June 11, 1946. W. N. HADLEY 2,401,926

METHOD OF OBTAINING MOISTURE REGAIN IN FIBROUS MATERIALS

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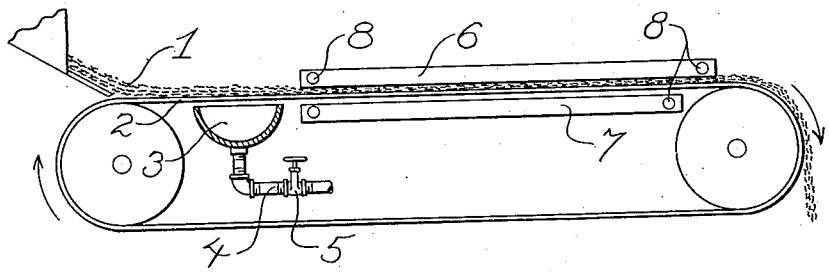


Fig. 1

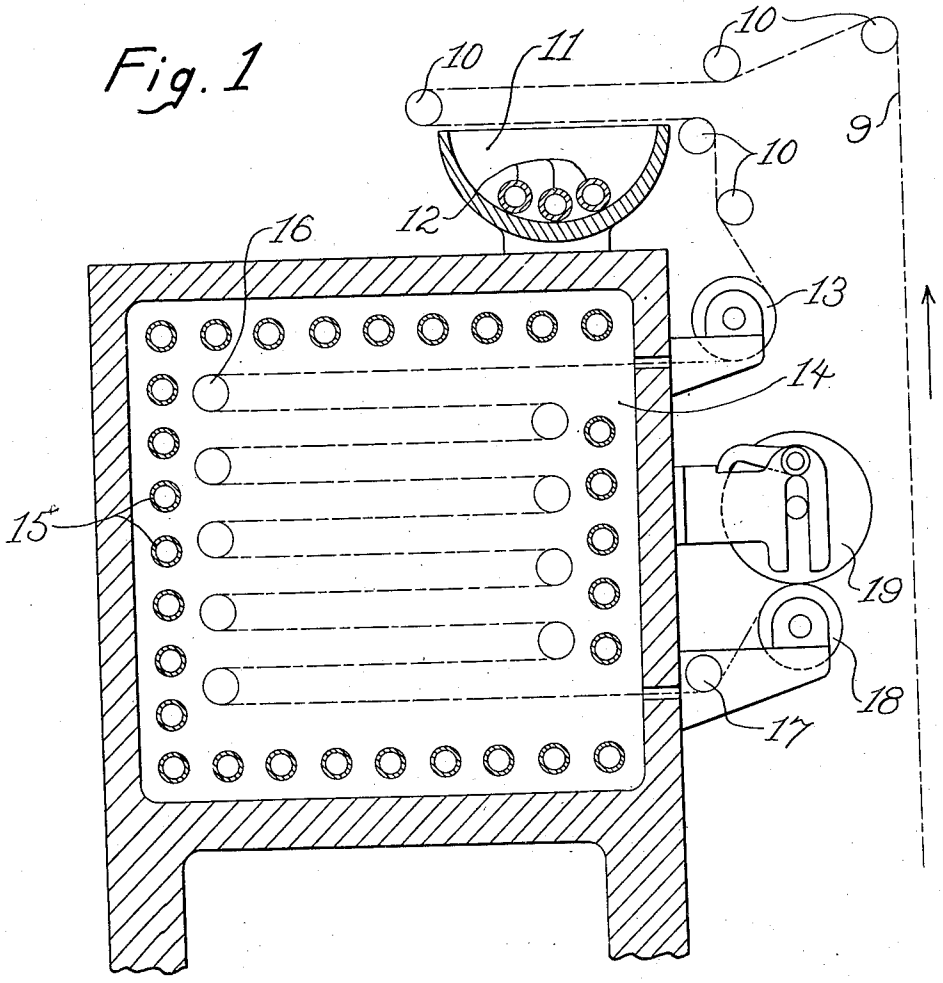


Fig. 2

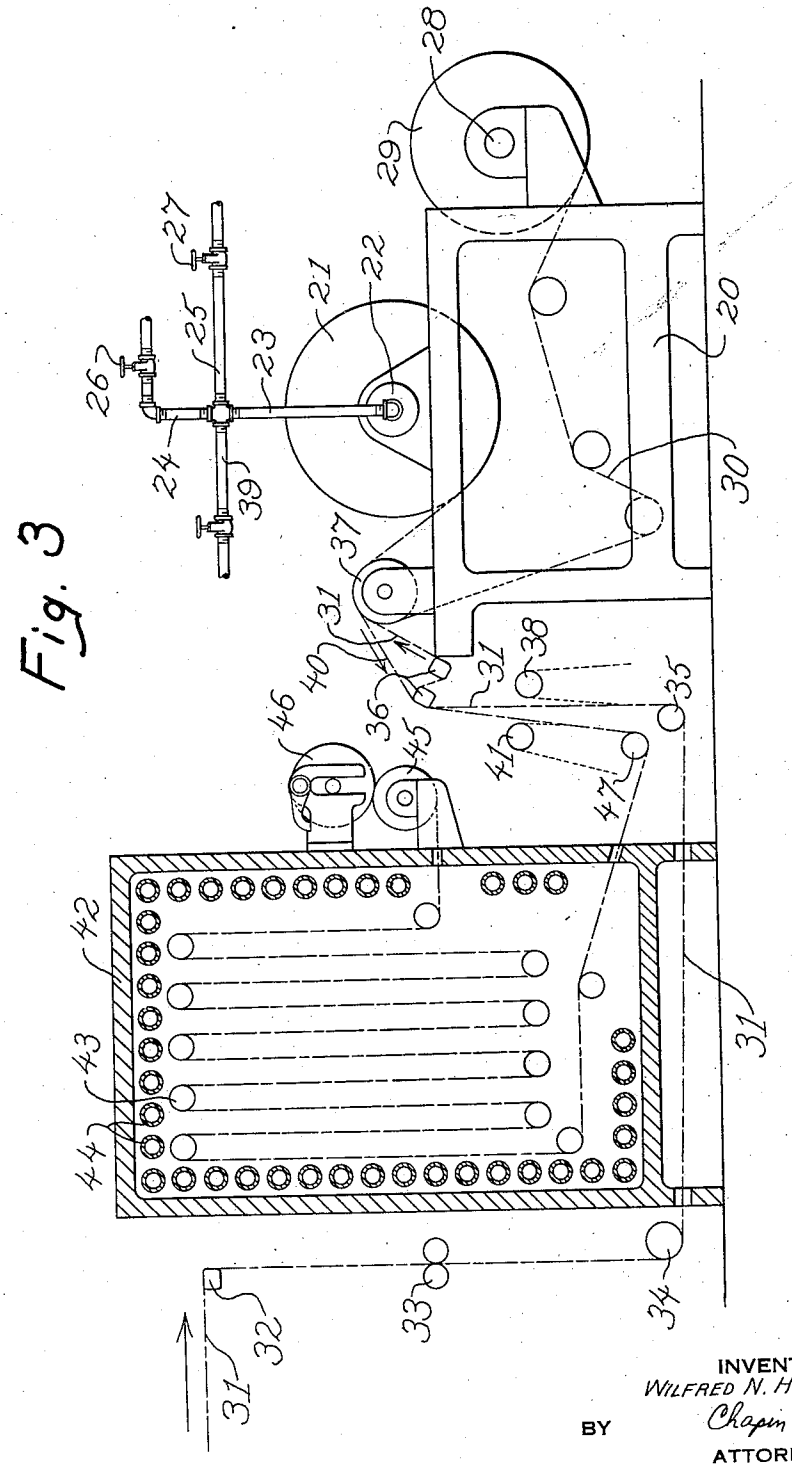
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Fig. 3



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METHOD OF OBTAINING MOISTURE REGAIN IN FIBROUS MATERIALS

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7 Claims. (Cl. 34—23)

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This invention relates to a method of quickly impelling moisture known as regain into wool, vegetable or synthetic fibres or materials made therefrom at various stages in process whenever said regain is necessary or desirable. It is an established fact that the natural regain of woolen fibre amounts by weight to 14.2%. Vegetable and synthetic fibres have affinity of less moisture content by weight.

The purpose of the invention is to improve upon prior methods used by the textile industry at the present time, not only to effect regain quickly, but also to increase the amount possible to and above the normal regain of 14.2% and in a controlled manner. A further and important object is to make available an improved method by which the product in the form of scoured or dyed fibrous raw stock, top, yarn or cloth, may be rapidly and continuously impregnated with normal or desired amount of moisture and may thereupon be immediately packaged for shipment or use, thereby eliminating the long time period heretofore required to obtain normal moisture regain and the additional handling of the stock as heretofore required.

Due to the intense heat used in the drying of wool stock after scouring or dyeing, the moisture is driven off to such a degree that the resulting wool fibre is so called "bone dry" and brittle when in this condition. During the picking and carding operations that follow the drying, these fibres would be broken where there is no regain present to lubricate the fibres, so to speak, as they come in contact with the wire clothed picker and card rolls that tend to arrange fibres in parallel position with relation to each other. Broken and short stapled fibre results in poor spinning and weaving qualities and in reducing the value of the finished top, yarn or fabric.

