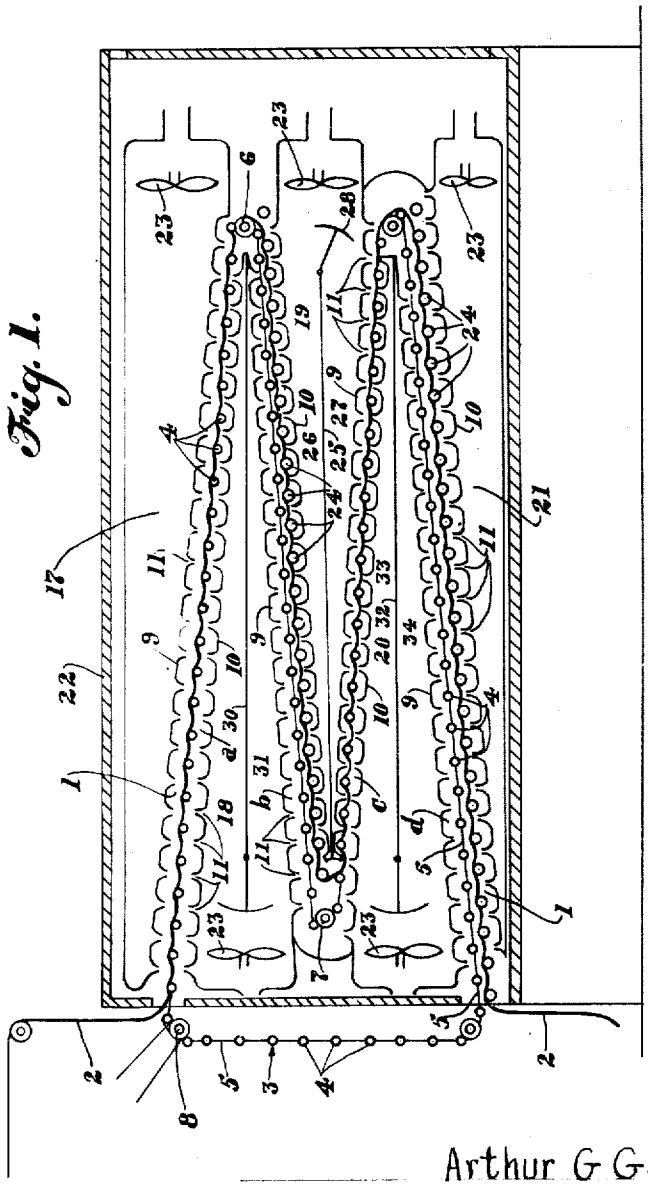
Feb. 22, 1949. A. G. GAUTREAU 2,462,380

METHOD AND APPARATUS FOR DRYING WEB MATERIAL

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Fig. 1.



