Nov. 5, 1929. S. L. CLUETT 1,734,897

DEVICE FOR SHRINKING CLOTH

Filed Jan. 16, 1929 3 Sheets-Sheet 1

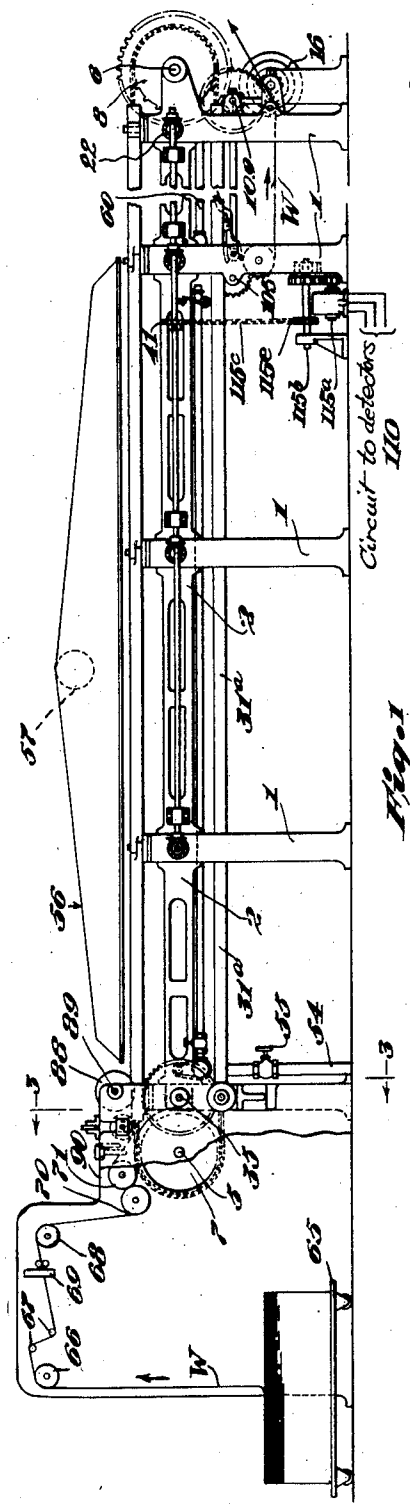

Fig. 1

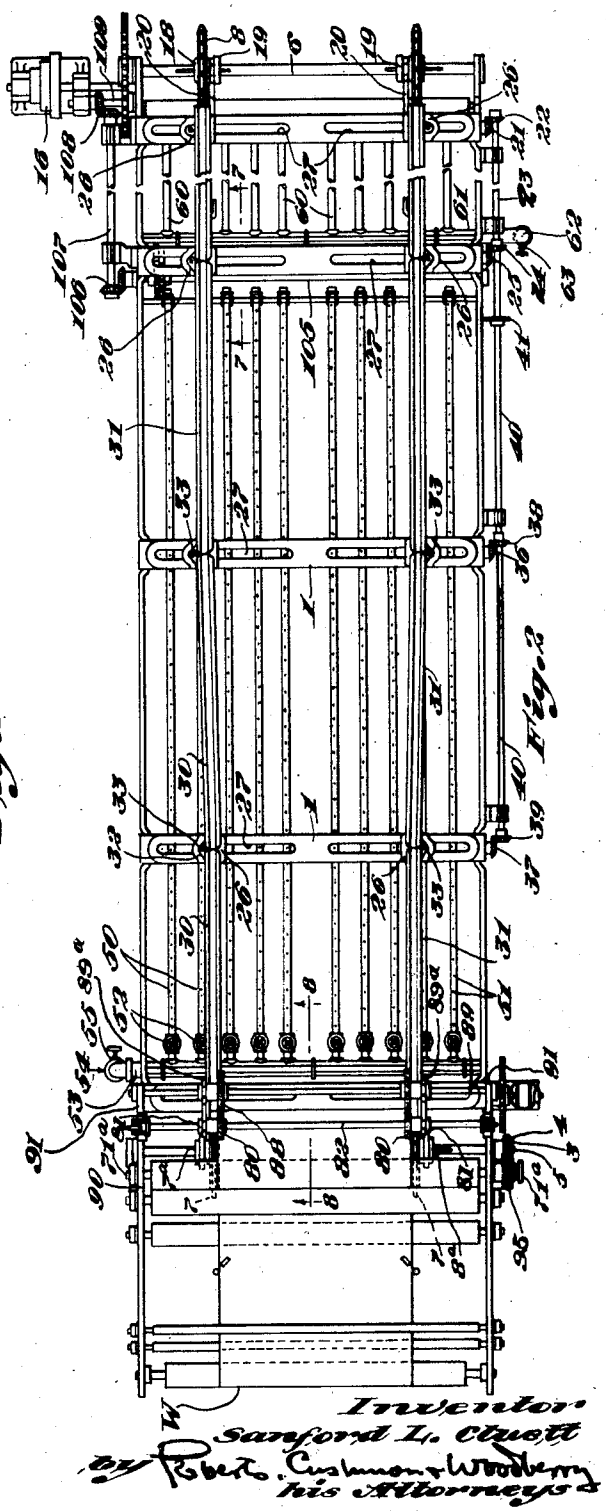

Fig. 2

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DEVICE FOR SHRINKING CLOTH