The same danger is ever present while this wool stock is subjected to additional top and yarn preparatory operations, such as gilling, combing and drawing. Here the stock is drawn through needled fallers and cylinders further to arrange the fibers parallel one to the other. The mere drawing of one fibre along adjacent fibres will cause breakage when not conditioned properly to lubricate the fibres and scale of the fibres. Yarns made up of short stapled stock cause breakage of the product in the loom and necessitate more mending of the cloth that is of poorer quality.

Wool, top, yarn and fabrics are sold to exact moisture weight specifications, the normal moisture content of wool being 14.2% by weight, and it will be apparent that substantial loss is sustained if the moisture content is below normal. For example, if the product has but 5% regain by weight, 9½% extra wool must be present to make up the deficiency. My invention permits the immediate and controlled addition of moisture regain to balance the deficiency and thereby effects substantial savings as will be readily understood.

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Prior methods employed in imparting this regain have included (1) the exposing of the product to moisture charged areas supplied by atomized water or steam vapor and (2) the storing of the wool, top, yarn or fabric in a damp cellar for days during which it absorbs the required amount of moisture. The latter method is satisfactory from the standpoint of regain obtainable but the time and work factors required make it impracticable under modern commercial conditions. The remaining known methods not only fall short of imparting the 14.2% normal regain, realizing at their best but 7% regain, but furthermore are slow and impossible to control. In contrast to these prior methods which provide no standardization of regain, my improved process is adaptable for treating fibres, top, yarn, or textile material in any stage of manufacture and enables the amount of regain to be quickly and economically restored and fixed in the material and exactly regulated in percentage irrespective of transient conditions of the atmosphere.

In accordance with my invention, the wool stock as it comes from the dryer is subjected to a damp or saturated steam, and immediately thereafter it is subjected to a sub-zero F. temperature for a time period sufficient suddenly to chill the stock and quickly solidify and fix the moisture therein. Various means and apparatus such, for example, as herein illustrated and described, can be employed for carrying the process into execution, and in accordance with my invention the amount and percentage of regain can be controlled by regulating the character and volume of steam employed and the speed of the product through the treating areas. The fixing step is preferably performed in a deep freeze unit maintained at a temperature approximating —120° F. and to which the stock is immediately conveyed following its saturation by the steam and I have found that the subjecting of the stock to this temperature for a period of thirty seconds is ordinarily sufficient to effect the object of the invention.

I have proved in practice that the subjecting of woolen cloth in continuous web form to saturated steam immediately followed by the passing of the cloth through a deep freeze chamber effects the immediate fixing of a moisture regain in the individual fibres to and exceeding 14.2% and such regain remains substantially permanent under normal conditions. The amount of regain can be controlled to a fraction of 1% enabling the operator to introduce an actual normal regain of 14.2% by weight or such variation thereof as may be desired. In contrast to present day conditioning machines that at best cannot produce in excess of 7% regain at a maximum speed of 18 yards

per minute, the production possibilities of my process are up to 100 yards per minute. The only presently available known means of imparting a total normal regain of 14.2% is by storage of the product in loose condition for several days in a damp cellar and such process is extremely limited and objectionable in several respects as will be understood. In contrast thereto, my invention permits the immediate and accurate impregnating of the product to the desired and normal degree and furthermore permits any further treating of the product immediately, rapidly and continuously in a manner eliminating the delays, uncertainties and repeated handlings of the product such as are required in processes heretofore known and employed.

The invention will be described in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic view showing one manner of applying the invention to woolen or other fibrous stock;

Fig. 2 is a diagrammatic view showing one manner of applying the invention to finished textile fabric such as woolen or mixed fibre cloth; and

Fig. 3 is a diagrammatic view showing an arrangement by which my improved process can be carried out with the assistance of an apron steamer and take place synchronously with the steam conditioning of the product.

In Fig. 1, I have shown in diagrammatic form one apparatus for treating woolen stock or synthetic or other fibres, it being understood that the construction, size and application of the various parts can be modified as appear best to accomplish the objects of the invention. Woolen stock is a term used to describe woolen fibres prior to the carding operation but after they have been subjected to scouring or dyeing followed by a drying operation. At this point the wool has been deprived of its normal moisture content, and in order to prevent the fibres from breaking during succeeding carding operations it is necessary to impart to it a degree of moisture in addition to what it had at the time of leaving the drier.

