

Oct. 29, 1946.

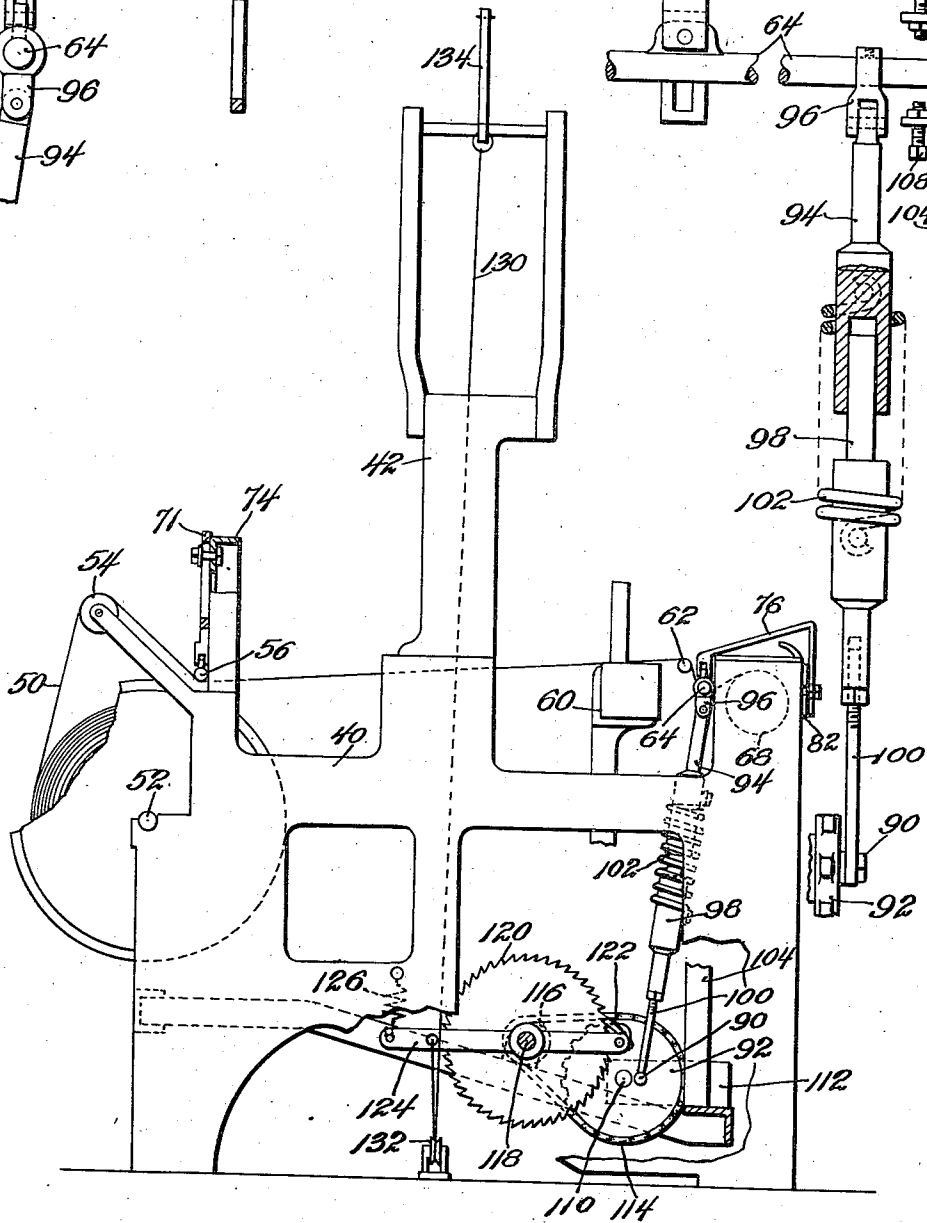
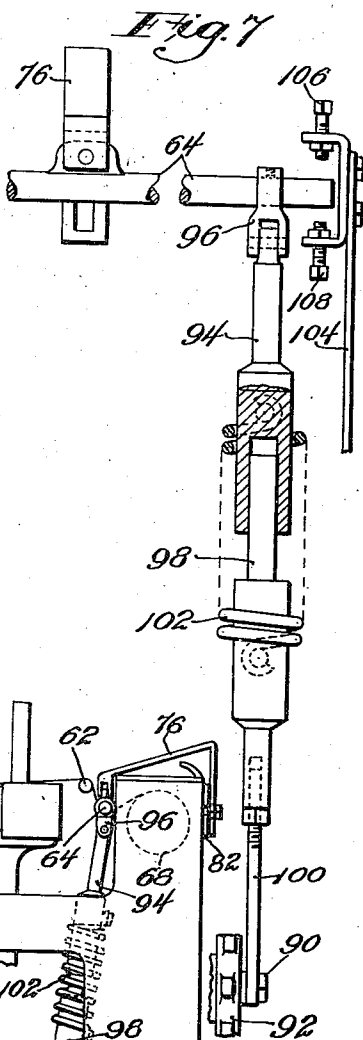
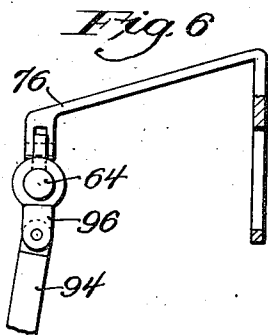
L. A. SAVAGE

2,410,394

MANUFACTURE OF TEXTILES

Filed April 28, 1944

3 Sheets-Sheet 1



Inventor
Lawrence A. Savage
by *Madison Fish*
att.

