construction in which the air is merely permitted to flow longitudinally of the enclosing tunnel or housing it is practically impossible to obtain uniformity of drying either widthwise or lengthwise of the fabric.

The principal objects of the present invention are to provide fabric conditioning apparatus such as to ensure substantial uniformity in conditioning the fabric while it is undergoing the tentering operation; to permit ready regulation of the amounts of air and/or heat employed; to provide means whereby air at relatively low velocity and pressure becomes effective for conditioning the material, thus reducing the cost of power consumed; to provide apparatus such that air at different temperatures or pressures may be employed at different points or zones lengthwise of the tenter frame in accordance with the requirements of particular conditions; to provide apparatus such that the delivery of air at selected points or zones in the length of the fabric may be stopped without affecting the flow at other points; to provide, if desired, for subjecting the fabric to the action of a cooling medium prior to its leaving the tentering frame, thereby to reduce its temperature to a point suitable for later steps in the finishing process; to provide apparatus in which air at a relatively low temperature is so uniformly distributed over the area of the material as effectively to dry the latter, thus reducing the amount of heat supplied to a minimum; and to furnish apparatus such that, if desired, the material, after first being completely dried, may thereafter have its moisture content increased to a predetermined and definite amount before leaving the tentering apparatus.

Further objects are to provide apparatus employing a plurality of independent, self-contained units each provided with air-circulating, air-distributing, and air-conditioning means, each such unit, for example, being applicable to one section or zone of a standard tenter frame, thus permitting ready variation in the total amount of heat and air supplied in accordance with the type of goods which are to be treated. A further object is to provide fabric conditioning apparatus readily applicable to tenter frames of variable width and operative without adjustment of the fabric conditioning apparatus to condition fabric of any of the widths for which the frame is designed.

A further object is to provide apparatus so designed, as, for example, by the use of a perforated septum or distributing plate or wall disposed closely adjacent to and substantially parallel with the cloth, to distribute the air over substantially the entire width of the fabric and in

such a way as to cause the air to flow without substantial rebound from the fabric, thereby employing the air in the most effective way to remove the moisture from the material.

Other and further objects and advantages of the invention will be more particularly pointed out hereinafter and by reference to the accompanying drawings wherein certain desirable embodiments of the invention are shown by way of example, and wherein:

Fig. 1 is a diagrammatic side elevation of a tentering frame of conventional type provided with fabric conditioning means in accordance with the present invention;

Fig. 2 is a plan view of the apparatus shown in Fig. 1;

Fig. 3 is a diagrammatic vertical section, to larger scale, substantially on the line 3—3 of Fig. 1;

Fig. 3ª is a fragmentary vertical section similar to the upper left-hand part of Fig. 3, but showing a slight modification;

Fig. 4 is a diagrammatic end elevation illustrating a preferred arrangement of adjacent tentering frames, each furnished with fabric conditioning means, such, for example, as illustrated in Fig. 1;

Fig. 5 is a side elevation similar to Fig. 1, but illustrating a slight modification;

Fig. 6 is a plan view of the apparatus of Fig. 5;

Fig. 7 is a fragmentary side view on a slightly reduced scale, partly in section and partly in elevation, of the unit shown in Fig. 3;

Fig. 8 is a perspective view illustrating a plenum chamber casing of a desirable type useful in the practice of the present invention;

Fig. 9 is a diagrammatic vertical section transversely of the tenter frame, and to somewhat larger scale than Fig. 3, indicating the way in which the air is delivered and distributed over the surface of the fabric;

Fig. 9ª is a fragmentary perspective view illustrating a portion of the perforate wall of the plenum chamber, provided with slits bordered by downwardly inclined flanges;

Fig. 10 is a fragmentary plan view showing the perforate wall of a plenum chamber provided with circular openings;

Fig. 11 is a view similar to Fig. 10, but showing the perforate wall provided with single parallel slots;

Fig. 12 is a fragmentary plan view showing the perforate wall of the plenum chamber as formed from a series of parallel bars with intervening slots;

Fig. 13 is a view similar to Fig. 3ª, but showing a unit provided with means for moistening the air before it is admitted to the plenum casing; and

Fig. 14 is a view similar to Fig. 3 showing a unit provided with means for cooling the air before it is admitted to the plenum casing.

