Sept. 1, 1925. 1,552,099

J. H. WALSH

PROCESS OF AND APPARATUS FOR DRYING PERVIOUS MATERIAL

Filed April 14, 1922 3 Sheets-Sheet 1

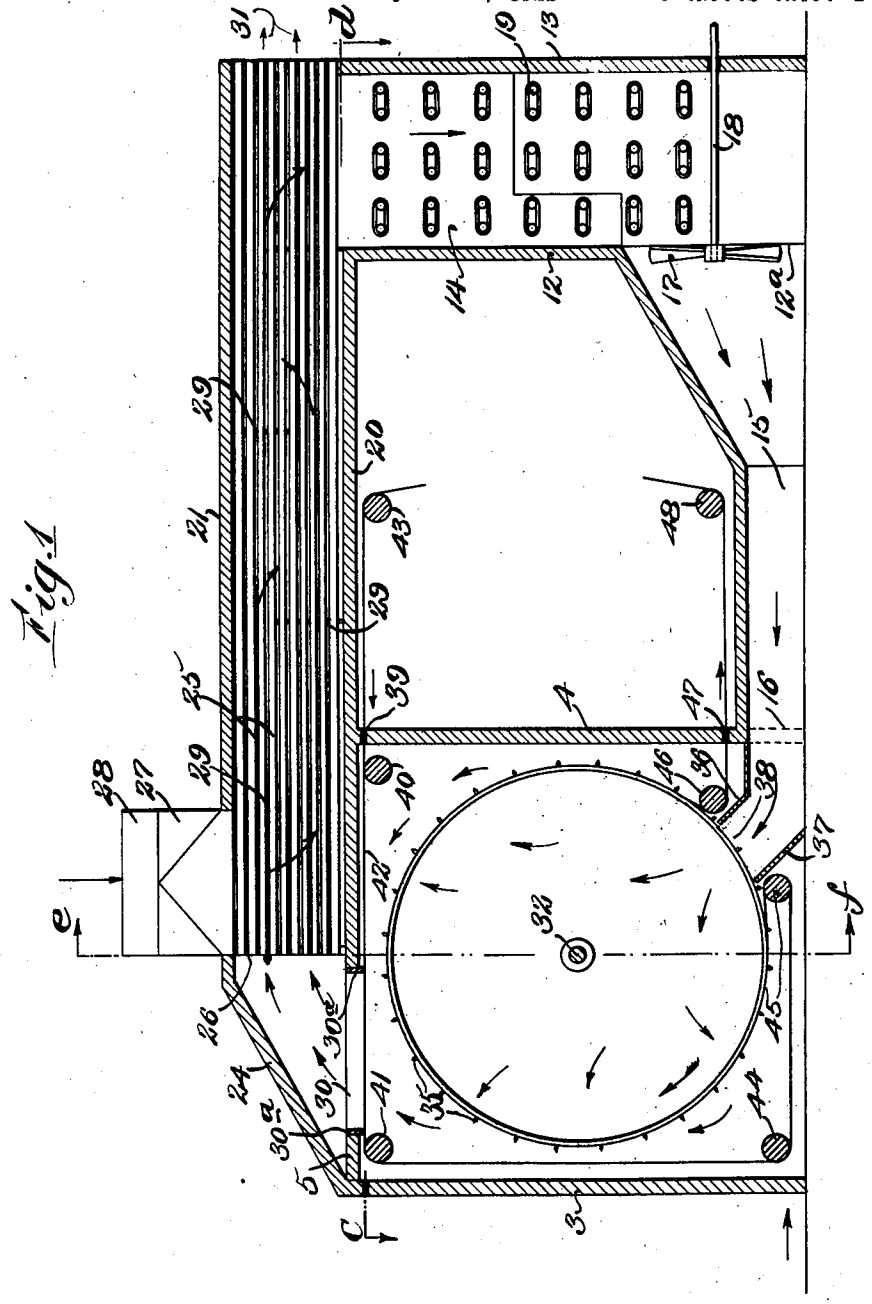

Fig. 1

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Fig. 4.