Oct. 29, 1946.

L. A. SAVAGE

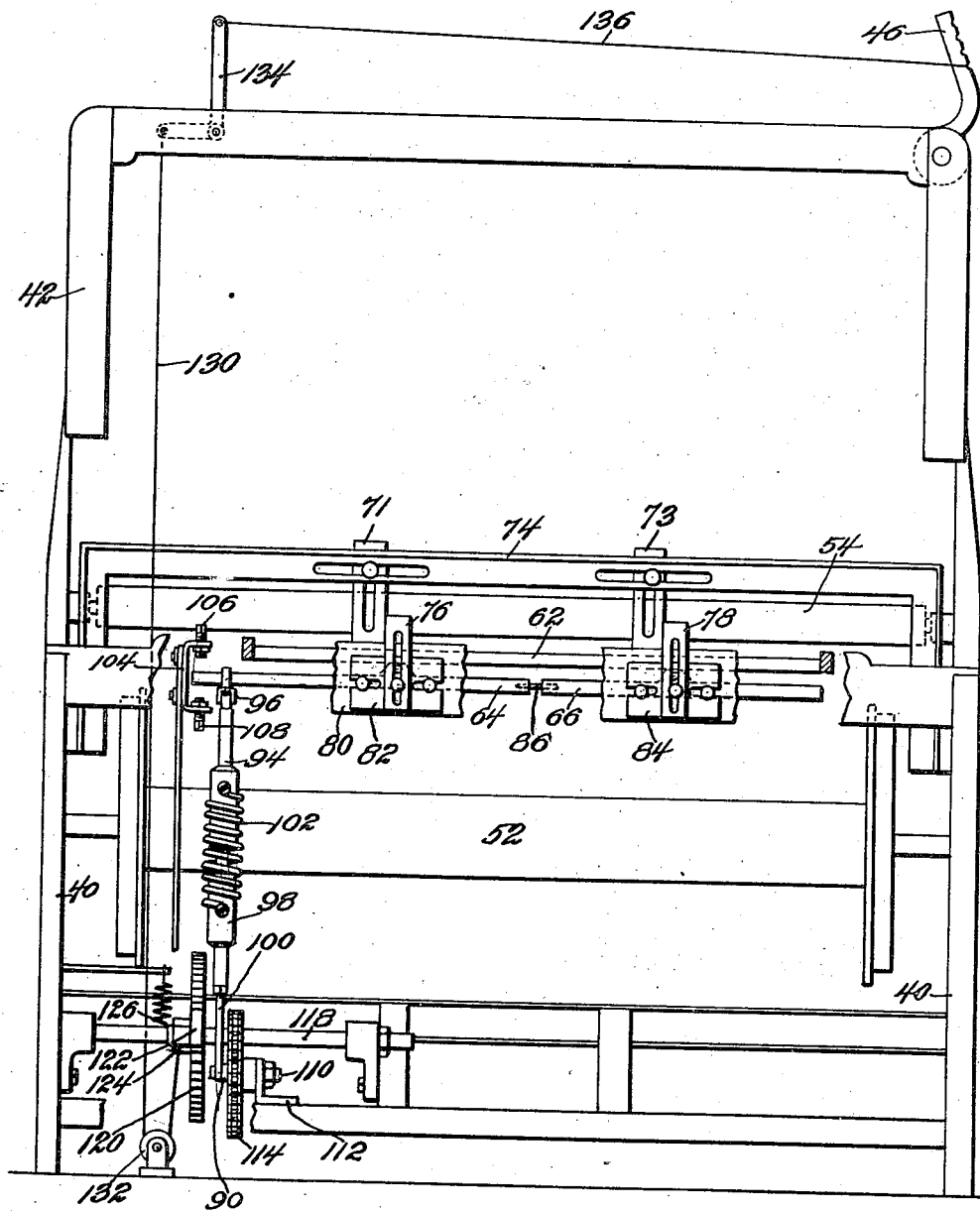
2,410,394

MANUFACTURE OF TEXTILES

Filed April 28, 1944

3 Sheets-Sheet 2

Fig. 2



Inventor
Lawrence A. Savage
3 Maxwell Park
att.