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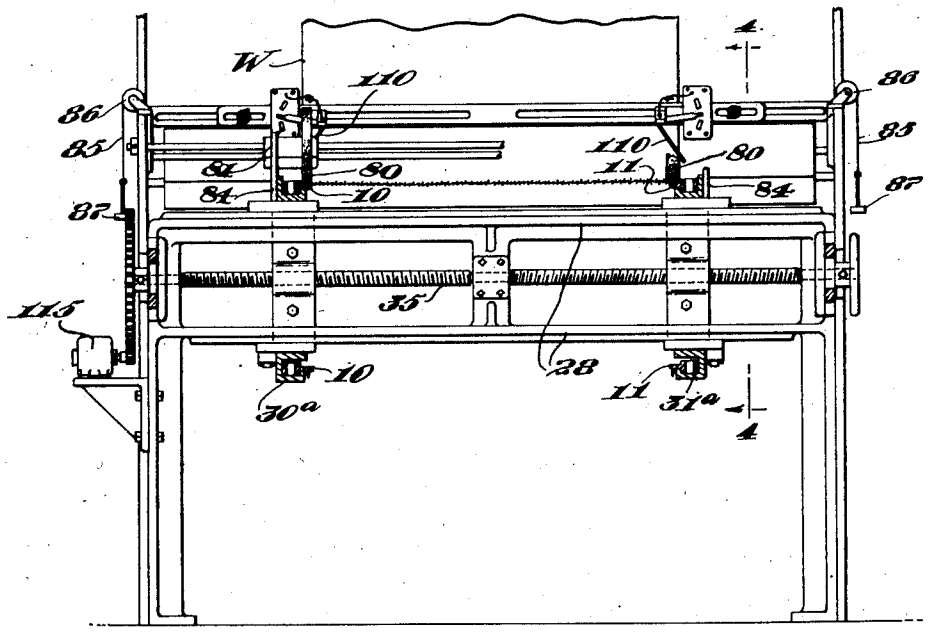


Fig. 3

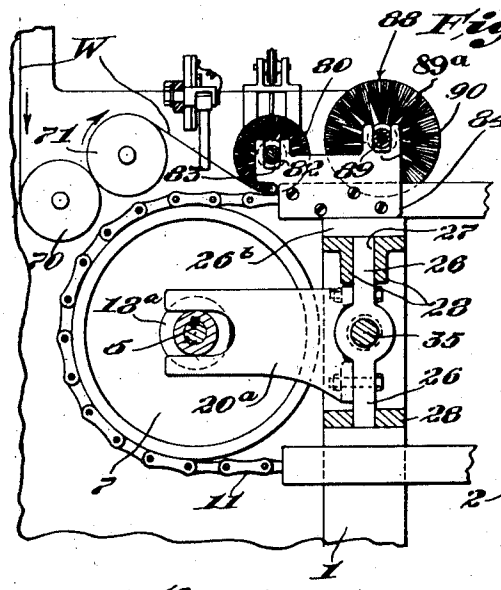


Fig. 4

Fig. 5

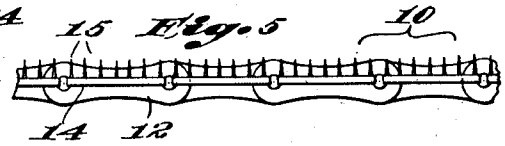
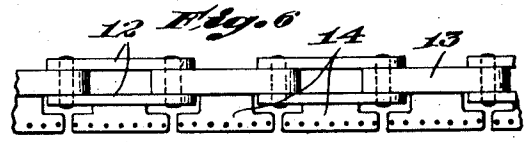