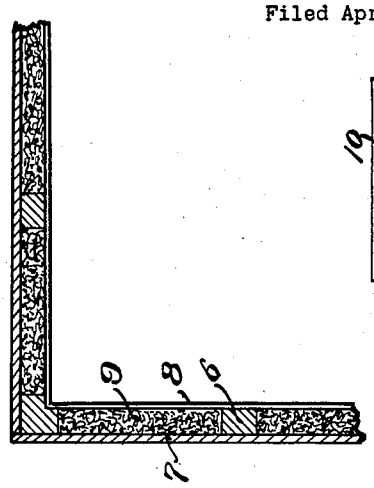
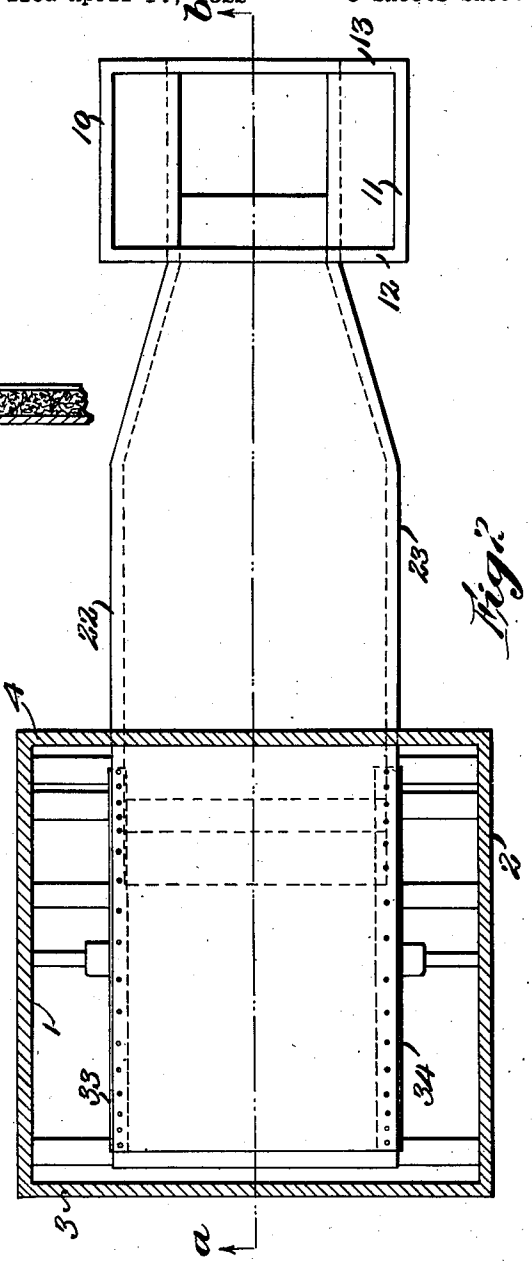


Fig. 2.



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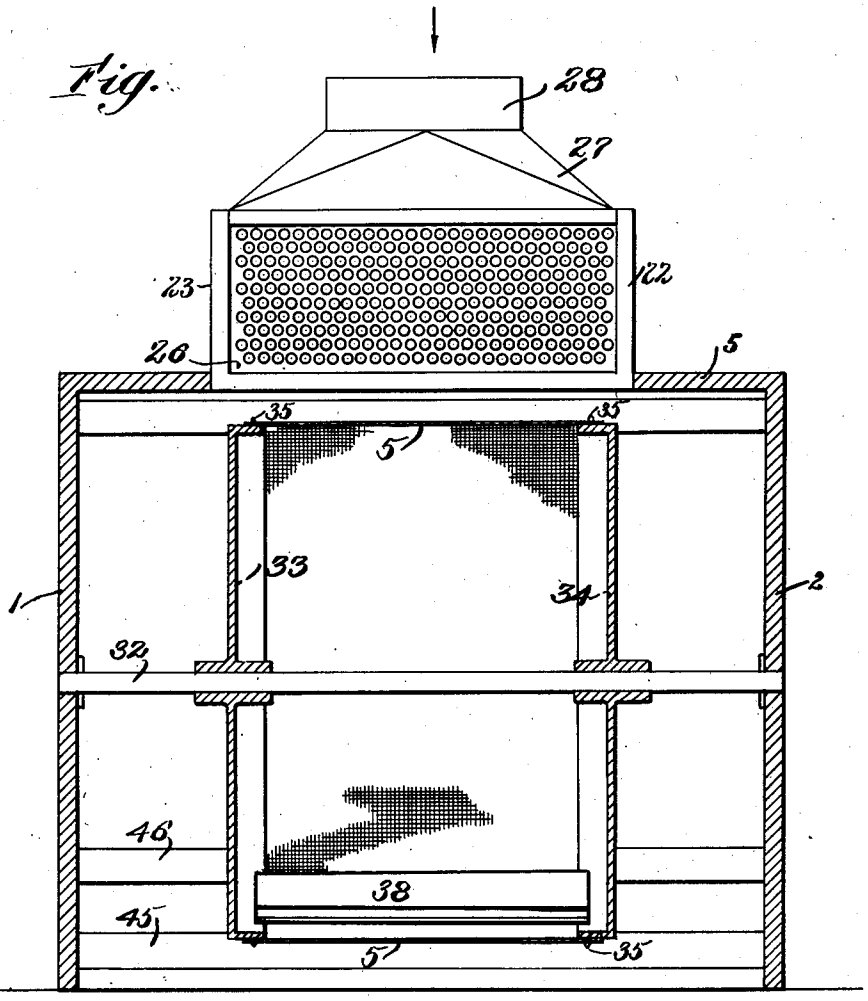
Filed April 14, 1922 3 Sheets-Sheet 3