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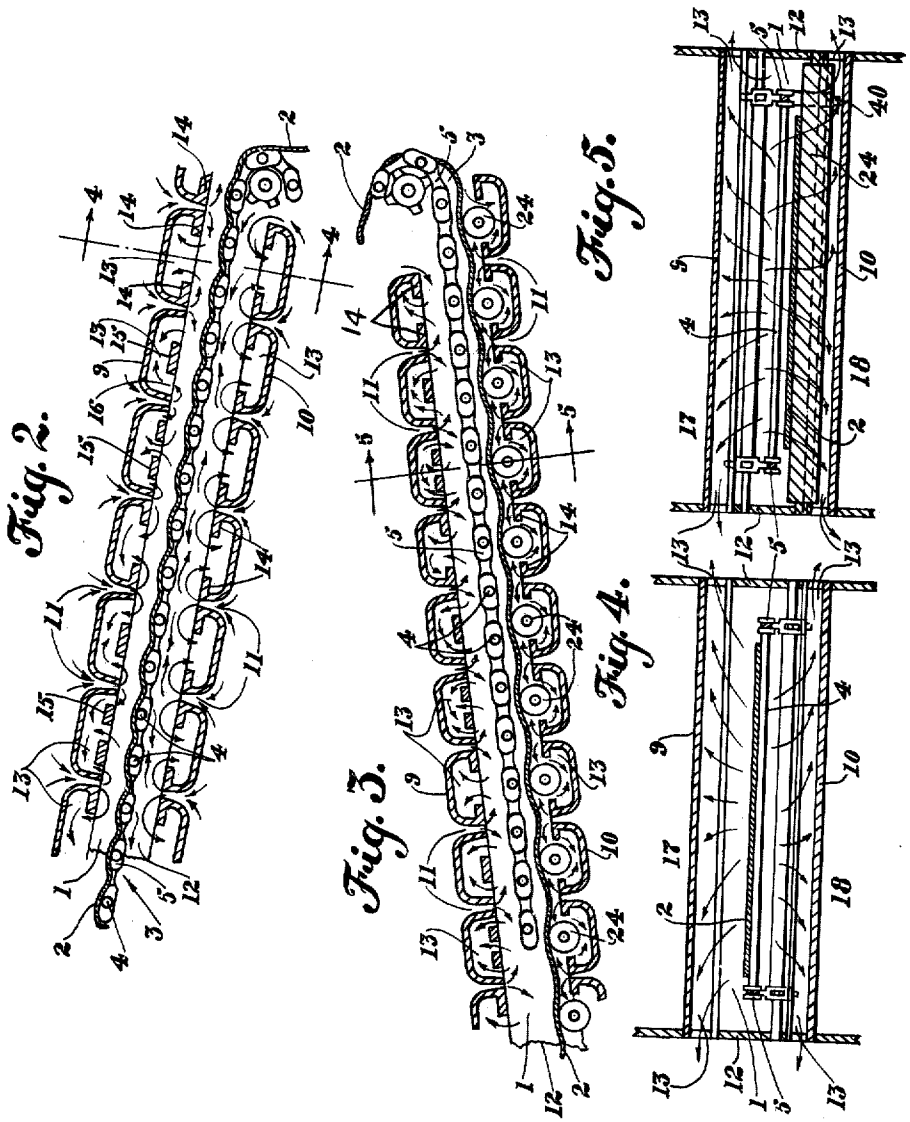


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

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Fig. 6.

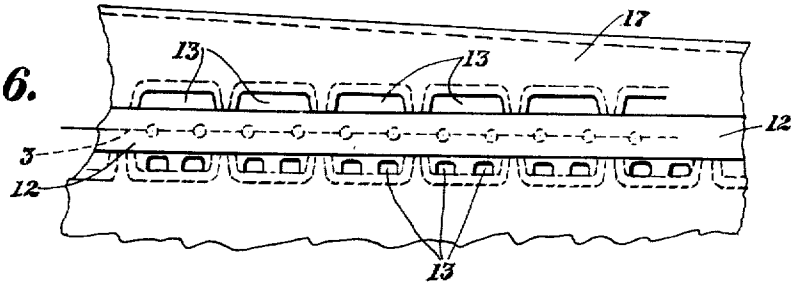


Fig. 7.

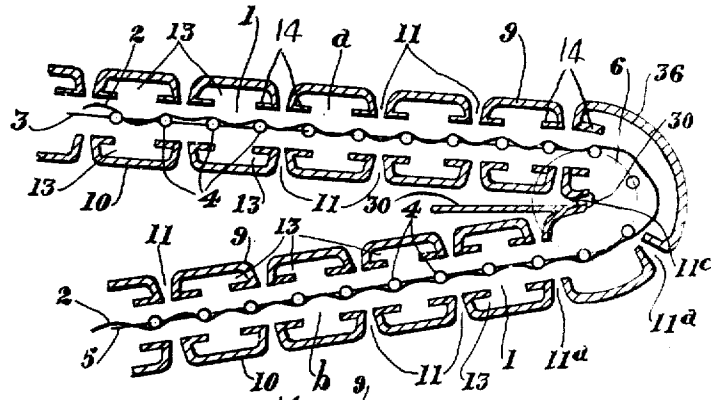
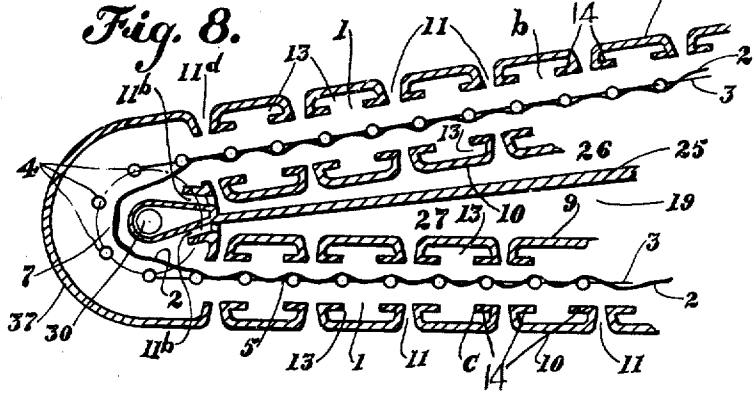