Fig. 6



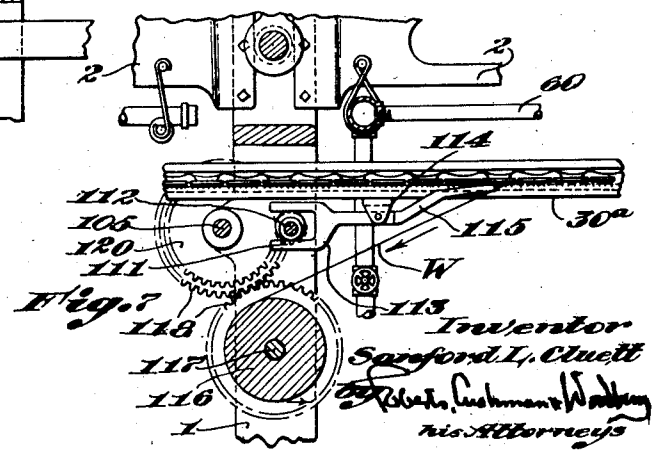


Fig. 7

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DEVICE FOR SHRINKING CLOTH

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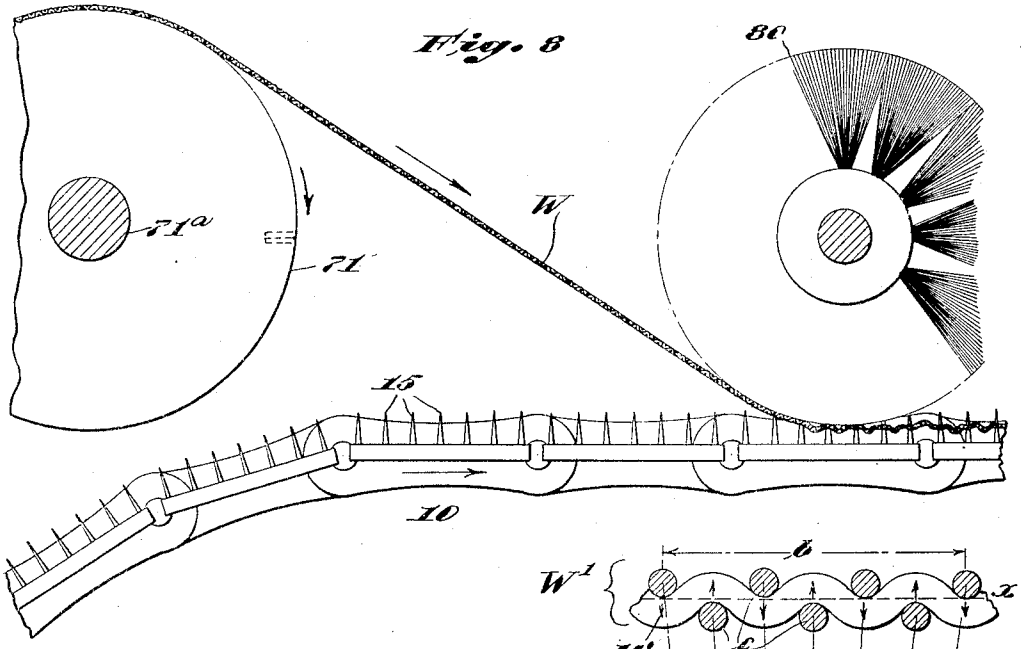
Fig. 8



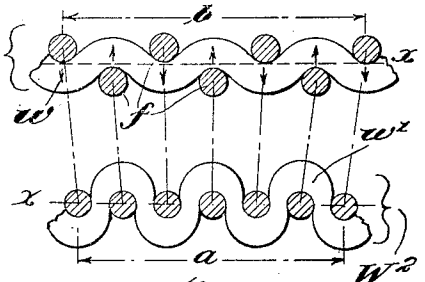
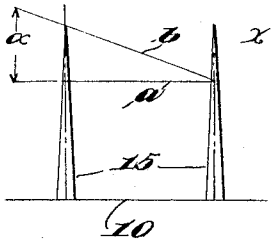


Fig. 11

Fig. 12



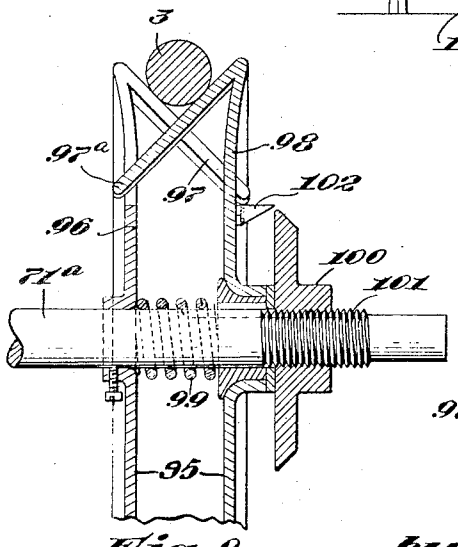


Fig. 9

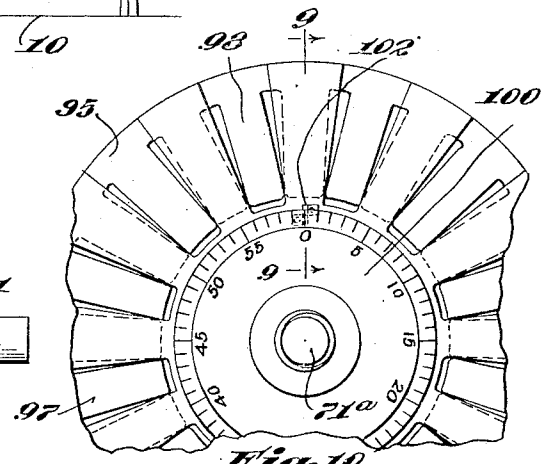


Fig. 10

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UNITED STATES PATENT OFFICE

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DEVICE FOR SHRINKING CLOTH

Application filed January 16, 1929. Serial No. 332,919.

This invention relates to a treatment for textile fabrics and especially to apparatus for practising the treatment.

One object of this invention is to provide for operating upon cloth, which may already be finished in the sense of having been bleached, mercerized, printed, dyed, calendered, starched, ironed or polished, or any of these, either in the yarn or on a finished web, or both, in such a way as to secure and set in the cloth a maximum contraction in one dimension of the web. Another object is to accomplish this without injury to the finished effect of the cloth treated. Another object is to cause and fix a rearrangement of the component yarns if the web is woven, or of the loop structure if the web is knit, with the result that at least one dimension of the treated web is shrunken, made as short or as much contracted as it is possible to make the web by washing or bleaching or other usual cleansing or laundry treatments, so that articles, garments or garment-sections cut from the web will be unalterable in that dimension in use, or if alterable will stretch slightly rather than shrink, and thus not be subject to shrinkage as a detrimental incident to use of the article or garment after repeated cleansings. While the invention is useful for the treatment of many different kinds of textile fabric, a typical and preferred utility is in the manufacture of articles of haberdashery from washable linen, cotton, silk, artificial silk or woolen cloth. Clothes in general and particularly shirts and shirt collars and cuffs, waist, neck and arm bands are most susceptible to damage from shrinkage, and a principal application of this invention is in the pre-cutting and pre-assembly treatment of cloths for the said uses to prevent damaging shrinkage when the garment is washed and ironed in use.