Fig.



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UNITED STATES PATENT OFFICE.

JOSEPH H. WALSH, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO JOHNS-MANVILLE, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PROCESS OF AND APPARATUS FOR DRYING PERVIOUS MATERIAL.

Application filed April 14, 1922. Serial No. 552,725.

To all whom it may concern:

Be it known that I, JOSEPH H. WALSH, a citizen of the United States of America, and resident of Boston, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Processes of and Apparatus for Drying Pervious Material, of which the following is a specification.

This invention relates to a method of drying material and to apparatus useful in performing such method, and more particularly to a method and apparatus especially useful for the economical and rapid removal of moisture from relatively thick but pervious sheet material such for example as webs of textile fabric and the like.

In the drying of textiles and particularly relatively heavy and napped fabrics, such for instance as blanket webs, it is difficult from a manufacturing standpoint to remove the moisture from the interior portion of the material by the mere application of a drying medium to the surfaces thereof. While some gain in rapidity and thoroughness of drying may be secured by increasing the temperature of the drying medium, it is evident that a limit is soon reached beyond which it is not possible to go without danger of scorching the outer surfaces of the material, and in fact at a much lower temperature than this, the material suffers substantial deterioration by reason, apparently, of the formation of steam in the interstices of the fabric and the yarns of which it is made resulting in the bursting apart of the yarns and breakage of fibres with damage to the quality of the fabric. In a modern mill, where the daily output is large, the problem of drying the material without undue consumption of heat is one worthy of careful consideration, and while the general principles involved in the economical use and conservation of heat have long been recognized by engineers, little attempt has apparently been made heretofore to apply such principles in a practical manner in the drying of heavy textile materials in commercial quantities.

A principal object of the present invention is therefore to provide a method and apparatus whereby relatively thick but pervious sheet material such for example as blanket cloth, may be dried rapidly and without substantial damage thereto of either a superficial or structural character, and whereby, at the same time, the heat consumed in the process may be reduced to a minimum.

In carrying this object into effect, the web of material may be caused to traverse a predetermined path, and at desired points in said path a current of warm air may be passed transversely through the interstices of the fabric from one side to the other side thereof. Preferably the same air is caused to pass repeatedly through the fabric, the incoming warm and relatively dry air first passing at a low velocity through that portion of the web which has already parted with some of its moisture and in which the drying process is nearly complete, and thereafter causing such air to pass, preferably with increased velocity, through the wetter portions of the web. Such warm and moisture laden air, after its final passage through the fabric may then be passed through an economizer device where it parts with most of its heat to the incoming fresh air.

In the accompanying drawings there is illustrated, by way of example, one embodiment of means proper for carrying the invention into effect, and in such drawings,—

Fig. 1 is a longitudinal vertical section through the complete apparatus on a line such as *a*, *b* of Fig. 2;

Fig. 2 is a horizontal section on the line *c*, *d* of Fig. 1;

Fig. 3 is a vertical cross section to somewhat larger scale on the line *e*, *f* of Fig. 1; and

Fig. 4 is a fragmentary typical section through a wall of the apparatus illustrating the heat insulating structure.