Fig. 8.



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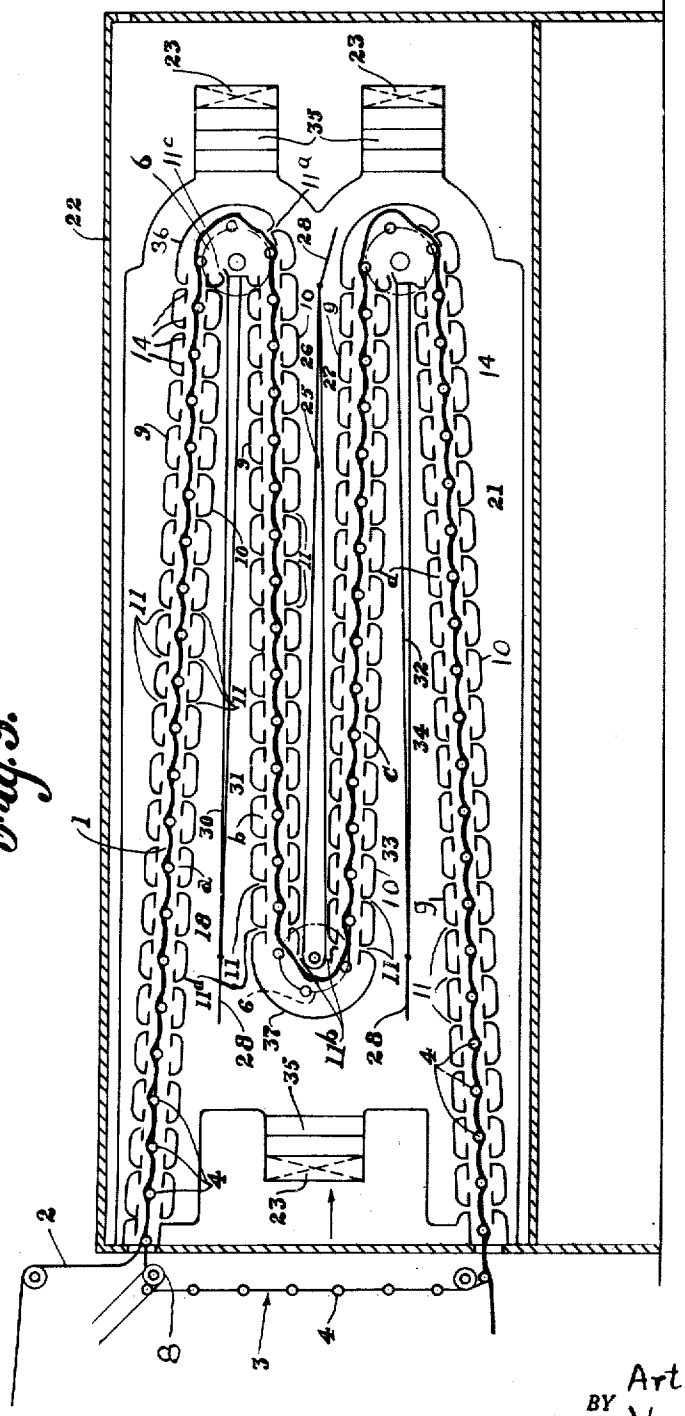
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Fig. 9.