Referring to Figs. 1 and 2, my improved conditioning apparatus is illustrated as applied to a usual type of cloth tentering frame comprising the parallel chains 1 and 2 guided over suitable sprockets and in conventional guideways which extend longitudinally of the frame, such chains being driven at the same linear speed by means of conventional driving mechanism disposed at the delivery end of the frame and receiving power through a belt 3. The cloth C enters at the left-hand end of the frame, as viewed in Figs. 1 and 2, and at the delivery end of the frame is rolled up by appropriate means to form the roll 4.

In accordance with the present invention most of the frame intermediate its receiving and delivery ends is enclosed within a housing, preferably of heat insulating character. For example, this housing may consist of panels of insulating material such, for example, as cork, interposed between sheets of metal, the several panels being united by connections of any appropriate type known to those skilled in the art.

Since a tentering frame is often very long and extends through several bays or sections of the mill, I prefer for this reason, as well as other reasons, to make my improved conditioning apparatus in the form of a plurality of treating zones each of which may include one or more independent units 6, each adapted to fit into the space between adjacent pedestals of the tenter frame construction and to act upon the cloth at predetermined zones or sections of the tenter frame. Since the units collectively may not necessarily extend throughout the desired length of the frame and since for some reasons it is desirable to space the units apart a certain distance, I preferably arrange them in series extending along the frame with the spaces between the individual units closed by means of side panels 7 (Fig. 1) and top panels 8 (Fig. 2). However, I contemplate the use of units of such individual lengths as to permit them to be fitted directly against each other, thereby collectively and of themselves forming the individual cloth-treating zones and the entire housing structure.

These several conditioning units 6 may be substantially alike, and it is only necessary to describe one of such units in detail together with such slight modifications as may be desirable in some of the units of the series.

Referring to Figs. 3, 7 and 9, the unit 6 is shown as comprising side walls 9 and 10 and a top wall 11, such walls, as above suggested, being of suitable insulating material, the wall 11 having an opening 12 therethrough, above which is arranged the conditioning housing comprising the end wall 13 which forms a vertical continuation of the wall 9, the top wall 14 and the opposite end walls 15 and 16, the portion 15 of the end wall preferably inclining so as better to direct the air which flows through this portion of the unit structure.

If desired, each unit may have end walls 9ª, 10ª, as illustrated in Fig. 7, such walls being furnished with openings of just sufficient width to admit passage of the cloth or to receive such elements of the unit structure as may project outwardly beyond the planes of these end walls. However, these walls 9ª and 10ª may be omitted, if desired. The upper part of the unit, that is to say, the portion which provides the conditioning casing, is likewise provided with end walls 13ª and 13ᵇ (Fig. 7). The unit casing may be braced by suitable structural elements 17, 18, 19 (Fig. 3) or the like and, if desired, the unit casing may have a bottom panel so as to form a complete closure provided the floor upon which the tenter frame rests is not of the proper character to provide the enclosed air space desired.

As illustrated in Fig. 3, the tenter frame comprises supports 20, carrying head members 21 from which project the lateral guide members 22 and 23 on which are adjustably mounted the supporting brackets 24 and 25 carrying the chain guides 26 and 27, respectively. The chains which travel along these guides support the cloth C in stretched condition at substantially the level indicated in Fig. 3.

The wall member 13ª of the conditioning cas-

ing of each unit is provided, as shown in Fig. 7, with an outstanding bracket **28** which supports an electric motor M. This motor has a shaft **29** which extends lengthwise through the conditioning casing, being mounted to turn in appropriate bearings carried by the casing, and on this shaft a plurality of fans **30**, **31**, **32**, etc. are mounted. As illustrated in Figs. 1, 2 and 7, three such fans are mounted on this shaft. Each fan has an individual casing **33**, **34**, **35**, respectively. Preferably these fans are of centrifugal type taking in air through a central opening and discharging it peripherally.

As illustrated in Fig. 3, the opening **12** which leads from the lower part of the unit casing into the upper part is normally guarded by means of a screen **36** pivotally supported at **37** and counterbalanced at **38**, the arrangement being such that if the screen becomes clogged with lint, the air pressure beneath it will raise it so as automatically to uncover the opening **12** and will free passage of air therethrough until the attendant has cleaned the lint from the screen.

The air which passes upwardly through the opening **12** enters chamber **39** in the upper part of the casing and thence passes through a bank **40** of heating coils into the part of the casing in which the fans are located. These heater coils may receive steam or other heating fluid through a main **41** (Fig. 1) having appropriate branches leading to each unit, such main being supplied with the heated fluid from any desired source, it being understood that appropriate valves are provided whereby the steam or other heating fluid supplied to each coil **40** may be regulated or cut off independently of that supplied to the other units.