It is customary in this manufacture to conserve the trade finish of the web material in new garments for sale. In shirtings, for example, the applied glossy finishes of linen, the glosses of many mercerized cottons, of certain artificial strands of rayon or other synthetic silks, and surface finishes of prints and many plain fabrics do not survive unaltered their first laundry treatment. Purchasers and users of these goods are familiar with and tolerate these effects, but they are not attracted by new garments which in part show the final effect of laundry treatment and in part do not. This has had the effect of deterring the maker from subjecting any part of a garment or the cloth before making up to laundry treatments of sufficient effect to attain the expected shrinkage in use. If a garment or the cloth is shrunk by laundry treatment prior to marketing any prior treatment for this of which I am aware, including repeated washings and dryings, is either no guarantee against future shrinkage or else causes such depreciation of the subsequent life of the garment as to make its sale as a new garment scarcely ethical. The effect of shrinkage so much depends on the nature of the washing treatment that it is quite impossible accurately to forecast what the size (length between buttonholes) of an unshrunken cotton, for example, will be after its fifth visit, for example, to a laundry. Collar manufacturers have heretofore shrunk the cloth for white collars, for example, by standard laundry treatments, but have never attained wholly exact results for the finished product after wear except with cloth of certain very dense weaves. The collars, cuffs, arm and neck bands of shirts increasingly are demanded to be of the same material as the body of the garment, and whereas shrinkage of the order of two or three one-hundredths in a dimension of the body of such garment is of no importance, in the said named parts such a degree of shrinkage may prevent its use; if allowed for by over-size dimensions, the garment is unsatisfactory to wear when new. Shrinkage of the transverse dimension of a collar, neck or arm band, for example, is, however, of no consequence. This invention provides a machine operating to cause such one-dimension shrinkage of parts or all of the fabric used in such a garment without disturbing the gloss or other characteristics of surface of the component yarns, and permits pre-shrunk parts to be made of uniform appearance with the remainder of the garment.

In order to cause a definite change in the position of component yarns in a woven web, and to fix the changed relation, this invention includes mechanism for automatically effecting this result. In a preferred form in connection with which the invention will be described, such a machine may include devices dealing with a continuous web for stretching one system of interwoven warp and weft, preferably the wefts, devices for securing freedom for rearrangement of the other system of yarns, means for temporarily softening stiffening inclusions tending to prevent any rearrangement, and means for resetting and stiffening the yarns in their new arrangement. The machine includes devices for accurately determining the quantitative ratio of shrinkage, and may include feeding and doffing means for handling continuous webs, and automatic devices for dealing with variable widths of the web treated. In the accompanying drawings

Fig. 1 is a side elevation of a machine constituting the said apparatus;

Fig. 2 is a plan corresponding to Fig. 1;

Fig. 3 is a vertical section, enlarged, parts being broken away, on line 3—3 of Fig. 1;

Fig. 4 is a vertical section on line 4—4 of Fig. 3;

Figs. 5 and 6 are respectively side elevation and plan of a tenter-claim preferably employed;

Fig. 7 is a detail vertical section employed, on line 7—7 of Fig. 2;

Fig. 8 is a diagram in enlarged vertical section at line 8—8 of Fig. 2;

Fig. 9 is an enlarged detail section;

Fig. 10 is a face view of an adjustable pulley for the cloth-feed mechanism;

Fig. 11 is an enlarged diagram of adjacent impaling pins illustrating the operation of the devices for determing the slack ratio lengthwise; and

Fig. 12 is a diagram of comparative longitudinal sections of the web before and after treatment explanatory of the change effected in the web treated.

Referring to Fig. 12, any cloth typified by the cloth shown in warpwise or longitudinal section at W^1 of plain or one-and-one weave comprises warps w and wefts f interwoven by initial passage each first to one side and then to another of a yarn of the other yarn system and the web. When, as is typical of the cloths most usefully treated according to this invention, the diameter, material and stiffness of warp and weft are nearly alike, or approach likeness, a yarn of each system of yarn bends about the yarn of the other at each crossing of warp and weft away from the median plane x, so that warp and weft each lie in curves like sine curves symmetrical on a line in plane x. A section along a weft f of fabric W^1 would be the same as the warpwise section shown. When fabric like W^1 shrinks, both systems w and f, by wettings and swellings of their yarns, by compactings and pressings, become still more curved or crinkled. In part this is the due to increase of diameter of the yarns, which swell when free, and consequent decrease of length. But principally the lessened length of warp or weft is due to increased amplitude of the crinkles of curvature due to enlarged diameter of the yarn of the other system. The cloth is thicker when shrunk.

