Dec. 22, 1925. 1,566,644

W. G. R. BRAEMER ET AL

METHOD AND MEANS FOR DRYING TEXTILE MATERIAL

Filed Dec. 10. 1924 2 Sheets-Sheet 1

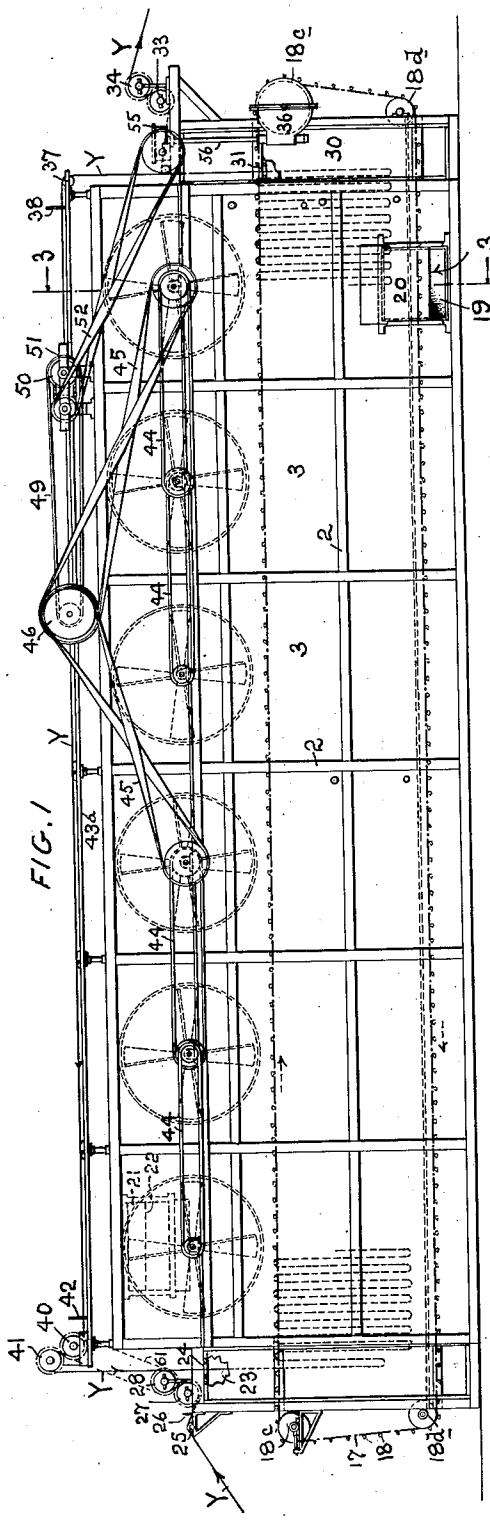