The walls of the lower part of the unit define the air space or chamber **43** (Figs. 3 and 7) into which the air is delivered after it has passed over the material to be dried and from which it moves upwardly through the opening into the chamber **29** for reheating and circulation by the fans. In the chamber **43** and above the level of the cloth C, I arrange a casing **44** providing a plenum chamber, and below the level of the cloth I provide a second casing **45** defining a second plenum chamber. A conduit **46** leads from the casing **34** of fan **31** downwardly to the upper plenum casing **44**, while conduits **47** lead from the casings **33** and **35** of the fans **30** and **32**, respectively, down to the lower plenum chamber **45**. Appropriate dampers **48** and **49** may be arranged in these conduits so as to regulate or cut off the amount of air which is permitted to flow through them.

The upper plenum casing **44** is furnished with a lower perforate wall **50** and the lower plenum casing **45** is furnished with an upper perforate wall **51**, such walls being approximately parallel to the plane of the cloth and spaced a short distance above and below the level of the cloth C. The perforate walls **50** and **51** extend longitudinally of the tenter frame a distance at least as great as the length of the unit, and they may even extend outwardly beyond the end walls of the unit, as indicated for example in Fig. 7, where the plenum casings **44** and **45** are shown as projecting beyond the end walls of the unit. These perforate walls **50** and **51** preferably are of a width transversely of the cloth not exceeding the width of the narrowest cloth which is to be treated. These substantially parallel portions **50** and **51** of the bottom and top walls of the plenum casings are provided with perforate marginal portions **52**, **53** and **54**, **55**, respectively, which incline outwardly and away from the cloth level, as shown in Figs. 3 and 9.

The plenum casings **44** and **45** are also each furnished with laterally extending air guiding aprons, the aprons **56** of the casing **44** extending downwardly and outwardly from their junctions with the casing and the aprons **57** of the casing **45** extending upwardly and outwardly. Each of the aprons **56** preferably is furnished with a substantially horizontal outer part **58** while the aprons **57** are also furnished with substantially horizontal portions **59**. These horizontal portions **58** and **59** of the upper and lower aprons extend outwardly to a point beyond the position of the edge of the widest cloth which is to be tentered, so that when the tenter frame has been extended to its widest capacity, the outer edges of the aprons **58** and **59** are disposed laterally beyond the respective tenter chains.

The perforate walls **50** and **51** preferably are made of sheet material and the openings through these walls preferably are arranged as nearly uniformly as possible. In Fig. 10 the openings **60** in the wall **50** are shown as substantially circular. However, as illustrated in Fig. 9[a], the wall or septum member **50[a]** has elongate slots **60[a]** therein formed, for example, by slitting the metal and then bending the metal bordering the slits downwardly to form inclined flanges. In Fig. 11 the wall of septum **50[b]** is shown as furnished with simple elongate slots **60[b]**, while in Fig. 12 the septum or wall **50[c]** is shown as having parallel slots **60[c]** defined by a grid-like arrangement of bars **61**.

Preferably each unit casing is furnished with an educt conduit **62** having a control damper **63**, the several conduits being connected to a main **64** which extends longitudinally of the series of units and which leads to a fan casing **65** in which is arranged an exhaust fan adapted to discharge the air drawn from the several units to a discharge pipe **66** which, for example, may lead to a stack extending through the roof of the mill.

Referring to Fig. 8, I have illustrated one desirable construction for the plenum casing, for example the lower plenum casing, which in this view is indicated at **45[a]**, and which is mounted upon suitable supporting legs **46**. The upper perforate wall **51[a]** of this casing is shown as of slightly pyramidal shape in order to give it the requisite stiffness and strength, although it does not depart sufficiently from a plane surface to have any substantial effect on the direction of the air delivered through the openings therein, and for all intents and purposes this surface may be regarded as substantially horizontal. The inclined marginal portions **54[a]** and **55[a]** of this perforate surface are formed with perforations of the same type preferably as those of the main horizontal portion of the upper wall or septum, and the aprons **57** extend upwardly and outwardly and then horizontally, as shown at **59**, the aprons preferably being hinged as shown at **57[a]** to the side walls of the casing and being held in an operative position by braces **59[a]**.