The apparatus as herein illustrated comprises a housing consisting of the side walls 1, 2, the end walls 3, 4, and a top wall or roof 5. Preferably such walls and roof are of heat insulating construction and may consist as illustrated in Fig. 4 of the studs or joists 6, an outer sheathing 7 of wood or other desirable material, an inner sheath-

ing 8 of "asbestos wood" or equivalent acid-resistant, water-proof material, and an inner filling 9 of fibrous asbestos or air cell sheet asbestos. When so constructed the housing serves to retain the heat of the drying medium introduced therein and to prevent the loss of such heat to the outside atmosphere. Spaced from the wall 4 of such housing is a second, auxiliary housing comprising the vertical side walls 10, 11 and the end walls 12, 13, such walls forming therebetween a chamber 14 which is open at its upper end. The wall 12 of this auxiliary chamber is provided with an opening 12^a at its lower portion, such opening communicating by means of a duct 15 with an opening 16 in the lower part of the wall 4 of the first named housing. Adjacent to the opening 12^a a fan 17 is arranged, such fan being carried by a shaft 18 which may be power driven in any suitable manner. In the chamber 14 and above the fan there are arranged a series of heating coils 19 which may be supplied with any suitable heating medium whereby air drawn downwardly through the chamber 14 by the fan 17 may be raised in temperature prior to its discharge through the duct 15.

The upper wall 5 of the first named housing is extended rearwardly as indicated at 20 and is united to the upper portion of the wall 12, the member 20 forming the floor of an economizer device. This economizer device comprises the top wall or roof 21, the side walls 22, 23, and the end wall 24, the latter wall sloping downwardly from the front edge of the roof 21 and being united to the top edge of the wall 3. Within the chamber formed between the walls 21, 22, 23 and the floor member 20 is arranged a series of substantially parallel open-ended tubes or pipes 25. Preferably such tubes or pipes are of thin metal or other heat conducting material. These pipes, at their forward ends are seated in openings in a vertical partition 26 which extends from the member 21 to the member 5, while at their rear ends such tubes pass through openings in a vertical extension of the wall 13. Immediately to the rear of the partition 26 an opening is formed in the top wall or roof 21 of the economizer device, and associated with such opening is a hood 27 of metal or other suitable material. This hood terminates in a flange or collar 28 to which may be secured a pipe or conduit for leading air to the hood. Within the economizer chamber a plurality of vertically disposed baffle plates 29 are preferably arranged, such plates being so disposed as to compel air which enters through the hood 27 to flow a tortuous course in moving longitudinally through the economizer chamber.

In the top member 5 of the first mentioned housing and immediately below the wall 24 of the economizer device, an air egress opening 30 is formed. With the arrangement thus far described it will be clear that upon rotation of the fan 17, air will be drawn downwardly through the chamber 14 and forced through the duct 15 into the first named housing from which such air will escape through the egress opening 30 and will pass thence through the economizer tubes and will be discharged into the outside atmosphere as indicated by the arrows 31. At the same time fresh air will be drawn through the hood 27 and will pass longitudinally of the economizer device and around tubes 25 so that the heat of the air passing through the tubes may be transferred to the incoming air.

Extending transversely across the first-named housing and journalled in openings in the walls 1, 2 thereof is a shaft 32 upon which is mounted a drum consisting of the spaced heads 33 and 34, said heads being provided with radial pins or spurs 35 projecting from their edges, such pins serving to engage the marginal portions of the fabric and hold it taut as it passes about the periphery of the drum.

Extending from the opening 16 at the lower part of the wall 4 is a conduit comprising the upper wall 36 and the lower wall 37, such walls terminating closely adjacent to the peripheral surface of the drum. This conduit provides an ingress opening 38 whereby air from the duct 15 may be caused to enter the interior of the drum. At the upper part of the wall 4 of the housing, a horizontal slot 39 is provided and immediately within said wall and closely adjacent to the top wall 5 is arranged a guide roller 40. Adjacent to the opposite wall 3 of the housing is a second guide roll 41, such rollers serving to guide a web 42 of fabric as it enters the opening 39. A guide roll 43 may be provided exterior to the housing for directing the web of fabric toward the slot 39. The rolls 40 and 41 are so disposed as to maintain the fabric in a plane parallel to the top wall 5 of the housing and very closely adjacent thereto, such fabric passing transversely across the opening 30. If desired, and for maintaining a tight joint between the wall 5 and the fabric as the latter passes the opening, strips of felt or some similar material 30^a may be caused to depend from the edges of the opening 30. Below the guide roll 41 is a guide roll 44 and, in the included angle between the drum and the member 37 is another guide roll 45. A guide roll 46 is also arranged in the included angle between the drum and the member 36, and in the wall 4 adjacent to the roll 46, a second slot 47 is provided for egress of the web of fabric from the housing. A