FIG. 1

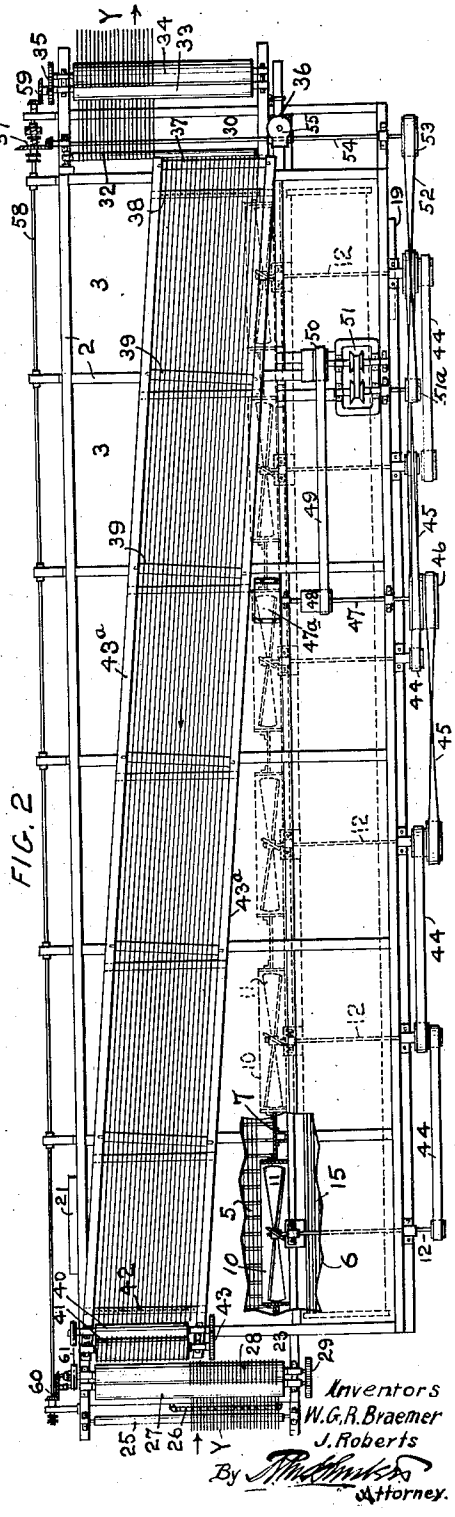

FIG. 2

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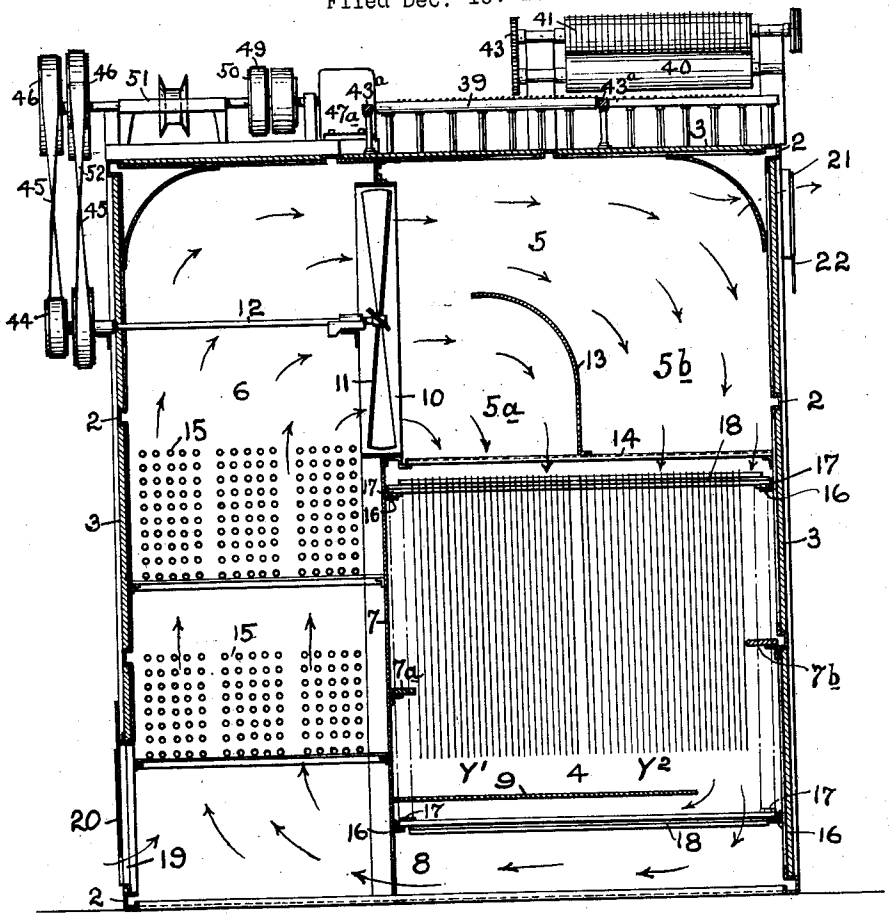