The operation of such a unit as that illustrated in Figs. 3 and 7 is substantially as follows: The fan shaft **29**, being rotated by means of the motor M, draws air through the heater coils **40** and discharges it through the conduits **46** and **47** into the upper and lower plenum chambers **44** and **45**. The air thus delivered to these casings is under slight pressure and escapes through the perforations in a multitude of substantially parallel

streams, as diagrammatically indicated in Fig. 9. These streams of air mingle substantially at the surface of the fabric and then flow outwardly toward the edges of the fabric, and as the air flows outwardly its velocity tends to increase as it approaches the selvages. Since the air passing through the inclined marginal portions of the perforate walls of the plenum casings is directed at an angle outwardly, such air commingling with the air which is flowing more or less parallel to the surface of the cloth, sets up a high degree of turbulence adjacent to the selvages of the fabric and thus the selvages are dried very effectively. Since the air can not escape from between the plenum casings **44** and **46** except as it passes between the guide shields which overhang the chains of the tenter frame, it is evident that, regardless of the width to which the frame is adjusted, the selvages of the fabric will be impinged upon and conditioned by the air which flows outwardly from the plenum casings, and it will further be noted that with the present arrangement it is not necessary to adjust any part of the conditioning apparatus concomitantly with the adjustment of the width of the tenter frame.

After the air has escaped from between the guide aprons, it flows upwardly through the chamber **43** and thence through the screen **36** and opening **12** into the chamber **39** where it is ready for recirculation through the heating coil **40** and the fans. By opening the damper **63** any desired portion of this air may be drawn off from the unit casing and discharged.

In Fig. 3[a] a slight modification is illustrated in which an opening **12[a]** is provided between the chamber **43** and the fan chamber, this opening being guarded by an adjustable damper **12[b]**. When the damper **12[b]** is opened a portion of the air passes directly to the fan chamber without flowing through the heater coils **40** and by adjusting this damper any desired portion of the air may be caused to be reheated before again circulating in contact with the cloth.

In Fig. 4 I have illustrated how my improved conditioning apparatus may be applied to a pair of adjacent tenter frames without loss of space. Thus the unit casings **6[a]** and **6[b]**, which cover the tenter frames **20[a]** and **20[b]**, are shown as directly abutting with no lost space between them, the casings preferably being disposed respectively in reversed position so that the fans with their motors and shafts will be disposed at the outer or more accessible parts of the casings.

In Figs. 5 and 6, I have shown a slightly modified construction in which each of the conditioning units is furnished with a motor M' having a shaft **29[a]** carrying four fans **75, 76, 77** and **78**, respectively, each having a conduit **79, 80, 81** and **82** (Fig. 5), respectively, leading therefrom, the two first conduits extending to the upper of the plenum casings and the other two conduits extending to the lower plenum casings. By reason of the uniform distribution of the air over the surface of the cloth, it is not necessary to develop a high velocity of the air and thus I am enabled to employ blower fans of relatively small diameter and, by using several such fans upon the same shaft, to provide the desired volume of air while at the same time by delivering the air from the several fans through independent damper controlled conduits, I can control the amount of air which is delivered to the cloth at any time with great precision.

In dealing with certain types of material, for example, glove silk and rayon, in which the material is subjected to finishing processes subsequent to the tentering and in which processes it is essential that the cloth be cool, I may find it desirable to furnish one or more of the units adjacent to the delivery end of the machine with cooling means rather than heating means in order that the cloth may be delivered at the proper temperature for subsequent treatment. Thus, for example, as shown in Fig. 14, I have substituted cooling coils **84** for the heating coils **40**. Preferably a drip pan **85** is arranged beneath the cooling coils to take care of any condensate, such pan being furnished with an appropriate drain. The cooling fluid is supplied to the coil **84** through a pipe **86**, and, if desired, the flow of cooling fluid may be automatically regulated by means of a thermostatic valve **87** controlled by a thermostat **88** which may be disposed at any suitable point in the casing, for example, adjacent to the opening through which the air from the chamber **43[b]** passes upwardly into the conditioning casing.

Since under some conditions it is desirable to have the cloth emerge from the tentering frame with a definite moisture content, and since it is not always easy to dry the material so as to leave just this desired amount of moisture remaining, I may prefer to remove substantially all of the moisture, leaving the fabric bone dry and then restore moisture to a predetermined amount during the passage of the fabric through the last units of the series.

For this purpose, as shown in Fig. 13, the unit **6[c]** may be furnished with a grid or baffle **89** in place of the heating coil **40**, such grid or baffle preferably having a drip pan **90** arranged beneath it, and against this grid or in the space immediately preceding it I may arrange a vaporizing nozzle **91** supplied with water or other appropriate fluid through a pipe **92**. The supply of liquid may be automatically regulated, if desired, by means of a valve **93** controlled, for example, electrically by means of a solenoid **94** responsive to a humidostat **95** arranged at any desired point within the casing.