In accordance with my invention the stock 1 is received from any suitable conveyor upon a foraminous apron or conveyor 2. This apron passes closely over a steam chamber 3 which can be supplied with damp steam from any suitable pipe 4 having a control valve 5. The steam from the chamber 3 passes through the apron and through the wool stock, imparting to the latter a degree of moisture which can be regulated by the degree of saturation of the steam and by the speed given to the apron 2. Immediately after passing the steam chamber the apron carries the wool stock between refrigerating plates 6 and 7 which can be supplied with a refrigerant from any desired source through pipes 8. These plates may be spaced to form a chamber, or may be in light contact with the stock, the exact form of refrigerating apparatus not being critical. The refrigerant is preferably maintained at a temperature sufficiently low so that the moisture present in the stock or cloth after the steaming operation will be frozen practically instantaneously. Thus the steam saturated product is immediately chilled and the steam-derived moisture contained in the product is set and fixed, thereby establishing a substantially permanent moisture regain the degree of which is controlled by the various factors heretofore described. If the saturation has been carried beyond the normal moisture content of the product the excess moisture tends to evaporate under normal atmospheric conditions.

In Fig. 2 I have shown an apparatus for carrying out the same fundamental idea to finished woolen cloth, which may be supplied from a roll or from the usual apron steamer which gives the final finish to the cloth. If an apron steamer, sometimes known as a semi-decator, is used, it may itself serve as a source of steam, as will be described below, otherwise the web 9 is fed over suitable guide rolls 10 across an open-topped steam chest 11 having within it suitable perforated steam entrance pipes 12. In the form shown the guide rolls 10 are arranged to pass the cloth once or twice over the top of the steam chest in order to increase the moisture regain for a given speed of the web. The cloth then passes over a guide roll 13 into a chamber 14 provided with coils 15 serving for the circulation of a refrigerant. As in the former case, the refrigerant is supplied at a temperature preferably sufficiently low to cause practically instantaneous freezing of the condensed steam vapor taken up by the fabric. Guide rolls 16 within the chamber direct the fabric in successive reversed paths to increase its length of travel within the cold chamber, and the fabric leaving the chamber is directed by a guide roll 17 to a positively driven windup roll 18 against which rests the usual windup reel 19. The speed of the cloth through the chamber can be regulated by changing the speed of the driven roll 18. The cloth will thus be wound on the roll 19 in a condition having a controllable amount of moisture within it which can readily be regulated to give to the cloth at the time when it is wound on the roll substantially the same moisture content as that required by equilibrium between the cloth and the atmosphere, under normal conditions.

In Fig. 3 is shown a modification in which the usual apron steamer or semi-decating machine is employed as the source of saturated steam. In this figure an apron steamer is shown conventionally as mounted on a frame 20. Upon this frame is journaled a hollow metal drum 21 having its outer surface perforated with closely spaced holes. The drum is mounted on a shaft 22 which can be rotated by any of the usual means. To the interior of the hollow shaft 22 is coupled a pipe 23 to which are coupled branch pipes 24 and 25 having valves 26 and 27 respectively located in them. By one of these pipes 24 superheated or dry steam can be admitted to the interior of the drum to be blown out through its perforations; through the other of the pipes 25 suction may be applied to the interior of the drum when desired. It will be understood that one valve would be closed before the other one was opened. Other valve and piping arrangements may of course be substituted. Mounted on a shaft 28 is a reel 29 for apron material 30 in the form of a wide web of suitable fabric. The cloth 31 to be treated passes over a smoothing bar 32 and over suitable supply and guide rolls 33, 34, and 35 to a pair of tension bars 36 around which it is looped as shown. It then passes together with the apron 30 over a roll 37 and is wound up on the large drum 21. When the thickness of cloth and apron on the drum 21 has been built up as much as is convenient for the steaming operation the cloth is separated at a cross seam (it being generally supplied in a chain of standard lengths sewed together) and its second or following end is thrown over a stationary bar 38. A few extra turns of apron are wound on the drum and superheated or dry steam passed through the cloth and apron for the desired period. The steam supply is then

shut off and suction turned on through another line 25. So far the operation is the same as in standard apron steaming or semi-decating.