FIG. 3

FIG. 4

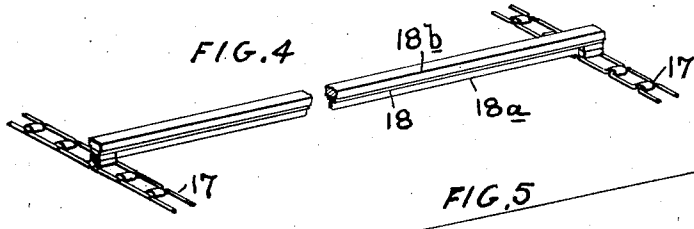
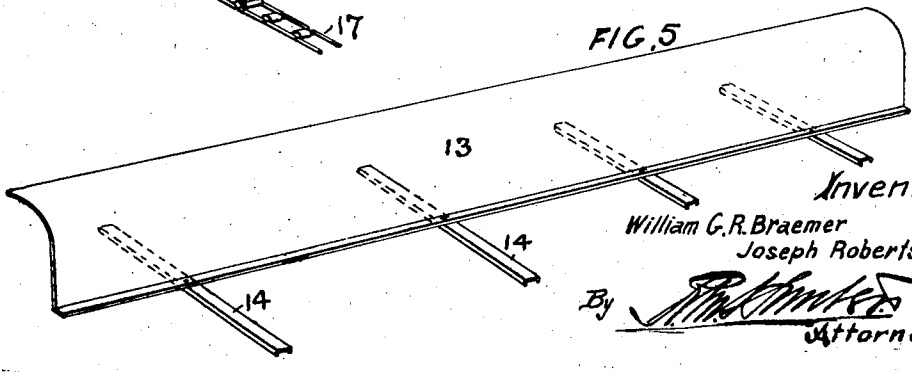


FIG. 5



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UNITED STATES PATENT OFFICE.

WILLIAM G. R. BRAEMER, OF HADDONFIELD, NEW JERSEY, AND JOSEPH ROBERTS, OF PROVIDENCE, RHODE ISLAND, ASSIGNORS TO GENERAL FIRE EXTINGUISHER COMPANY, A CORPORATION OF NEW YORK.

METHOD AND MEANS FOR DRYING TEXTILE MATERIAL.

Application filed December 10, 1924. Serial No. 754,889.

To all whom it may concern:

Be it known that we, WILLIAM G. R. BRAEMER and JOSEPH ROBERTS, both citizens of the United States, and residents of Haddonfield, county of Camden, State of New Jersey, and Providence, county of Providence, State of Rhode Island, respectively, have invented an Improvement in Methods and Means for Drying Textile Material, of which the following is a specification.

An object of our invention is to provide an automatic dryer for warps and, more particularly, for mercerized cotton warps whereby the same may be given two passages through the drying chamber with the result that for a given time of treatment and speed of movement of the yarn, the drying chamber may be greatly reduced in length than would otherwise be required.

Our object is also to so automatically apply yarns in looped condition over travelling poles that very great lengths of yarn are possible of treatment in a drying chamber of limited size and the looped yarn so provided and fed through the drying chamber will provide air spaces between the suspended yarn carried by the poles for permitting ready access and circulation of the cross currents of heated air to insure a speedy and perfect drying of the materials.

Our invention also has for its object a circulation of the heated drying medium, such as air, in a helical course along the length of the drying chamber from the discharge end toward the intake end and, at the same time, introducing fresh air gradually into the circulation at the discharge end and permitting the escape of moist air from the intake end, and so guiding the yarn through the drying chamber in which such air circulates as to induce a duplicate treatment of the yarn with the same general air conditions; that is to say, the relatively dry and fresh air is caused to act upon the yarn, in the final drying operation upon it, before it leaves the dryer and also to act upon that portion of the yarn intermediate of the length thereof which is under drying operation within the drying chamber, and, similarly, causing the most moist air to be moved in contact with the incoming wet warps and also in connection with the treatment of the warps where they enter the drying chamber to make the second passage therethrough.

A further object of our invention is to insure a passage of the same warp twice through the same drying chamber, whereby it is subjected to the drying medium twice in its course through the drying chamber and, at the same time, causing the warp, when subjected to the first drying operation, to be exposed in its heated condition to the outside atmosphere prior to its second drying treatment and while passing through substantially the same currents of drying air to which it was subjected in the first instance.

With the above and other objects in view, the nature of which will be more fully understood from the description hereinafter, the invention consists in the novel method of drying and construction of drying apparatus, as hereinafter more fully described and defined in the claims.

Referring to the drawings: Fig. 1 is a side elevation of our improved drying apparatus; Fig. 2 is a plan view of the same, with a portion of the casing broken open; Fig. 3 is a transverse section of the same, taken on line 3—3 of Fig. 1; Fig. 4 is a perspective view illustrating one of the poles and portion of the chains constituting the conveyor means; and Fig. 5 is a perspective view on a small scale showing the baffle plate employed in the drying chamber.

The general casing is made up of channel iron structures 2 filled in with insulating wall sections 3 which permit of ready removal to provide convenient access to the interior when necessary. Any other form of building up the compartment or casing structure may be employed in lieu of that shown.