According to this invention I cause the yarns of one system to lie substantially straight, and in the median plane, by placing the yarns of that system each under longitudinal tension and releasing the yarns of the other system, and thereafter setting by stiffening (and compacting, pressing, dressing or otherwise if desired) the yarns. As shown at W^2 for example, the wefts f have been brought to the median plane by endwise tension on them during freedom of the warps w, whereupon the warps w take on deeper curves, as they must do to pass on opposite sides of successive wefts in their new position. The wefts f are now substantially straight from side to side of the fabric; where the web in its state W^2 had a longitudinal dimension b including a certain number of wefts f, in its state W^2 the same number of wefts are included in the shorter dimension a. Straightening the wefts f among other things involved moving each curved run of the weft above a warp in the direction of the arrows in the upper part of Fig. 12 in relation to that warp; this required more warp length; this could come only from a longitudinal distance, since each warp everywhere was under the same stress from a multiplicity of wefts all requiring more warp to straighten; the longitudinal dimension of the fabric necessarily shortens to supply this length of warp not required when the cloth was in its state W^1.

The converse of this is that if the longitudinal or warp dimension of the cloth is prevented from yielding, no amount of stress on the wefts f will be effective to straighten them or more deeply curve the warps. So far as I am aware, all tentering, stretching and drying machines or processes heretofore in use have applied longitudinal tension to the cloth, and their operation has therefore done nothing to shrink the cloth in either dimension, but on the contrary has often imposed on the warp and weft yarns alike an elongating stress, which is promptly countervailed by shrinkage when the cloth is next wet.

I preferably perform the steps of shrinking the cloth to a maximum longitudinally according to this invention as follows:

The operation implies releasing the cloth from all tension longitudinally or warp-wise,

and seizing the lateral margins or selvages of the cloth in such a way as to avoid imposing any resistance to shrinking, take-up, or shortening under the effect of increase in tension on the wefts exerted between the marginal places of seizure. For these purposes lateral stretching or tentering instruments of the prior art are obviously not the best instruments, since by design and use the exertion of lingitudinal tension on the fabric is an incident of their design and operation. For example, such machines and operations of the prior art as seize the margins of the cloth in gripping devices quite obviously prevent the cloth at the margins from responding by shrinking to the effect of elongating the wefts; the ordinary devices for feeding and applying a web of cloth to the stretching devices of tenter frames invariably depend on longitudinal stress on the cloth for part of the effect of impaling or gripping the cloth at its margins; and such apparatus, machines and systems of which I am aware which make the fabric moist, or cause it to be made moist in progress of the operation and subsequently dry the cloth have no provision whatever for permitting recession of length in the direction of the warps.

Referring now to Fig. 1 the preferred form of the machine of this invention comprises supporting cross frames 1, which may be of any suitable design and provided with any type of longitudinal stiffening strut, for example, as shown at 2. The frames 1 are erected at suitable distances apart to provide for a considerable travel of the web. It is desired to provide in the machine means for specially feeding or applying the already finished web to devices for stretching it weftwise; means for softening stiffening inclusions, if any, in the web treated, preferably in the form of devices for progressively steaming the fabric during a considerable length of travel, corresponding to the exertion of lateral stretching; and devices for drying the fabric in its readjusted form following the completion of the stretching to set the stretch applied to the wefts. For wholly automatic operation a recommended form of the machine includes automatically acting devices sensitive to the width of the web entering the machine, and adjusting devices for the stretching devices responsive to the indications of these sensitive devices and acting automatically to set the position of the grasping instruments and the degree of their subsequent separation to stretch the fabric. A recommended form of the machine also contains devices for doffing the shrunk, set and/or dried cloth without imposing upon it any longitudinal stress.

Referring again to Figs. 1 and 2, there may be provided at the extreme ends of the machine transverse shafts 5 and 6 respectively, carrying transversely adjustable sprocket wheels 7 and 8 on hubs 7^a, 8^a splined on shaft 5. These sprocket wheels support and drive two otherwise independent chains 10 and 11, see Figs. 3, 4, 5 and 6, each made up of hollow links 12 and solid links 13, each of said links carrying upon one face a T headed projection 14 bored and provided with impaling pins 15 at evenly spaced distances. The T headed construction of the projection 14 enables the end of pins of two adjacent links to be the same distance apart as the other pins 15 in the body of the T headed projection.

Either the shaft 5 or the shaft 6 may be a driven member relied upon to move each of the chains 10 and 11 at a predetermined rate longitudinally of the machine.

In the form shown, the shaft 6 is the driver, the machine being provided with cone pulleys at 16 suitably geared to said shaft 6 upon which the hubs 18 for the sprocket wheels 8 are splined. These hubs 18 may be provided with concentric grooves 19, 19 for forks 20 adapted to slide on the adjacent end of frame 1 and provided, as presently mentioned, with a transverse adjusting screw shaft 21 geared at 22 to longitudinal shaft 23, Fig. 2, in turn geared at 24 to a similar shaft 25. The shafts 21 and 25 are oppositely threaded at their opposite ends, and engage threaded openings in cross head slides 26, which as best shown in Fig. 3 may be provided at any of the frames 1 to slide in slots 27 in the transverse struts 28 of the respective frame members. The forks 20 for the sprockets 8, for example, may be bolted on the end face of the slides 26 in the same manner as the similar structure shown in Fig. 4.

