The apparatus disclosed in said patent comprises in combination a closed steam chamber, a conveyor disposed in the chamber and movable laterally therein, means for introducing a ribbon or sheet of cloth continuously into the chamber, means for forming a series of accordion folds in the ribbon of cloth, means for depositing the folded ribbon continuously on the conveyor with the folds in a substantially upright position, and means for withdrawing the steamed ribbon of cloth continuously from the conveyor and from the chamber.

The specific embodiment of the invention described in said patent comprises a steam chamber of considerable length enclosing a single lateral conveyor of almost equal length. In such apparatus the period of time during which the textile is in contact with the steam is largely dependent upon the length of the chamber and the enclosed conveyor and the rate of movement of the conveyor through the chamber. Accordingly, practical considerations have necessitated the building of a chamber of considerable length, requiring the use of relatively large amounts of construction material and a relatively large floor area for installation.

The present invention provides improvements in steamers of the general type therein described, whereby the length of the chamber is materially decreased relative to the path of the fabric through the chamber. The invention permits material economy in construction, material and floor space occupied, as well as economy in steam required in its operation.

In general, our improved steamer comprises in combination a closed steam chamber, a plurality of lateral conveyors disposed one above the other in the chamber, means for introducing a ribbon of cloth continuously into the chamber, means for delivering the cloth in accordion folds onto the uppermost conveyor with the folds in a substantially upright position, and means positioned at the discharge end of each conveyor but the last for transferring the folded cloth to the receiving end of the next lower conveyor whereby the cloth moves through the chamber in accordion folds on each of the conveyors. The apparatus also provides means for continuously removing the cloth from the discharge end of the lowermost conveyor and from the chamber.

The apparatus may comprise two or more lateral conveyors, however it has been found particularly desirable to use an odd number of conveyors, as by this arrangement the fabric is more conveniently introduced to one end of the steam.
chamber and withdrawn from the other end. These and other features of our invention will be more thoroughly understood in the light of the following detailed description of a presently preferred form of our apparatus in conjunction with the accompanying drawings in which:

- **Fig. 1** is a broken side view of an apparatus comprising three conveyors;
- **Fig. 2** is an end view of the apparatus along line 2-2 of Fig. 1;
- **Fig. 3** is a sectional plan view of the feed end of the steamer along the line 3-3 of Fig. 1; and
- **Fig. 4** is a partial side view of the end portion of a conveyor showing a modified form of the apparatus.

The apparatus illustrated in the drawings comprises a steam chamber 10 housed by an elongated cabin 11 with an upwardly extending feed-end portion 12. Three elongated endless type positively driven lateral conveyors 13, 14 and 15 extend in a horizontal position longitudinally from substantially one end of the steam chamber to the other. A ribbon 16 of fabric is introduced at full width into the upper portion of the feed end of the chamber through the slot or gland 17 by a feeding mechanism comprising positively driven rolls 18, 19 and 20, the latter being positioned within the steam chamber. From the roll 20 the ribbon of fabric passes downwardly by gravity over positively driven beater roll 21, and from thence falls in accordion folds 18a onto the inclined guide member 22.

The beater roll 21, as more clearly appears from Fig. 1 of the drawings, is composed of cross arms 21a positioned at either end and secured to a driving shaft 23, designed to be driven by the pulley 24. These cross arms 21a are spaced apart a distance somewhat greater than the width of the ribbon of textile and support cross rods 25 and 26 placed at different distances from the axis of rotation, so that the cloth passing over the beater roll 21 is caused to wave back and forth by rotation of the beater roll and to fall in substantially uniform accordion folds onto the inclined guide 22. It is desired that the position of the cross-rods 25 and 26 be adjustable with respect to the axis of rotation.

The inclined guide 22 is advantageously made up of a plurality of parallel rods 21a, joined at either end by supports 25. The rods 27 are advantageously of stainless steel, though other materials which will not injure the fabric may be employed, for instance wood. The supports 25 may be of any suitable material and are preferably adjustable so that the angle of inclination of the guide and its position relative to the beater roll may be varied somewhat. For example, the axis of the upper support 28 may terminate in the form of threaded rods 28a which extend through slots 28b in the side walls of the cabin 11 and are held in position by lock nuts 28c. The optimum angle of inclination of the inclined guide may vary somewhat, depending primarily upon the weight of the textile and the speed at which the ribbon is fed into the steamer. The optimum angle is generally somewhat greater than 40° from the horizontal. An angle of about 55° from the horizontal will generally satisfy results.

The depth of the accordion folds may be varied somewhat by varying the speed at which the beater roll 21 is revolved, by varying the speed at which the fabric is fed over the beater roll, and by varying the difference between the distances of rods 25 and 26 from the angle of rotation.

For convenience and clarity, the lateral conveyors shown in the drawing are of a conventional endless rope type, however various other conventional types of conveyors may be utilized. For instance, a conventional endless plate-type conveyor, formed by a multiplicity of hinged perforated plates of stainless steel, may be used with particular advantage and is frequently preferable.