The general casing is divided by a longitudinal vertical partition 7 into a drying compartment 5 and heating compartment 6 through the former of which the yarns or textile material are caused to travel and in the latter of which are provided heating coils for heating the circulating drying medium. Furthermore the heating chamber and drying chamber are in substantially continuous communication at their lower parts at 8 and are also in communication along their upper parts by tubular passages 10 in which revolving circulating fans 11 are ar-

ranged and driven by means of rotating shafts 12. As indicated in Figs. 1 and 2, there are a series of these circulating fans so that the air is, in effect, circulated transversely at all places along the length of the casing, being caused to flow upwardly through the heating coils 15 in the heating chamber 6, thence transversely into the upper part of the drying chamber 5, thence downwardly through said chamber and over the materials to be dried, and thence horizontally through the passage 8 into the bottom of the heating chamber for re-circulation. The upper part of the drying chamber 5 is provided with a longitudinal baffle plate 13 having its upper part curved in a direction toward the center of the fans and said baffle plate supported by transverse bars 14 extending across the compartment and sustained at each end from the casing. The general shape of this baffle plate 13 is shown on a small scale in Fig. 5. This baffle plate 13 divides the air currents and causes them to be deflected downward, respectively through passage 5^a to the textile material as it passes first through the drying chamber and through passage 5^b to the same material when it repeats its passage through the drying chamber. The baffle plate, furthermore, insures a substantially equal body of air reaching the textile material in each of the two cases. However, it will be noted that the upper end of the baffle plate is slightly above the level of the axis of the fan shafts 12, so that the volume of heated air which passes to the textile material during its first passage through the drying chamber is somewhat greater than the volume of heated air that is delivered to the textile material when passing the second time through the drying chamber and at which time it is much dryer than during the first passage.

The lower part 4 of the drying chamber is partly closed by a horizontal baffle plate 9 which extends horizontally from the division wall 7 for about three-quarters of the width of the drying chamber, said baffle or deflecting plate performing the function of causing the air passing downward through the textile material to flow toward the side of the chamber most distant from the heating chamber as indicated by the arrows, and thence passing downward through the passage 8 below the baffle plate 9 into the lower part of the heating chamber 6 below the heating coils 15 therein. In this manner, heated air as the drying medium is caused to fully circulate over the textile material as it passes through the drying chamber in a more or less uniform manner.

A wooden guide 7^a is arranged along the division wall 7 and projecting toward the yarn or other textile material in the drying chamber, to prevent the same from riding off the supporting poles and coming in contact with the heated division wall. A similar guide may be arranged along the outer wall at the opposite side of the drying chamber, as indicated at 7^b, if so desired.

In the particular construction shown, the conveying means for the warps constituting the textile material to be dried consists of two endless chains 17 guided at an operating level about chain wheels 18^c and at a return level about guide wheels 18^d. These chains are driven in any suitable manner, but preferably as hereinafter described. The links of the chains 17 are connected by transverse bars or poles 18 of suitable construction. In our preferred construction, each of these bars are formed of a metallic T shaped bar 18^a connected at its ends to the respective chains and having secured to its flanged part a transverse wooden bar 18^b, as is more fully shown in Fig. 4. The wooden bar preferably extends slightly beyond the metallic T-shaped member and the warps Y are hung over bars of this construction spaced apart sufficiently to allow the warps to hang in looped or festooned form, as is indicated in Fig. 1, and at the same time to allow free circulation of the heated air about the warps during the drying operation.

During the functioning of the machine, the conveyor travels in the direction indicated by the arrow, that is, it conveys the warps during the drying operation from left to right, in Fig. 1. During this operation, the air is circulated through the drying chamber and heating chamber, as indicated by the arrows in Fig. 3, said circulation being induced by the action of the fans 11. As the air becomes laden with moisture from the wet warps being introduced into the drying chamber, it is necessary to permit the circulating air, when it becomes very moist, to escape from the drying chamber into the atmosphere and, at the same time, to permit an inflow of an equivalent quantity of fresh dry air. The dry air is admitted through an intake passage 19 adjacent to the delivery end of the machine and the quantity of air admitted may be regulated by a sliding damper 20, as shown in Fig. 1. The moist air is permitted to escape through an outlet 21 controlled by a sliding damper 22 arranged at the intake end of the drying chamber and preferably at the upper part thereof. In this manner, it will be understood that during the transverse circulation of the air, as indicated in Fig. 3, the escaping moist air from the outlet 21 and the corresponding inflow of fresh dry air by the inlet 19, will induce the circulating air under the influence of the fans to travel in a spiral course; that is to say, that the escaping air being displaced by a corresponding inflow of fresh air will cause the dual body of air within the drying and heating chambers to pass gradually from