It is of course to be understood that all of the units may be substantially like that illustrated in Fig. 3 or that I may employ any combination of units such as those shown in Figs. 3, 13 and 14 as circumstances may warrant.

Furthermore, while I have illustrated the invention in a specific embodiment as showing a desirable arrangement of parts for obtaining the desired results, I wish it to be understood that the invention is not necessarily limited to the particular arrangements here shown, but may be embodied in any construction employing equivalent elements or arrangements within the scope of the appended claims.

I claim:

1. In combination with a cloth tentering frame, a plurality of individual conditioning units each corresponding to a predetermined section of the frame, said units being distributed longitudinally of the frame and collectively defining a housing about said frame, each unit comprising a pair of fan housings, a centrifugal fan in each housing, means for driving each fan, means for changing the temperature of air on its way to the fan housings, air distributing septums disposed above and below the cloth level respectively and substantially parallel to the plane of the cloth, each septum having a multitude of open-

ings therethrough and guide means extending laterally to points spaced outwardly beyond the positions of the edges of the cloth, and a conduit arranged to deliver air from one fan housing to the space above the upper septum, and a conduit arranged to deliver air from the other fan housing to the space below the lower septum.

2. In combination with a cloth tentering frame, a plurality of individual conditioning units each corresponding to a predetermined section of the frame, said units being distributed longitudinally of the frame and collectively defining a housing about said frame, each unit having a power driven shaft, a plurality of fans carried by each such shaft, means for varying the temperature of air on its way to the fans, plenum chamber casings above and below the cloth level respectively, said casings having substantially parallel walls disposed above and below the cloth respectively, each of said walls having a multitude of substantially uniformly distributed openings therethrough and guide means extending laterally to points spaced outwardly beyond the positions of the edges of the cloth, a conduit leading from each fan to one or the other of said plenum chamber casings respectively, means directing the air discharged from said casings, after impingement upon the cloth, back toward the fans, and means operative to vary the proportion of such returning air which passes through the temperature varying means on its way to the fans.

3. In combination with a cloth tentering frame, a plurality of conditioning units each corresponding to a predetermined section of the frame, said units being distributed longitudinally of the frame, each unit having a power driven shaft, a plurality of fans carried by the shaft, means for varying the temperature of air on its way to the fans, plenum chamber casings above and below the cloth level respectively, said casings having substantially parallel walls disposed above and below the cloth respectively, each of said walls having a multitude of substantially uniformly distributed openings therethrough, a conduit leading from each fan to one or the other of said plenum chamber casings respectively, means directing the air discharged from said casings, after impingement upon the cloth, back toward the fans, a screen for removing lint from the returning air, a pivotal support for the screen, and a counterweight for the screen such that the screen moves automatically to leave an unobstructed passage around it when it becomes clogged with lint.

4. In combination with a cloth tentering frame, a plurality of individual conditioning units each corresponding to a predetermined section of the frame, said units being distributed longitudinally of the frame and collectively defining a housing about said frame, each unit comprising a housing covering a predetermined section of the tenter frame, each such unit housing enclosing a plurality of power driven fans, plenum chamber casings disposed above and below the cloth level respectively, each casing having a wall which is substantially parallel to the plane of the cloth, said wall having a multitude of substantially uniformly distributed air delivery openings therethrough and guide means extending laterally to points spaced outwardly beyond the positions of the edges of the cloth, a conduit leading from each of the several fans to one or another of the plenum chamber casings, heat exchange means for varying the temperature of air discharged from said casings, after impingement upon the cloth and before its return to the fans, and educt conduit leading from the housing, and adjustable damper means for determining the volume of air which escapes through said educt conduit.

5. In combination with a cloth tenter frame of adjustable width, means for delivering air against the surface of the cloth being treated, said means comprising a fixed distributing element which extends transversely of the cloth but whose transverse dimension does not exceed the minimum width of cloth to be treated, and fixed guide means extending laterally from said distributing element to points outwardly beyond the positions of the edges of cloth of maximum width being treated in the frame.

6. In combination with a tenter frame of adjustable width, means for delivering air against the surface of the cloth being treated, said means comprising a fixed distributing element, said distributing element comprising a perforate plate having a central portion substantially parallel to the plane of the cloth, and perforate margins inclined outwardly and away from the cloth, and fixed guide aprons extending beyond said margins, said guide aprons having portions disposed substantially parallel to the plane of the cloth and reaching outwardly to a point beyond the margins of the cloth when the frame has been extended to its maximum width.

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