The conveyors shown in the drawing are substantially identical, and comprise a plurality of spaced conveyor ropes 28, which form an endless conveyor extending longitudinally through the steam chamber. The spaced ropes run in grooves in head pulleys 29 and tail pulleys 31, positioned respectively at the feed and discharge ends of the conveyors. In addition, the head and tail pulleys the ropes are supported by a plurality of sheaves 32 and idlers or take-up pulleys 33, the latter serving principally to prevent the ropes from sagging.

All of the pulleys are somewhat wider than the ribbon of cloth, and all are clearly shown on Fig. 2 of the drawings, the outside grooves of the pulleys are somewhat greater in diameter than the inside grooves of the pulleys, and consequently the ropes at the outer sides of the pulleys are slightly elevated above the inside ropes and serve as side guides to prevent the folded textile ribbon from sliding sidewise off the conveyors.

As more clearly shown on Figs. 2 and 3 of the drawing, the various pulleys are supported by shafts, which in turn may be supported within the chamber but preferably extend through the sides of the chamber through appropriate stuffing boxes to supporting bearings located without the chamber.

The tail pulleys 31 located at the discharge end of the conveyors may be driven by suitable means, for instance pulleys 34.

The ribbon 16 of fabric which has been formed in accordion folds on the inclined guide 22 by cooperation of the beater roll 21 and the inclined guide 22, moves by gravity down the inclined guide onto the upper conveyor which is to be operated at a rate coordinated with the rate at which the folds are formed on the inclined guide. The ribbon, in the form of accordion folds in a substantially upright position, is thus carried by the conveyor 13 through substantially the length of the steam chamber.

A second inclined guide 35 is positioned just beyond the discharge end of the conveyor at a distance from the tail pulleys greater than the height of the accordion folds. The inclined guide 35 is at least as wide as the ribbon of textile, and may be of a construction similar to the inclined guide 22, both of which are advantageously adjustable so that the angle of inclination of the guide and its position relative to the beater roll may be varied somewhat. For example, the axis of the upper support 28 may terminate in the form of threaded rods 28a which extend through slots 28b in the side walls of the cabin 11 and are held in position by lock nuts 28c.

The optimum angle of inclination of the inclined guide may vary somewhat, depending primarily upon the weight of the textile and the speed at which the ribbon is fed into the steamer. The optimum angle is generally somewhat greater than 46° from the horizontal. An angle of about 55° from the horizontal will generally satisfy results.

The depth of the accordion folds may be varied somewhat by varying the speed at which the beater roll 21 is revolved, by varying the speed at which the fabric is fed over the beater roll, and by varying the difference between the distances of rods 25 and 26 from the angle of rotation.
variations in the depth of the accordion folds. Generally, the angle of the guide \( \theta \) with the horizontal plane should be somewhat greater than \( 45^\circ \), say about \( 55^\circ \). The textile having been formed in uniform accordion folds falls from the discharge end of the conveyor onto the inclined guide \( 35 \) and slides down said guide onto the conveyor \( 14 \) without substantial disturbance of the folds, and is picked up by the conveyor \( 14 \) with the folds in a substantially vertical position and carried by said conveyor to the opposite end of the steam chamber, where it is discharged onto the third conveyor \( 15 \) as just described. Though three conveyors are shown in the drawing, any suitable number may be used.

The ribbon of cloth which has been subjected to the steaming operation is withdrawn from the discharge end of the lower conveyor over roll \( 38 \) and withdrawn from the steam chamber through gland \( 37 \).

In the particular apparatus illustrated in the drawings, we have shown means consisting of a beater roll and inclined guide \( 21 \) and forming the accordion folds, however any known means for forming the ribbon of cloth on the conveyor in uniform, substantially vertical accordion folds may be employed, for instance substantially upright chutes, such as described in our previously noted patent, may be used with advantage.

Although the apparatus has been described with particular reference to steam treatment, it will be understood that it can be used with other vapors or gases, the term “steam” being employed herein to include various gases used for textile treatment.

In addition to its compactness, the improved steamer of our present invention has the added advantage that the textile being treated is more uniformly subjected to the steam by reason of the fact that the folded textile in passing from an upper conveyor to a lower conveyor is turned over so that the lower edges of the folds which have been in contact with the conveyor surface are fully exposed to the atmosphere of the steamer during the subsequent passage through the steamer chamber on the lower conveyor.

Improved steamer has the further advantage that the transfer of the textile from one conveyor to the other is effected solely by gravity, thus avoiding complicated mechanisms for accomplishing this purpose, and further avoiding the danger of pulling or tearing or deforming the textile.

The speed of the respective conveyors and of the feed rollers, which introduce the cloth into the steam chamber, and the speed at which the cloth is withdrawn from the chamber, may be so correlated that the folds remain substantially unchanged as the cloth moves along the respective conveyors and is deposited upon a subsequent conveyor with the folds in a substantially upright position. The cloth thus arrives at the discharge end of the lower conveyor with the folds in a substantially upright position so that it may be withdrawn therefrom and from the steam chamber without danger of deforming or tearing the textile.