guide roll 48 may be provided for guiding the fabric as it emerges from the housing. As will be noticed, the arrangement of the guide rolls 45 and 46 is such that the fabric is held closely against the peripheral edges of the drum heads 34, 35, except at such portion of said edges as at any time lies adjacent the air ingress opening 38.

In the operation of the device, the fabric entering through the slot 39 passes over the guide rolls 40 and 41 and transversely across the opening 30, thence downwardly around the rolls 44, 45, about the drum heads, thence around the roll 46 and out through the slot 47. During such travel of the fabric air is caused to flow through duct 15 in the manner above described, such air entering the interior of the drum through the ingress opening provided at 38 and passing thence outwardly through the interstices of the fabric. It is clear that the area of the peripheral surface of the drum through which the air is thus discharged is much greater than the cross sectional area of the duct 15. Thus the velocity of air passing outwardly from the drum through the fabric may be very slight as compared with its velocity in the duct 15. As the air emerges into the housing after passing through the fabric surrounding the drum, it is free to circulate in contact with the horizontal runs of fabric between the rollers 40, 41 and the rollers 44, 45 respectively, as well as with the vertical run of fabric extending beneath the rollers 41 and 44. The air is unable to escape, however, from the housing except by passing through the fabric which extends across the egress opening 30 and as the area of such opening is relatively small as compared with the peripheral area of the drum, it is evident that the velocity of air through such opening and through fabric which lies immediately beneath the same must be substantially greater than its velocity on emerging from the drum. After passing through the opening 30 the warm and moisture laden air escapes through the economizer tubes 25 in the manner previously pointed out and during its passage through such tubes imparts some of its warmth to the incoming fresh air. The air, after passing through the tubes 25 may, if desired, instead of being discharged into the open atmosphere, be conducted in any suitable manner to some point where warm and moist air is desirable, as for example the weave room of a mill. As the web of fabric passes the opening 30 soon after entering the housing, it is clear that at this point such web is in a very moist condition, so that the air escaping through the opening 30 and which air has already received some moisture, may by reason of its high velocity, remove a substantial portion of the moisture from the web at this point. As the web travels on, more moisture is absorbed by the air in the housing and as the web passes about the drum, it is subjected to the action of the relatively slow moving but relatively hot air which emerges from the interior of such drum. It is thus clear that the drier portions of the web are traversed by slow moving and relatively warm currents of air while the wetter parts thereof are traversed by high velocity currents of air of a somewhat lower temperature and containing a greater amount of moisture. The device as thus arranged is found to operate in a highly efficient manner, the material emerging through the slot 47 being substantially dry even though the speed of travel of the web through the apparatus may be comparatively rapid. The forcing of the air currents through the interstices of the material in a plurality of steps serves to remove the moisture in a very thorough manner without necessitating the employment of a degree of heat such as might injuriously affect the material, either at its superficial surface or in its interior structure. By passing the warm and moist air emerging through opening 30 in heat transferring relationship to the incoming air, a high economy in the use of heat is also attained so that the apparatus not only serves to dry the material rapidly, but also performs this operation with a minimum expenditure of heat.

While a preferred form of apparatus has been illustrated it will be understood that various changes and rearrangements of parts, as well as substitutions of equivalent materials for those herein mentioned, may be made without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent of the United States is:

1. That process of removing moisture from pervious material which comprises forcing a current of air to traverse the interstices of said material at a relatively high velocity and thereafter causing air to traverse the interstices of such material at a relatively low velocity.

2. That process of drying pervious material which comprises forcing a current of relatively cool and moist air at a relatively high velocity transversely through the interstices of the material, and thereafter forcing a current of relatively hot and moisture absorbent air transversely through the material at a relatively low velocity.

3. That process of drying webs of textile fabric which comprises subjecting such a web successively to air currents of successively decreased velocity, and successively increased temperature.