the delivery end of the machine to the intake end thereof, or from the right hand end to the left hand end in Fig. 1. The speed of travel of the air in this direction is governed by the extent of the opening in the intake passage 19, it being understood that the smaller the passage, the slower will be the movement of the air longitudinally through the drying chamber, but without any material effect upon the transverse circulation, indicated by the arrows in Fig. 3. It will, of course, be understood that the change in the circulating air as a drying medium, due to the elimination of moist air and an equivalent reception of dry air, should not be greater than is sufficient to insure the thorough drying of the warps in passing twice through the machine. This is, of course, governed somewhat by the speed of travel of the conveyor means through the drying chamber and the extent of moisture which is carried into the machine by the warps.

Considering now the means shown for feeding the warps to the conveyor and delivering them from the conveyor, together with the means for re-transferring the warps to the conveyor for the secondary treatment, the following instrumentalities are employed. At the receiving end of the apparatus, the warps Y pass over a guide roller 25 and between guiding pins 26 by which they are properly spaced apart. The warps then pass between feeding rolls 27 and 28 (which are geared together at 29) and which positively draw the warps over the roller 25 and deliver them downward in a looped condition over the transverse bars 18 of the conveyor 17. As the warps are fed downward from the feed rollers, they pass through a slot 24 in the top of a compartment extension 23 to the end of the drying chamber, as will be understood by reference to Fig. 1. The depth of the loops or festoons formed by the warps is regulated by the speed of the feed rolls 27 and 28, as compared with the speed of travel of the conveyor, and hence the said length or depth of the warp loops may be given any proportion desired. At the delivery end, the warps Y are drawn upward through an aperture 31 in the top of a compartment extension 30 at the delivery end of the drying chamber, and said yarns rise to an elevation above the general casing of the apparatus and then pass horizontally over a guide roller 37. These warp threads are then passed between guide pins 38 and thence over a series of horizontal guide rollers 39 supported by a longitudinal frame 43ª resting upon the top of the casing and having its direction of length arranged diagonally, so that its delivery end is brought to the position which is out of alinement with the intake end of the drying chamber, previously described. The warps are guided between further spacing pins 42, and thence between and about feed rolls 40 and 41 geared together at 43, and whereby the warps pass downwardly as in the first case through the transverse slot 24 of the compartment extension 23, by which the warps are delivered to the transverse bars 18 of the conveyor 17, in loops or festoons, and to one side of the looped warps which are delivered to the conveyor by the feed rolls 27 and 28, as previously described. When the conveyor is provided with two sets of looped warps, they are arranged side by side, as indicated at Y′ and Y² in Fig. 3, so that the total width of the drying chamber is substantially filled by the warps. After the warps are subjected to the drying operation and are to be delivered finally from the drying chamber, they are drawn upward from the compartment chamber 30 through the transverse slot 31 therein, thence guided over the roller 32 and delivered from the machine by the feed rollers 33 and 34 which are geared together at 35.

We do not confine ourselves to any particular driving mechanism for operating the feed rolls 27 and 28, 40 and 41, and 33 and 34, as they may be driven in any suitable manner. We have shown, however, the following manner of driving the said rolls. 58 is a longitudinal shaft extending for the full length of the drying chamber and said shaft is geared at one end, by bevel gears, 59 to drive the feed rolls 33 and 34. At the other end, the shaft is provided with bevel gears 60 for driving the feed rolls 27 and 28. The feed rolls 40 and 41 are driven by a sprocket chain transmission 61 arranged between the shafts of the rollers 28 and 40. It is manifest that the feeding speeds of all of the three sets of driving rolls should be the same. The shaft 58 may be directly driven by any suitable power, but, as shown, it is operated by a transverse shaft 54 having its end geared to shaft 58 by bevel gearing 57. This shaft 54 operates through suitable worm and worm wheel gearing 55 to drive a vertical shaft 56, said vertical shaft operating through worm and worm wheel gearing 36 to drive the conveyor 17, so that the speed of the conveyor has a certain definite relation to the speed of the feeding rolls. The shaft 54 is provided with a belt pulley 53 which is driven by a belt 52 from the pulley 51ª of the variable speed transmission device 51, the same being driven by a belt 49 receiving power through a driving pulley 48 and transmitting it to the variable speed transmission device by means of a fast and loose pulley 50. By shifting of the belt 49, the feeding of the conveyor and warps may be stopped at any time while permitting the fans to continue in operation, if so desired.