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UNITED STATES PATENT OFFICE

2,462,380

METHOD AND APPARATUS FOR DRYING WEB MATERIAL

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Application January 5, 1946, Serial No. 639,323

3 Claims. (Cl. 34—24)

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This invention relates to drying apparatus for drying cloth or other web material, and particularly to drying apparatus which is equipped with an elongated drying space or passage through which the cloth to be dried is conveyed by means of a traveling apron, the top and bottom walls, in other words the roof and the floor, of the drying space being provided with nozzles through which heated air is directed against the cloth during its traveling movement.

In order to save floor space, the elongated passage or space in which the cloth is being dried may be broken up into sections that are arranged in zigzag formation and located one above another, and with this construction, the endless chain apron or cloth carrier would also be arranged in zigzag formation with one run of the conveyer or carrier in each section of the drying passage.

If the cloth to be dried is delivered to the top run of the endless chain carrier so that it rests on the carrier while traveling through the top section of the drying passage, then as the cloth passes from the delivery end of the first section of the drying passage into the receiving end of the second section, said cloth will be on the underside of the carrier.

An object of my invention is to provide novel means for supporting the cloth in proper position between the opposed nozzles while it is traveling through the second section of the drying passage and is located beneath that run of the endless chain carrier located in said second section. When the cloth is delivered from the second section of the drying space, it will again be deposited on top of that run of the endless chain carrier which is located in the third section of the drying space and will be supported thereby during its movement through said third section. If there is a fourth section to the drying space, then the cloth will be located on the underside of the carrier while traveling through such fourth space and my invention provides suitable means for properly supporting the cloth while thus traveling through said fourth section.

In the preferred form of my invention the cloth is supported and held against the underside of the cloth carrier in those drying space sections in which it is located below the carrier by unbalanced air pressure, i. e., by maintaining

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an air pressure on the underside of the cloth which is sufficiently greater than that on the upper side thereof to overcome the weight of the cloth.

Another object of the invention is to provide means to float the cloth free from the cloth carrier throughout its entire width during its traveling movement from one drying space section to the next drying space section, and to maintain the cloth free and separated from the cloth carrier during the entire time it is traveling from one drying space section to the next, so that as the cloth enters each drying space section, it will come back onto the carrier in a slack condition notwithstanding any shrinkage that may have occurred in the cloth.

Other objects of the invention will be apparent from the following description of some embodiments of my invention.

In the drawings:

Fig. 1 is a vertical sectional view through a drying apparatus embodying my invention.

Fig. 2 is an enlarged fragmentary sectional view showing a portion of the drying space in which the cloth is resting on the endless chain carrier.

Fig. 3 is a similar view illustrating mechanical means for supporting the cloth when it is traveling in the section of the drying space in which it is located below the endless chain carrier.

Fig. 4 is an enlarged section on the line 4—4, Fig. 2.

Fig. 5 is an enlarged section on the line 5—5, Fig. 3.

Fig. 6 is a fragmentary side elevation of a portion of the drying space and the adjacent air ducts showing the eduction ports.

Figs. 7 and 8 are fragmentary sectional views of the drying space sections where they join, showing the cloth held against the under side of the endless chain carrier by air pressure and also showing the manner in which it is separated from the carrier while it is passing from one drying space section to the next. Fig. 9 is a sectional view similar to Fig. 1 but showing a different embodiment of the invention.

In the drawings, the elongated drying space in which the cloth is to be dried is indicated at 1, and 2 is the web of cloth to be dried.

The elongated drying space 1 is herein shown

as formed of a plurality of sections *a*, *b*, *c*, and *d* arranged one above the other in zigzag fashion, the sections being connected at their ends to provide a continuous zigzag shaped drying space. 3 indicates an endless cloth carrier by which the cloth is conveyed through the drying space, said cloth carrier being of the usual type comprising a plurality of transverse bars or rods 4 which are connected at their ends by endless chain elements 5 thereby providing an endless chain carrier. This endless chain carrier extends the length of the section *a* of the drying space, thence around a direction pulley 6, and thence through section *b* of the drying space, then around another direction pulley 7, and through the section *c*, etc.