Referring again to Fig. 2, the chains 10 and 11 are respectively guided in channel slideways 30, 31 which, as best shown in Fig. 2, may be provided in sections extending from frame 1 to frame 1, the said sections having overlapping lugs at 32 bored for a connecting bolt 33, and adapting the channels 30, 31 to be moved to define a diverging path for the tenter chains 10 or 11 between any two or more frames 1. The return run of the chains 10 and 11 may be carried in similar channel bars 30^a, 31^a. The link sections of the runs 30^a, 31^a of the guide for the chains 10 and 11 may be mounted on the lower end of the slides 26, and the bolts 33 connecting the sections of the guide channels 30, 31 of the upper run of the chains 10 and 11 respectively may be screwed into a hole in and be moved by the upper head of the cross heads 26. It will therefore be seen that the provision of transverse threaded screw shafts 35, one of which is illustrated in Fig. 3, and is typical of the others, will enable the channels carried by the cross heads 26 to be adjusted laterally without disturbing the relative position of any part of the component links of these channels in respect to another part. In practice, it

is preferred to cause the stretching divergence of the chains 10, 11 over the middle and towards the end of a part of travel of the web of the cloth through an atmosphere of steam, and as shown in Fig. 2, a divergence of the appropriate sections of the channels 30, 31 may be fixed by the original adjustment of a screw shaft 36 in relation to another screw shaft 37 controlling the respective slides 26 at two adjacent frames 1. These screw shafts are geared at 38, 39 respectively to a longitudinal shaft 40, which may be a mere extension of the shaft 23. The shaft 40 may carry a sprocket at 41, rotation of which will set the width apart of the channels, 30, 31, 30^a, 31^a, the sprockets 7 and the sprockets 8 in a like way.

As shown in Fig. 4, a preferred construction of the cross heads 26 at the left end frame 1 of the machine comprises forks 20^a similar to forks 20 bolted on the respective slides 26 and taking into an annular slot 18^a in the hub of each of the sprocket wheels 7, which of course is free to slide on its shaft 5. The upper head 26^b of the slide 26 at the left-hand end of the machine is relied upon to adjust the lateral position of other parts presently mentioned.

The first few sections of the machine as defined by the frames 1 to the right of its entrance end (at the left of Fig. 1) is preferably provided with steaming pipes 50 which may be perforated as shown at 51, extend longitudinally under the upper run of a web traveling with the chains 10 or 11, each pipe being provided with an individual valve at 52 controlling its connection to a header 53 connected to a supply pipe 54 having a main valve 55. Over the machine and above the pipes 50 a suitable hood 56 and exhaust main 57 may be provided to collect steam above the upper surface of the web traveling in the machine and dispose of its elesewhere than in the room containing the machine. Any desired number of sections defined by frames 1 of the machine at the right-hand end of Fig. 1 and Fig. 2 may be provided with longitudinally extending heating pipes 60 which may be connected to a suitable header 61 to supply pipe 62 and main valve 63. As shown, the heating pipes 60 extend beneath the course of travel of the web after the web has been stretched. The effect of the heat radiated by the pipes 60 is to set the cloth in its laterally stretched and longitudinally shrunkened condition.

A cloth web W entering the machine, see Figs. 1 and 2, may be fed from any suitable supply, for example a book-folded continuous length carried on a truck 65 from which the web travels overhead to a guide roller 66 past tension bars 67 for the removal of longitudinal wrinkles, if desirable or necessary over any suitable scrimp bar device, not shown, which may occupy the position shown for a guide roller 68, and thence downwardly to the first of two tractor rollers 70 and 71 relied upon to provide the entire energy of longitudinal feed of the entering web. One or both of these rolls, for example, the roll 71, may be a sand or rubber covered roller for maximum tractive effect on cloth, and the speed of the surface of this roller sets the entering speed of the web W.

Between the tension device 67 and the roll 68, in the preferred form, one of the well known Foxwell guides shown at 69 may be relied upon to laterally position the cloth without longitudinal wrinkles prior to its passage under the roll 70 and over the roll 71.

In the normal operation of the machine the surface of the roll 71 moves at a linear rate as much faster than the chains 10 and 11 as is required to provide a sufficient slack of fabric to accommodate the shrinkage induced by the subsequent stretching of the wefts, and the effect illustrated in Fig. 12.

Referring now to Fig. 8, if it is desired to shrink the fabric one inch in the yard, the linear speed of the surface 71 should cause travel .027778 times as fast as does the chain 10, and a lesser or greater ratio of slack of the application of the fabric to the impaling pins 15 should be provided for to induce the effect of Fig. 12. But a mere correct setting of rates of the roller 71 and the chain 10 will not alone suffice. It is desirable that so much of the fabric as extends between any two adjacent pins 15 should be applied to those pins so that its ratio of slack, as compared with the distance apart of centers of adjacent pins, corresponds to the ratio of shrinkage to be attained. For this purpose, I prefer to resort to an applicator or impaling device which I prefer to make in two parts, one providing that the edges of the material are impaled upon the pins with the proper ratio of slack, and the other completing the impalement by forcing the fabric down on the pins 15 into contact with the faces of the projections 14.