4. That process of drying webs of textile fabric which comprises passing such a web through a heat insulated chamber, causing

air at relatively low temperature and high velocity to pass transversely through such web adjacent to its point of entrance to the chamber, and causing warm air to pass through such web at a relatively low velocity within the chamber.

5. The art of drying webs of textile fabric comprising causing a current of warm air to pass through every part successively of said web at successively decreasing velocities, heating air to be used for this purpose in part by the retained heat of the air previously used, and increasing the heat of the current of air prior to its first passage through the web of fabric.

6. A drying apparatus for pervious material comprising means for supporting the material to be treated, and means for forcing the same air to traverse successive portions of the material at different velocities, the first passage of the air through the material being at the lower velocity.

7. An apparatus for drying webs of textile fabric comprising means for guiding such a web for longitudinal movement, and means for causing air to traverse said material at a relatively high velocity at an early stage of its path of movement, and at a lower velocity at a later stage thereof.

8. Drying apparatus comprising means for guiding a continuous web for movement in a predetermined path, and means for causing an air current of given volume, first to pass through a relatively large area of said web, and thereafter to pass through a relatively small area thereof.

9. Drying apparatus of the class described comprising a heat insulated chamber provided with means whereby successive portions of a web traversing such chamber may be subjected to air currents of decreasing velocity, means for expelling warm and moisture laden air from said chamber, and means for causing fresh air to pass in heat transferring relationship to such warm, moist air on its way to the chamber.

10. A drying apparatus comprising a heat insulated chamber having egress and ingress openings, means within said chamber for guiding a web of fabric whereby to cause it to pass successively across said openings, and means for introducing a desiccating medium through said ingress opening whereby such medium is caused to traverse such web a plurality of times in escaping from the egress opening.

11. A drying apparatus comprising a chamber having egress and ingress openings, means within said chamber for guiding a web of fabric directly across the egress opening, other means for guiding such web in a circuitous path past the ingress opening, and means for introducing warm air through said ingress opening.

12. Drying apparatus comprising a chamber having egress and ingress openings, a rotatable, peripherally open drum within said chamber, means for guiding a web of fabric across said egress opening and about said drum, and means for forcing warm air into the interior of said drum.

13. Drying apparatus comprising a heat insulated chamber, a peripherally open drum rotatably mounted therein, said drum having closed ends, means for guiding a web of fabric peripherally about a substantial portion of the circumferential extent of said drum, and means for introducing warm air into said drum at a point where it is free from said web.

14. Drying apparatus comprising a chamber having an air ingress opening, a drum rotatably mounted in said chamber, said drum comprising spaced heads having fabric engaging elements, such elements constraining the fabric to assure a cylindrical form, means for guiding a fabric web into contact with such engaging elements except at that portion thereof which is opposite said ingress opening, and means for forcing air through said opening.

15. Drying apparatus comprising a chamber having egress and ingress openings, a rotatable, peripherally open drum within said chamber, the interior of said drum being constantly in communication with said ingress opening, means for retaining a web of material to be dried in close engagement with said drum whereby to prevent escape of air therefrom except through the interstices of the fabric, and means for forcing warm air through said ingress opening and into said drum.

16. Drying apparatus comprising a heat insulated chamber having an egress opening at one side and an ingress passage at the opposite side, a rotatable, peripherally open drum, guide rolls at either side of the ingress passage for holding a web of material closely against said drum, other guide rolls for compelling the web to travel directly across said egress opening, and means for forcing heated air through said ingress passage and into the drum.

17. Drying apparatus comprising a heat insulated housing having egress and ingress openings, an economizer comprising a series of parallel tubes communicating with said egress opening, a fan for inducing fresh air to pass over the outer surface of said tubes whereby to take up heat from warm air passing therethrough, means for further heating said incoming air and for directing it to said ingress opening, a peripherally open drum in said housing arranged transversely of said ingress opening, guide rolls for compelling a web of material, in traversing said chamber, closely to embrace said

drum except at that portion thereof extending across the ingress opening, and other guide rolls for compelling said web to pass directly across said egress opening.

18. The art of drying webs of textile fabric comprising causing a current of warm air to pass through every part successively of said web at successively decreasing velocities, and increasing the heat of the current of air prior to its first passage through the web of fabric.

Signed by me at Boston, Massachusetts, this twenty-eighth day of January, 1922.

JOSEPH H. WALSH.