The endless chain carrier 3 may be driven in any suitable way as by means of a driving sprocket 8.

The drying space 1 is of that known construction in which the top wall or roof 9 as well as the bottom wall or floor 10 is provided with a plurality of nozzles 11 through which heated air under pressure may be delivered against the cloth passing through the space. These nozzles may conveniently be in the form of slots extending transversely of the passage from one side to the other of the drying space, so that a sheet-like jet of heated air or drying medium will be delivered from each nozzle 11 against the web of cloth throughout its entire width. The upper wall 9 of each space section constitutes the bottom wall of an air duct into which heated air under pressure is delivered thereby to provide the pressure necessary to deliver the heated air through the nozzles. The bottom wall 10 of each section of drying space constitutes the top wall of a similar duct. A somewhat similar construction is illustrated in Patent 2,071,015, February 16, 1937, and in my Patent No. 2,144,919, January 24, 1939.

In the device illustrated in said patents, the air which is delivered from the nozzles against the bottom and top of the cloth is discharged from the drying space at the opposite sides thereof in the plane in which the cloth is moving and the air which is moving over the surface of the cloth therefore not only has a movement longitudinally of the cloth, but also has a lateral movement which, unless carefully balanced, tends to shift the cloth sidewise in its drying space.

There is therefore provided a construction by which the movement of the air that is in contact with the cloth is controlled so that it has only a movement in the direction of the length of the cloth, thereby eliminating any tendency of the cloth to shift sidewise in said space.

This end is accomplished by providing the drying space with side walls 12 extending vertically from the nozzles in the upper wall 9 to the nozzles in the lower wall 10 thereby closing the sides of the drying space between the upper and lower nozzles, and by providing eduction openings 13 at the sides of the space 1 above and below the side walls 12. The air which is delivered through each nozzle 11 which projects from the upper wall of the space 1 will be divided by its impact against the cloth and will flow lengthwise of the cloth, said air then rising toward the upper wall 9 and being discharged laterally through the eduction openings 13. In the same way the air which is delivered through the nozzles in the lower wall 10 of each space will flow along the surface of the cloth in the direction of its length and will then flow to the floor 10 and out through the lower eduction openings 13.

With this arrangement the air which is in contact with the cloth is flowing in the direction of the length of the cloth and there will be no tendency for the cloth to be shifted sidewise.

In order to eliminate eddy currents, I may, if desired, either provide each nozzle with laterally extending deflecting flanges 14 which will assist in giving the air issuing from each nozzle its direction longitudinally of the cloth, or I may employ a baffle plate 15 situated between the adjacent nozzles and which extends from one side wall 12 to the other, each baffle plate being arranged so as to allow suitable passages 16 between it and the adjacent nozzles through which the air may pass to the eduction openings 13. Such baffle plates may either be integral one-piece elements, or they may be divided longitudinally to present two or more sections spaced from each other. The apparatus may be made with either the deflecting flanges 14 or the baffle plates 15 extending through the entire length of the drying space or of each section thereof, or both deflecting flanges 14 and baffle plates 15 may be used in the same drying space section.

I have referred above to the fact that the upper and lower walls 9 and 10 of the drying space 1 constitute bottom and top walls of air ducts through which the heated air is delivered to the nozzles. Referring now to Fig. 1, the duct which is located above the upper drying space section *a* is indicated at 17. The space between the lower wall 10 of the section *a* and the upper wall 9 of the section *b* is divided by a partition 30 into two ducts 18 and 31, the duct 18 supplying the air to the nozzles 11 in the floor 10 of the section *a* and the duct 31 supplying air to the nozzles 11 in the roof 9 of section *b*. Similarly the space between the lower wall 10 of section *b* and the upper w 9 of section *c* may be divided by the partition 25 into two ducts 26—27, the duct 26 supplying the air under pressure to the nozzles in the floor 10 of section *b* and the duct 27 supplying air under pressure to the nozzles in the roof 9 of section *c*.