While means other than those shown in the drawing may be used for introducing the ribbon of textile into the steam chamber, friction rolls such as shown are preferred over nip or press rolls customarily employed for feeding cloth through treating operation, because the friction rolls not only prevent tearing of the textile but also avoid the formation of creases or crows' feet therein and do not unduly squeeze from the ribbon the treating solution with which the cloth may be impregnated.

In the particular apparatus illustrated, the lateral conveyors are so disposed, one above the other, that the discharge end of each conveyor but the last is positioned above the next lower conveyor at a point somewhat removed from the feed end of said lower conveyor. This has been found a particularly desirable arrangement as it facilitates the transfer of the folded textile from a higher to a lower conveyor. However, by suitably extending the inclined guide \( 35 \), the discharge end of one conveyor may be directly above the feed end of the next lower conveyor.

It is desirable that the inclined guides such as shown at \( 35 \), extending transversely of the conveyor, be adjustably supported, as previously noted, so that they may be spaced from the delivery end of the conveyor a distance approximating the height of the folds of the textile. This is desirable so that in operation the folded textile falling from the conveyor onto the inclined guide may pass freely between the pulley \( 31 \) and the guide \( 35 \). Further, the angle of inclination of the guides \( 35 \), as well as of the guide \( 21 \), should be such that the folded textile will slide by gravity down the inclined guide onto the conveyor. Generally, the inclined guide should be spaced from pulley \( 31 \) a distance only slightly exceeding the depth of the folds of the fabric.

The apparatus of the present invention folds the cloth into relatively loose folds which do not form permanent creases. In operation the loose folds are preserved and do not pack together for the reason that during the major part of the travel through the steamer they are carried in a vertical and substantially free position and are not subjected to packing or undue compression. By maintaining the cloth in loose folds, the entire fabric is kept uniformly saturated with the treating solution, and consequently is subjected to a substantially uniform treatment.

Further, by maintaining the folds in a substantially upright position, the weight on any given portion of the cloth is relatively slight so that the treating liquor is not squeezed uniformly out of any portion of the cloth. Moreover, the loose vertical folds of cloth are such as to permit free access of the steam to all portions of the cloth, and this together with maintenance of uniform saturation of the cloth with the treating solution leads to exceptionally thorough effective and uniform results, at the same time avoiding crows' feet and other blemishes which tend to be formed in the steamings of fabrics.

The inclined guide members \( 35 \) have been shown in the drawings as inclined planes. It will be understood, however, that these guide members may have concave surfaces conforming generally, throughout a portion of their height, at least, with the curvature of the tail pulleys and being spaced from said pulleys a distance approximating the depth of the folds of the ribbon of fabric. Such a curved guide member \( 35 \) is shown in Fig. 4 of the drawings.

We have herein mentioned stainless steel as a desirable material of which to fabricate portions of our apparatus which come in contact with the textile. It will be understood that for use under caustic conditions ordinary steel may be used.

We claim:

1. In apparatus for steamling textiles, the com
bination which comprises a closed steam chamber, a plurality of lateral conveyors disposed one above the other in the chamber, the discharge end of each conveyor, but the last, being positioned above the next lower conveyor, means for introducing a ribbon of cloth continuously into the chamber, means for delivering this cloth in accordion folds onto the uppermost conveyor with the folds in a substantially upright position, an inclined guide positioned at the discharge end of each conveyor, but the last, above the receiving end of the next lower conveyor extending transversely of the conveyor and spaced from the said discharge end thereof a distance approximating the height of the accordion folds to be formed, and adjustably supported to permit the varying of its angle of inclination, and the distance between the inclined guide and the discharge end of the said conveyor, so that in operation the folded cloth will fall from said discharge end of the conveyor onto the inclined guide and thence freely slide onto the next lower conveyor with the folds in a substantially upright position whereby the cloth moves through the chamber in substantially vertical accordion folds on each of the conveyors, and means for continuously removing the cloth from the discharge end of the lowermost conveyor and from the chamber.

2. In apparatus for steaming textiles, the combination which comprises a closed steam chamber, a plurality of lateral conveyors disposed one above the other in the chamber, the discharge end of each conveyor, but the last, being positioned above the next lower conveyor, means for introducing a ribbon of cloth continuously into the chamber, means for delivering this cloth in accordion folds onto the uppermost conveyor with the folds in a substantially upright position, an inclined guide positioned at the discharge end of each conveyor, but the last, above the receiving end of the next lower conveyor, extending transversely of the conveyor, spaced from the said discharge end thereof a distance approximating the height of the accordion folds to be formed, and adjustably supported to permit the varying of its angle of inclination, and the distance between the inclined guide and the discharge end of the said conveyor, so that in operation the folded cloth will fall from said discharge end of the conveyor onto the inclined guide and thence freely slide onto the next lower conveyor with the folds in a substantially upright position, whereby the cloth moves through the chamber in substantially vertical accordion folds on each of the conveyors, and means for continuously removing the cloth from the discharge end of the lowermost conveyor and from the chamber.

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