A suitable variator or speed control means performing the function of the device 51 is

set out, by way of example, in Letters Patent No. 1,377,593, and reference is made thereto as showing an example of a suitable mechanism. We, however, do not limit ourselves as to the means for varying the speed of the conveyor and warps relatively to the speed of the circulating fans.

The pulley 48 is secured to a shaft 47 which may be driven by an electric motor or other means 47a. This shaft 47 is provided with pulleys 46 from which belts 45 drive two of the shafts 12 of the fans 11 and these driven shafts, by means of power transmitting belts and pulleys 44, operate to drive the remaining shafts 12 of the other fans. In this manner, all of the fans 11 are rotated at the same speeds and these speeds may remain constant while, through the variator 51, the speed of travel of the conveyor and warps may be increased or decreased, as desired.

In the carrying out of the method of drying performed by this apparatus, it is seen that the wet warp is partly dried in its first passage through the closed drying chamber and then, in the heated condition, it is exposed to the outside atmosphere to reduce the extent of its moisture and to permit it to be returned to the conveyor whereby it is fed through the closed drying chamber a second time for the completion of the drying operation. During this operation, it is observed that in the parallel passage of the warps in the two instances through the drying chamber, they are in each case being gradually dried, but, in the first passage, the warps contain greater moisture than in the second passage; and as there would be a tendency of the heated air to more readily circulate through the dryer portions of the warp provided by the second passage of it through the drying chamber, this is guarded against by the use of the deflector or baffle plate 13 which positively insures approximately half, and preferably slightly more than half, of the circulating air to pass downward over the warps containing the most moisture and constituting those in the first passage through the drying chamber.

We have described our improved method and means in that particularity which we deem to be the best exposition of our invention and that which we prefer in commercial practice, but we do not restrict or confine ourselves to the minor or secondary details, as such are susceptible of modification and which may be resorted to as matters of mechanical skill and without a departure from the spirit of the invention.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a drying apparatus, the combination of a casing having a drying chamber provided with inlets at one end and outlets at the other end for yarn or other material being dried and a heating chamber parallel to the drying chamber and in communication with the bottom portion thereof, heating coils arranged in the heating chamber for heating the circulating air, a plurality of circulating fans arranged at intervals along the length of the chambers to provide a plurality of transversely circulating means for causing the currents of air to circulate successively through the drying chamber and heating chamber, means for conveying the yarn or other material to be dried lengthwise through the drying chamber, two sets of means for feeding the yarn or other material into the intake end of the drying chamber at different places transversely situated, and two separate means for delivering the treated yarn or other material from the outlet end of the drying chamber and at different places transversely situated, whereby the yarn or other material being dried is passed through the apparatus in two stages and thereby receives two consecutive drying treatments, the means for delivering the yarn or other material after it leaves the drying chamber in the first stage or passage therethrough of the drying operation being constructed for feeding the yarn or other material to the intake end of the drying chamber preliminary to the second stage of the drying treatment thereof.

2. The invention according to claim 1, wherein the means for delivering the yarn after the first stage of the drying treatment to the means for feeding it into the intake end of the drying chamber in the second stage of the drying treatment, comprises diagonal guide means for insuring the delivery of the yarn or other material into the drying chamber for the second stage of the treatment to one side of the same yarn as it is fed into the drying chamber in the first stage of the drying treatment, whereby the preliminary feeding of the yarn into the drying chamber and its final delivery therefrom take place at places out of direct alinement.

3. The invention according to claim 1, wherein further, the casing is provided at its delivery end with a valve controlled air intake for permitting fresh dry air to enter into the circulation within the casing, and valve controlled exit means arranged adjacent to the inlet end of the casing and drying chamber for permitting the escape of moist air from the interior of the casing, whereby the circulating air is caused to follow a helical course through the longitudinal drying and heating chambers while moving in a direction from the outlet end to the inlet end of the drying chamber and the excess of moisture is gradually eliminated from the interior of the drying chamber.