The space between the sections *c* and *d* may also be divided by a partition 32 into two ducts 33—34, the duct 33 supplying air to the nozzles in the floor 10 of the section *c* and the duct 34 supplying air to the nozzles 11 in the roof 9 of the section *d*.

The nozzles 11 in the floor 10 of section *d* are supplied with air from a duct 21.

Air under pressure may be delivered to these ducts through suitable blowers or air moving devices 23 and if desired, suitable heaters 35 may be used in connection with the blowers so as to supply the ducts with heated air under pressure. In the construction shown, the eduction openings 13 communicate with the interior of the housing 22 and the blowers 23 are arranged to take air from the housing and deliver it to the ducts.

Assuming that the cloth 2 to be dried is delivered to the upper drying space section *a* at one end as shown in Fig. 1, said cloth will be supported in a slack condition on the bars 4 of the upper run of the endless chain carrier and during its travel through said section *a*, it is subjected to the drying air currents as above described. When the cloth reaches the discharge end of said upper drying space section and enters the second drying space *b*, the cloth will be on the underside of the supporting bars 4 while traveling through said section.

In order to maintain the cloth in proper posi-

tion for being dried while traveling through the drying space section *b*, there is shown in Figs. 1 and 3 a plurality of supporting rolls **24** which extend transversely of said space and are located between the nozzles **11**, said rolls being situated to support the cloth **2** closely adjacent to the underside of the run of the endless chain carrier while moving through said space section *b* so that the cloth will be properly positioned in said space section *b* to be correctly dried. Any suitable number of such supporting rolls may be employed, but I preferably will use one roll between each two adjacent nozzles so that the cloth will have no extended unsupported portions while traveling through the section *b* of the drying space. If desired, each roll **24** may have a sprocket wheel **40** thereon which meshes with the chain **5**, so that the rolls will be positively driven.

As the cloth is delivered from the delivery end of said section *b*, it will drop on to the top of the run of the endless chain carrier which is located in the section *c* of the drying space and will be properly supported by the carrier as it travels through said space. As the cloth is delivered from the delivery end of the section *c*, it is delivered to and is supported by another series of rotatable rolls **24** situated beneath the run of the endless chain carrier that is located in said section *d*.

Another way of supporting the cloth while it is traveling on the underside of the carrier through the space sections *b* and *d* is to provide means for holding the cloth by air pressure against the underside of said endless chain carrier in said sections *b* and *d*. One way of doing this is illustrated in Figs. 7, 8 and 9 in which means are provided for delivering air under increased pressure through the nozzles **11** in the bottom wall **10** of each of the space sections *b* and *d* thereby to build up sufficient pressure underneath the cloth in said sections to hold it against the underside of the bars **4** of the endless chain carrier. For this purpose there may be provided gates **28** in connection with the partitions **30**, **25**, and **32**, which gates may be adjusted to control the relative amount of air which is delivered to the ducts on either side of said partitions. Such gates are shown as arcuate members, each having an arm extending radially therefrom and pivotally mounted at its end to permit the arcuate member to swing about said pivot. In connection with the ducts **26** and **27**, if the gate **28** is adjusted as shown in Fig. 9, an increased amount of air will be delivered into the duct **26** thereby building up sufficient pressure in said duct so that the increased pressure of the air jets issuing from the nozzles **11** in the floor **10** of the space section *b* will be sufficient to support the cloth and hold it against the underside of the endless chain carrier **3**, as indicated in Figs. 7, 8, and 9.

The air pressure which is developed in the duct **21** will be sufficient to hold the cloth against the underside of the endless carrier in the space section *d*.

The differential pressure in each of the drying space sections *b* and *d* by which the cloth is held against the underside of the run of the endless chain carrier in said sections may also be obtained by making the nozzles **11** on the floor **10** of each of said sections of greater capacity than the nozzles projecting from the roof **9** of said sections so that the greater volume of air will be delivered underneath the cloth in said sections *b* and *d* than is delivered above the cloth.