Leaving the fabric and apron still wound upon the drum 21, supersaturated or damp steam is admitted through a valved line 39 for a length of time sufficient to permit the dried-out fabric to regain the desired amount of moisture. The apron is then wound back on the drum 29 and when the end of the fabric 40 appears it is secured to the end of the preceding run, or to a cotton leader, which has been thrown over a bar 41 at the conclusion of the preceding operation. The previous cloth piece, or the leader, has its end projecting from the freezing chamber 42 which, in the case shown, is provided with guide rolls 43 and pipes 44 for the circulation of a refrigerant. A power driven wind-up roll 45 receives the fabric from the chamber and winds it on a take-off roll 46. A guide roll 47 is employed to direct the remoistened fabric 40 from the tension bars 36 to the freeze chamber. It may be remarked that in general it will not be necessary to loop the fabric reversely about the tension bars 36 in withdrawing it from the roll 31 in the same way as it was reversely wound through these bars while it was being wound up on that roll for the reason that tension during the freezing operation is not important. Subjecting the warm, moisture ladened cloth to the deep freeze chamber solidifies and sets this moisture in its state of permeation throughout each individual fibre comprising the fabric and provides the normal amount of moisture regain which remains within and as a substantially permanent content of the product.

It will be understood that the form of apparatus and the various factors employed in the steam saturation and freezing steps of the process may be quite substantially varied within the scope of the invention and that these factors will to a considerable extent depend upon the character of the product to be treated. In general, however, I desire it to be understood that I preferably employ a substantially damp and saturated steam and in such volume as will quickly penetrate and provide the desired moisture in the fabric, and that I further preferably subject the steam treated fabric immediately to a deep-freeze temperature that will solidify and fix the moisture in the fabric substantially instantaneously. Such preferred treatment not only facilitates speed and economy in the process but also produces a superior product.

The term "deep freeze" is used herein in the sense in which it is usually applied to industrial chilling equipment which is readily available for providing temperatures in the order of 50° F. below zero to 120° F. below zero. Such temperatures or any sub-zero temperature effective to solidify and set the moisture laden stock is contemplated for the freezing step of my improved method.

The apparatus illustrated is not claimed herein but forms the subject matter of my copending application Serial No. 590,706, filed April 27, 1945.

Having thus disclosed my invention and described in detail illustrative methods of practicing it, I claim as new and desire to secure by Letters Patent:

1. A method of rapidly impregnating with moisture and effecting normal moisture regain in fibrous material containing less than normal moisture content, which consists in subjecting the moisture-deficient fibrous material directly to the action of damp steam and immediately thereafter subjecting the material to a sub-zero F. atmosphere for a time period sufficient to chill the material and solidify and set the contained moisture derived from the steam.

2. A method of continuously impregnating with moisture and effecting normal moisture regain in fibrous material containing less than normal moisture content, which includes the steps of continuously feeding said material through a steaming zone, subjecting the material directly to the action of damp steam at said zone, immediately passing the material from said zone into a refrigerating chamber, and subjecting the steamed material in said chamber to a sub-zero F. temperature for a time period sufficient to chill the material and solidify and set the contained moisture derived from the steam.

3. A method of continuously impregnating with moisture and effecting normal moisture regain in strip fabric containing less than normal moisture content, which consists in continuously feeding said fabric through a steaming zone, subjecting the fabric directly to the action of saturated steam at said zone, immediately passing the fabric from said zone into a refrigerating chamber, subjecting the steamed fabric in said chamber to a sub-zero F. temperature for a time period sufficient to chill the material and solidify and set the contained moisture derived from the steam, and continuously passing the fabric from the refrigerating chamber and rolling it into package form after a predetermined exposure in the refrigerating chamber.

4. A method of impregnating with moisture and effecting normal moisture regain in cloth containing less than normal moisture content, which includes the steps of winding the cloth into a rolled package containing a plurality of layers, forcing steam outwardly through the cloth from the center of the package, unwinding and passing the cloth into a refrigerating chamber, and subjecting the cloth in the chamber to a sub-zero F. temperature for a time period sufficient to chill the cloth and solidify and set therein the moisture derived from the steam.

5. A method of steaming cloth and impregnating it with moisture to effect normal moisture regain therein, which consists in winding the cloth together with a supporting apron into a rolled package containing a plurality of cloth layers with the apron therebetween, forcing steam outwardly through the cloth and apron from the center of the package, unwinding the cloth and apron and passing the cloth into a refrigerating chamber, and subjecting the cloth in the chamber to a sub-zero F. temperature for a time period sufficient to chill the cloth and solidify and set therein the moisture derived from the steam.

6. The method defined in claim 1, in which the steam treated material is immediately subjected to a deepfreeze treatment at a temperature sufficiently low to solidify and set the moisture derived from the steam substantially instantaneously in the material treated.

7. The continuous method defined in claim 2, in which the steam treated material is immediately subjected in said refrigerating chamber to a deepfreeze treatment at a rate of about 100 yards per minute and at a temperature sufficiently low to solidify and set the moisture derived from the steam substantially instantaneously in the material treated.

WILFRED N. HADLEY.