Referring now to Figs. 1, 2, 3, 4 and 8 particularly, in the preferred form the first part of the applicator, for accurately performing the impaling operation, I prefer to make as a brush roller 80, which may be made as two separate disks of sufficient thickness for their work, as best shown in Figs. 2 and 3, which disks are mounted on hubs 81 preferably free to rotate and slide on a shaft 82, the hubs of these brush wheels having annular grooves bearing in parallel sided forks 83, Fig. 4, respectively carried by bearing plates 84, each attached to one of the cross head slides 26. The effect of these arrangements is to give no freedom of motion on the shaft 82 of the applicator brushes 80 longitudinally of the machine, but to leave these wheels free to rise and fall according to the forces acting upon them. Preferably at each end of the shaft

82 there is provided a bearing ring having a place for attaching a cord 85 run over a pulley 86 to an adjustable counterweight 87 on each side of the machine, so that the weight of the roll 80 effective to act on the web W may be adjusted to a nicety.

In operation, referring to Fig. 8 and Fig. 11, the brush wheels 80 float on the fabric, the diameter of the brush wheel, and the degree of its osculation with the line of the tops of the pins 15 determining the slope at which the web W, having been penetrated by a pin 15 is applied to the point of the next pin 15. In turn, the vertical position of the wheel 80 is a function of the rate of feed of the web W by the sand roller 71.

Referring to Fig. 11, if the tangent angle of web W, which has already been impaled upon the pin 15 to the right in Fig. 11 to the line of the points of said pins when it makes contact with the pin 15 to the left in Fig. 11, is a substantial angle α as shown, it will be apparent that the distance a between the centers of pins 15 will then bear a ratio to the distance b measured along the slope of the entering fabric which will define the ratio of slack, which will be according to the expression $\frac{b-a}{a}$; $b-a$ obviously varies as the the versine of the angle α. Referring now to Fig. 12 the relation between the entering web and the finished web, in operation according to the invention, is the numerical relation of hypothenuse b to base a.

The fabric having been impaled according to its slack ratio is slack between every pair of pins 15. The heavier brush wheel 88 on a shaft 89, Figs. 1 and 3, the roller having a grooved hub held in a fork 89ª of the plates 84, Fig. 3, may be relied upon to force the margins of the fabric home to full engagement with the pins 15.

The brush wheel 88 for the purposes explained need not be vertically movable in respect to chains 10 and 11, and its shaft 89 may have any ordinary kind of bearing in brackets 91, Fig. 1, fixed on the end frame of the machine. The brushes 88 may be driven by the cloth and chain, but are laterally adjustable to follow changed positions of the chains by the forks 89ª.

In order to relate the surface speed of roller 71 to the speed of the chains 10 and 11 according to the precalculated slack ratio, it is preferred to derive the motion of roll 71 from that of the chains through shaft 5, which carries a drive pulley 4 for a preferably round belt 3. Roll 71 is integral with or attached to a shaft 71ª in bearings in brackets 90, which shaft projects beyond one bracket to receive an adjustable driven pulley 95, Figs. 9 and 10, capable of being varied in diameter. A preferred adjustable pulley as shown comprises a cone 96, which may be a stamping having a hub fast on the shaft, having angular peripheral segments 97 alternating with similar segments 97ª of a like cone 98 splined on said shaft. A micrometer nut 100 on the reduced and threaded end 101 of shaft 71ª reacts against spring 99 to vary the diameter of the circle of intersection of segments 97, 97ª. Adjustment may be read at angular graduations on nut 100 against index 102 on cone 98.

Referring now to Figs. 1, 2 and 6, the treated web runs around the sprockets 8 still on the pin chains, and is preferably doffed without longitudinal stress on the fabric from the return run of the pin chains. A transverse shaft 105 on one of the frames 1 may be driven by bevels 106 from a shaft 107 and bevels 108 on a short shaft 109 geared to the drive pulleys 16. A gear 120 on one end of shaft 105 drives a small pinion 111 on a shaft 112 having eccentric portions near its ends, over which eccentric portions take forks 113 of doffer levers 115 pivoted in brackets 114 on the under faces of channel guides 30ª, 31ª, the forward ends of levers 115 rapidly striking the upper face of the web W just within the rows of pins 15 during operation. The web W passes under and to the right from a roller 116 on transverse shaft 117 geared at 118 to shaft 105.

In order to control the lateral position of the tentering chains and their accessories, the machine may include sensitive devices to feel the position of the edges of the web entering it, and means responsive to the indications of said devices for shifting the lateral position of the chains, the fabric impaling means, and the channel guides. For example, edge-detectors 110 made as circuit-closing bell-crank levers may be mounted on a transverse strut to feel the web edges between feed roll 71 and brush rolls 80. The levers 110 close one or another circuit (not shown) of a reversing connection to motors 115 on a bracket on the machine frame and geared to the screw shaft 35. When the web edges are normally positioned, the detectors 110 open circuit. Such edge detectors and controlling circuits are well known.

Another motor 115ª controlled by detectors 110 may be coupled to a shaft, 115ᵇ, having a sprocket 115ᶜ and chain 115ᵈ for moving sprocket 41 and laterally positioning the whole course of the stretching chains according to width of the received web.

I do not herein claim any invention common to this application and my application for Letters Patent Serial No. 296,976 filed August 2, 1928.

I claim:

1. Machine for treating textile webs having in combination edge carriers adapted to hold the web against lateral stresses and to permit the web to yield to shortening or longitudinal shrinking stresses, means for moving the carriers in paths having mutually

divergent portions for lateral stretching, and means for feeding web to said edge carriers in a longitudinally slack condition, permitting the web to shorten longitudinally.