Where the nozzles are in the form of transverse slots, then the slots in the floor **10** may be made slightly wider than those in the roof **9** of said drying space sections.

In Fig. 6 the eduction ports **13** below the cloth carrier **3** are shown as having a smaller port area than the eduction ports above the cloth carrier. The smaller ports beneath the carrier **3** restrict the escape of air from the drying space to a greater extent than the larger eduction ports **13** above the carrier, and because of such restriction, there is a tendency to build up a greater air pressure beneath the carrier than above it.

This construction is of a special advantage in connection with those drying space sections in which the cloth is located on the under side of the carrier and in which it is held against the carrier by the greater air pressure below the cloth than above it. As stated above, the restricted eduction ports **13** below the cloth carrier as shown in Fig. 6 cooperate with the gates **28** to maintain the desired greater pressure beneath the cloth which is necessary to hold the cloth against the under side of the carrier.

I will preferably provide means for lifting the cloth entirely free from the bars **4** of the endless chain carrier during the entire time that the cloth is passing from the section *a* into the section *b* and similarly for lifting the cloth entirely free from the said bars during the entire time that the cloth is passing from section *c* into section *d*.

The cloth is thus held in a free floating condition separated from the bars of the cloth carrier during the entire time that it is traveling from the delivery end of one drying space section to the entering end of the next drying space section. As a result when the cloth enters the drying space section *b*, for instance, it will be laid back onto the cloth carrier in a slack condition notwithstanding any shrinkage that may have occurred in the cloth during the drying operation to which the cloth was subjected in the drying space section *a*, and similarly whenever the cloth enters any drying space section, it will be again brought into contact with the cloth carrier in a slack condition. The cloth is, therefore, lifted off from the cloth carrier at the delivery end of each drying space section and laid back on the carrier in a slack condition at the entering end of the next drying space section so that there will be a re-adjustment of the cloth on the carrier immediately before it enters any drying space section. By this means the cloth will be held in a slack condition throughout its entire length notwithstanding any shrinkage which may occur in the cloth during the drying operation.

Moreover because of this re-adjustment of the cloth on the carrier as it enters each drying space section, the bars of the cloth carrier in each section will have contact with the cloth at different points from that at which the bars of the previous section contacted the cloth and hence the cloth will not remain in contact with any particular bar for a sufficient length of time to cause the bar to leave a mark on the cloth.

This end may be secured by arranging the nozzles at the end of space section *a* and the beginning of space section *b* as shown in Fig. 7 and by arranging the nozzles at the end of space section *b* and the beginning of space section *c* as shown in Fig. 8. In Fig. 7 the last nozzle in the floor **10** of space section *a* and the first nozzle in the roof **9** of space section *b* are arranged closely adjacent the sprocket wheel **6** around which the

endless carrier passes from one section to the other and said sprocket is enclosed by a housing section 36 which extends from the last nozzle in the roof 9 of section *a* around to the nozzle 11*a* in the floor of the section *b*. There is also an additional nozzle 11*c* situated to deliver a jet of air against the underside of the cloth just after it leaves the last nozzle in the roof 9 of the space section *a*. The air pressure developed underneath the cloth by the air jet issuing from this nozzle 11*c* serves to lift the cloth entirely free from the bars 4 as it passes around the direction sprocket wheel 6 as shown in Fig. 7. As stated above, the cloth will be maintained in contact with the underside of the bars 4 of the cloth carrier while it passes through the space section *b*, by the increased air pressure beneath the cloth.

At the point where the space section *b* delivers the cloth into space section *c*, there will be provided a housing 37 which encircles the direction pulley 6 so that when the cloth leaves the last nozzle 11*d* in the roof 9 of space section *b*, it will tend to fall away from the underside of the bars 4. Special nozzles 11*b* are provided which are directed in the direction of the length of the runs of the space sections *b* and *c* and which hold the cloth from sagging too much at this point and allow the cloth to drop back on to the bars 4 in a slack condition as it enters the space section *c*.