4. The invention according to claim 1,

wherein further, power means are provided for driving the circulating fans at a uniform speed, and variable speed driving mechanism are provided for controlling the speed of the conveyor means for carrying the yarn through the drying chamber and also for governing the speed of the means for delivering the yarn into and out of the drying chamber and for conveying it intermediate of the two stages of the drying operation.

5. The invention according to claim 1, wherein further, the drying chamber and the heating chamber are separated in part by a vertical wall which also is provided with guiding means for the conveyor means for the yarn, and a laterally extending guide board carried by the vertical wall at a distance below the conveyor means upon which the yarn is supported whereby said yarn is maintained at a definite distance away from the wall during its passage through the drying chamber.

6. The invention according to claim 1, wherein the fans are arranged for forcing the air into the upper part of the drying chamber and above the conveyor means for the yarn, said upper part of the drying chamber provided with a curved baffle plate extending longitudinally of the drying chamber for dividing the air currents from the fans into two bodies and being separately directed downward, one body of circulating air being projected downward upon the yarn during the first stage of the drying operation and the second body of circulating air being directed downward upon the yarn during the second stage of the drying operation.

7. The invention according to claim 1, wherein further, the upper portion of the drying chamber is provided with a longitudinally arranged and transversely curved baffle with its curved end directed toward the fans for dividing the air currents into two circulating bodies of air and causing them to be projected downward, and wherein further, the lower portion of the drying chamber is provided with a longitudinal horizontal baffle plate extending from the division wall between the drying chamber and heating chamber but part way across the drying chamber and forming a lower circulating passage from the drying chamber into the heating chamber below the heating coils therein.

8. The invention according to claim 1, wherein the means for delivering the yarn from the delivery end of the first stage of the treatment to the intake end of the second stage of the treatment comprises guiding means arranged above the top of the drying chamber.

9. The invention according to claim 1, wherein the means for delivering the yarn from the delivery end of the first stage of the treatment to the intake end of the second stage of the treatment comprises guiding means arranged above the top of the drying chamber, said means comprising a plurality of guide rolls arranged diagonally, and a plurality of guides at each end of said guiding means for guiding the warps and keeping them separated from each other.

10. The invention according to claim 1, wherein the means for conveying the yarn through the drying chamber comprises a pair of endless chains having transverse connecting bars over which the yarn is looped in festoons, and feeding and discharging chambers are provided at the inlet and delivery ends of the drying chamber with transverse openings at the top for the passage of the yarn vertically downward to the conveyor at one end and upward from the conveyor at the other end, and connecting means whereby the speed of delivery and removal of the yarn is timed in respect to the speed of travel of the conveyor whereby the yarn will be uniformly distributed along the conveyor between the feeding and discharge chambers.

11. The herein described method of drying textile material in long lengths, which consists in producing within a long drying chamber transverse currents of heated air by the recirculation of the air content of the drying chamber and at the same time slowly advancing the heated body of air through the drying chamber from the delivery end to the intake end and controlling the speed of movement of the air longitudinally of the drying chamber by continuously supplying fresh dry air in controlled quantities at one end of the circulating air body and removing a corresponding amount of moist air from the opposite end of the air body, and during the said recirculation of the heated air body causing the textile material to be dried to be fed through the circulating heated air body in a direction contrary to the direction of longitudinal travel of the latter through the drying chamber to produce a preliminary drying of the material and thereafter returning the textile material so dried and causing said material to again pass through the circulating heated air in a direction contrary to the longitudinal travel of the air through the drying chamber to complete the drying operation, and finally causing the textile material to leave the body of circulating heated air and pass out of the drying chamber in a substantially dried condition.

12. The method according to claim 11, wherein further, the material to be dried is in the form of warps and said warps while passing through the drying chamber are caused to be suspended in festoon form and with the warps in substantially separated

condition, and wherein also the warps in being fed a second time through the drying chamber are caused to pass from the delivery end of the drying chamber in a diagonal direction outside of said chamber to the intake end thereof for a second treatment, and wherein further, the warps in passing through the drying chamber in the second treatment are kept separate from the warps simultaneously passing through under their first treatment.

In testimony of which invention, I hereunto set my hand.

WILLIAM G. R. BRAEMER.

In testiomny of which invention, I hereunto set my hand.

JOSEPH ROBERTS.