2. Machine for treating textile webs having in combination edge carriers adapted to hold the web against lateral stresses and to permit the web to yield to shortening or longitudinal shrinking stresses, means for moving the carriers in paths having mutually divergent portions for stretching, and means for softening adhesions between yarns of the web acting prior to passage of the web by said divergent portions.

3. Machine for treating textile webs having in combination endless edge carriers adapted to hold the web against lateral stresses and to permit the web to yield to shortening or longitudinal shrinking stresses, means for moving the carriers in paths having mutually divergent portions for stretching, and means for continuously engaging a greater length of web with one run of said carriers than the length of said carriers in said run.

4. Machine for treating textile webs by stretching, having therein in combination means for stretching the web in one dimension and means for holding the edges of the web permitting the web to shrink in respect to said holding means in the other dimension.

5. Machine for treating textile webs by stretching having therein in combination means for stretching the web crosswise and means for holding the edges of the web permitting the web to shrink lengthwise in respect to said holding means.

6. Machine for treating textile webs by stretching having therein in combination means for stretching the web crosswise, means for holding the edges of the web permitting the web to shrink lengthwise in respect to said holding means, and means for softening stiffening substances acting during said crosswise stretching.

7. Machine for treating textile webs by stretching having therein in combination means for stretching the web crosswise, means for holding the edges of the web permitting the web to shrink lengthwise in respect to said holding means, means for softening stiffening substances acting during said crosswise stretching, and means for setting the web in its stretched condition acting on the web after the completion of said stretching.

8. Automatic machine for treating textile webs having therein in combination holders for edge impaling pins, means for moving said holders in paths diverging at a part of their travel at a predetermined rate whereby to stretch the web laterally and shrink it longitudinally, feeding means for moving the web into impalement on said pins at an incrementally higher rate than the rate of travel of said holders.

9. Automatic machine for treating textile webs having therein in combination holders for edge impaling pins, means for moving said holders in paths diverging at a part of their travel at a predetermined rate, means for steaming the web at said part of its travel whereby to stretch the web laterally and shrink it longitudinally, and feeding means for moving the web into impalement on said pins at an incrementally higher rate than the rate of travel of said holders.

10. Automatic machine for treating textile webs having therein in combination holders for edge impaling pins, means for moving said holders in paths diverging at a part of their travel at a predetermined rate, means for steaming the web at said part of its travel and means for subjecting the material to drying while held by said pins, whereby to stretch the web laterally and shrink it longitudinally, feeding means for moving the web into impalement on said pins at an incrementally higher rate than the rate of travel of said holders.

11. In a continuous automatic machine for laterally stretching and longitudinally shrinking a textile web, the combination of endless series of uniformly spaced web edge impaling pins with means for holding and moving a plurality of said series in paths mutually divergent in part, and means for running the edges of a length of web on such pins adapted to apply on said pins a greater length of web between each pair of pins of a segment of said series of pins than the length between adjacent pins of said segment.

12. In a machine for laterally stretching and longitudinally shrinking a textile web, the combination of endless series of uniformly spaced web edge impaling pins with means for holding and moving a plurality of said series in paths mutually divergent in part, and means for impaling the edges of measured lengths of web longer than the distance between adjacent pins on adjacent pins at the passage of said pins by a point in their path of movement.

13. A tentering machine having therein in combination a movable endless series of web-edge holders traveling in a plane comprising spaced impaling pins, in combination with a web-feeding device adapted to deliver web edges at an angle to the direction of progress of said impaling pins in said plane, and a primary impaling device for pushing the angularly-delivered web onto the pins acting to push the web onto a preceding pin before penetrating it by the next following pin.

14. A tentering machine having therein in combination a movable endless series of web-edge holders comprising spaced impaling pins, in combination with a web-feeding de-

vice adapted to deliver web edges at an angle to the direction of progress of said impaling pins, a primary impaling device for pushing the angularly-delivered web onto the pins, and a rotary brush acting to force the web into deep engagement with said pins.

15. A tentering machine having therein in combination a movable endless series of web-edge holders comprising spaced impaling pins, in combination with a web-feeding device adapted to deliver web edges at a rate greater than the rate of motion of said holders and at a predetermined angle to the direction of progress of said impaling pins, and a prmiary impaling device comprising a rotary brush for pushing the angularly-delivered web onto the pins at the said angle of delivery.

16. In a tentering machine adapted for shrinking a web longitudinally, the combination of endless edge holders having impaling pins, and a web doffer and means to vibrate said doffer behind the web to strike the web repeatedly in the direction of the free ends of the pins to remove the web from engagement with the pins without pulling upon it.

17. In a continuous automatic machine for laterally stretching and longitudinally shrinking a textile web, in combination, endless series of uniformly spaced web edge impaling pins with means for holding and moving a plurality of said series in paths mutually divergent in part, and means for running the edges of a length of web on such pins adapted to apply lengths of web between successive pins uniformly greater than the distance between successive pins.

18. In a machine of the character described, comprising endless series of web engaging pins, means for feeding a web to be engaged by said pins in a path angularly converging to the plane of travel of the series of pins at a velocity exceeding that of the pins, and means operating on the web edges in said path to cause it to engage the pins in succession and to include between successive pins a length of web in excess of the spacing between successive pins, proportionate to the excess of velocity of approach of web over the velocity of travel of the pins.

Signed by me at Washington, District of Columbia, this 15th day of January, 1929.

SANFORD L. CLUETT.