In accordance with this invention, therefore, a sufficiently unbalanced pressure is maintained against the opposite sides of the cloth as it passes from each drying space section to the next to separate the cloth entirely free from the carrier and to hold it so separated during the entire time that it is traveling from one drying space section to the next, whereby as the cloth enters each drying space section, it is delivered against the cloth carrier in a slack condition regardless of any shrinkage which the cloth may have experienced.

I claim:

1. The method of drying cloth in an apparatus comprising an elongated drying space formed in connecting sections arranged one above another and having a cloth carrier presenting transverse bars connected in endless chain formation extending through said drying space and presenting a plurality of runs, one in each section of the drying space, which method consists in delivering the cloth to be drived on to the top surface of said carrier in the top drying space section, delivering the cloth from said top drying space section into the drying space section immediately beneath and in a position in which the cloth is on the underside of the carrier in said latter drying space section, delivering air jets against both sides of the cloth while traveling through both sections of the drying space, maintaining a sufficiently unbalanced pressure against the opposite sides of the cloth while it is traveling through the drying space section in which it is located beneath the carrier to hold the cloth in contact with the bars in said drying space section, and maintaining a sufficiently unbalanced pressure against opposite sides of the cloth throughout the entire width thereof during the entire time it is traveling from each drying space section to the next to separate the cloth throughout its entire width from the bars of the cloth carrier and to hold it in a free floating condition free from said bars until it enters said next drying space section, whereby the cloth will be delivered in a slack condition to the carrier at the entry end of each drying space section.

2. A cloth drying apparatus comprising an elongated drying space formed in connecting sections arranged one above the other in zigzag fashion, an endless chain cloth carrier extending through said drying space from one end to the other and including a plurality of transversely-extending cloth-supporting bars, said cloth carrier presenting a plurality of connected runs, one in each section of the drying space, means to deliver the cloth to be dried on to said carrier in the top drying space section, said cloth when traveling through the drying space sections being located on top of the run of the cloth carrier in the top section, underneath the run of the cloth carrier in the second section, on top of the cloth carrier in the third section and underneath the cloth carrier in the fourth section, etc., means to deliver air jets against both sides of the cloth while traveling through each section of the drying space, means for maintaining against the underside of the cloth while traveling through those drying space sections in which the cloth is on the underside of the carrier, an air pressure sufficiently greater than that on the top side of the cloth to hold the cloth against the underside of the bars of the cloth carrier, and means to maintain a sufficiently unbalanced air pressure against opposite sides of the cloth throughout its entire width during the entire time it is traveling from each drying space section into the next drying space section to separate the cloth throughout its entire width from said cloth carrier and to hold it in a free floating condition separated from the carrier during the entire time it is traveling from each drying space section to the next, whereby the cloth will be delivered to the cloth carrier in a slack condition and its position on the cloth carrier will be re-adjusted as it enters each drying space section.

3. The method of drying cloth in a drying apparatus having an elongated drying space formed in the plurality of connecting drying space sections arranged one above the other in zigzag fashion and also having an endless chain cloth carrier extending in zigzag fashion through said connecting drying space sections, which method consists in delivering the cloth to be dried to the upper side of the run of the cloth carrier in the top or first drying space section, passing the cloth from the upper side of the cloth carrier around the outside thereof to the under side of the cloth carrier as it moves from the top drying space section into the second drying space section immediately beneath, passing the cloth on the underside of the cloth carrier from the under side of the run of the cloth carrier in the second section to the top side of said cloth carrier in the third section, delivering jets of air against both sides of the cloth as it moves through each drying space section, maintaining an air pressure relation on opposite sides of the cloth which holds the cloth against the top of the carrier in those drying space sections in which the cloth is located above the carrier and against the bottom of the carrier in those drying space sections in which the cloth is located beneath the carrier, and providing a sufficiently unbalanced pressure against the opposite sides of the cloth as it passes from each drying space section to the next to separate the cloth from the carrier and hold it so separated while moving from one drying space section to the next, whereby as the cloth enters each drying space section it is delivered against the

carrier in a slack condition regardless of any shrinkage which the cloth may have experienced.

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