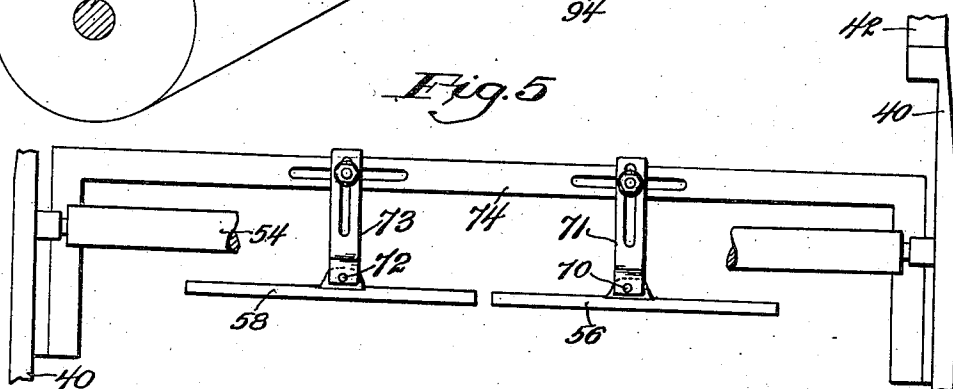
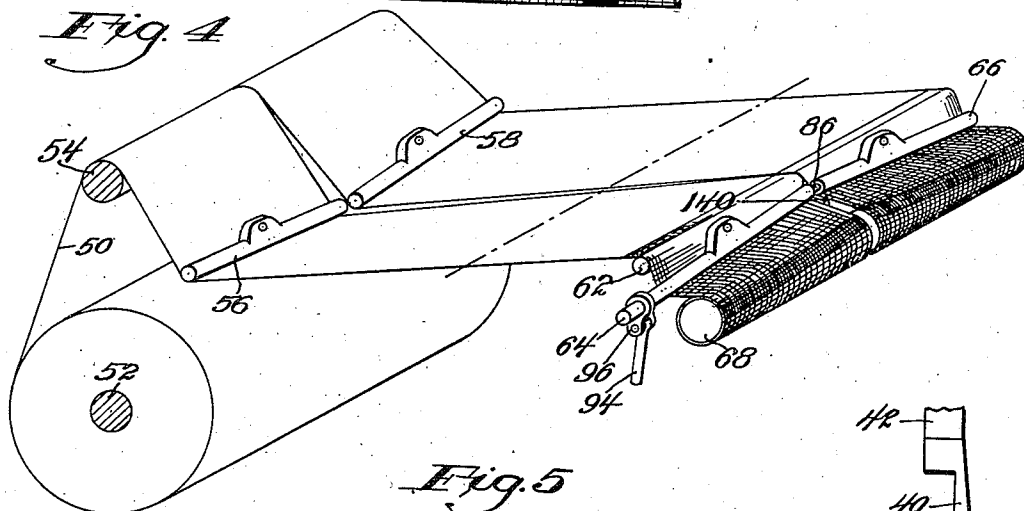
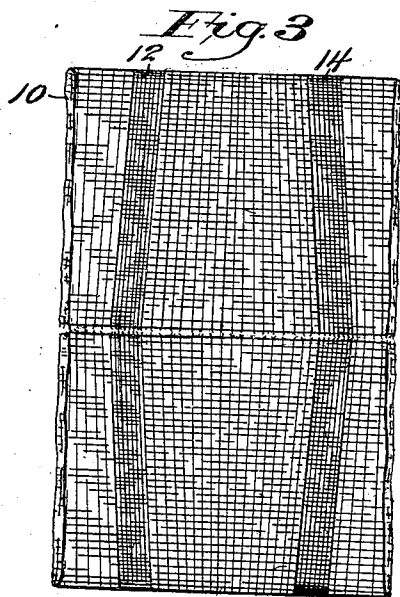
Oct. 29, 1946.

L. A. SAVAGE
MANUFACTURE OF TEXTILES

2,410,394

Filed April 28, 1944

3 Sheets-Sheet 3



Inventor
Lawrence A. Savage
by Maxwell Fish
Att'y

UNITED STATES PATENT OFFICE

2,410,394

MANUFACTURE OF TEXTILES

Lawrence Alexander Savage, Pelzer, S. C., assignor
to The Kendall Company, Boston, Mass., a corporation of Massachusetts

Application April 28, 1944, Serial No. 533,156

16 Claims. (Cl. 139—35)

1

The present invention relates to improvements in the manufacture of textiles, and more particularly to a method of weaving and apparatus for producing a fabric in which the angular relation of the filling and warp yarns is controlled to produce a distinctive and useful structural characteristic of the woven fabric and articles produced thereby.

The method of weaving which forms the subject-matter of the present invention is well adapted for the weaving of fabrics intended for special uses wherein the unusual qualities imparted to the fabric by changing the relative angular position of the filling and warp yarns will have a substantial value. Such variation may be employed, for example, to produce a distinctive design characteristic in the fabric, or to cause the direction of the individual filling yarns to conform with the outline or shape of articles to be made from the fabric. Controlled variations in the angular relation of the filling and the warp yarns may also be employed to impart an unusual strength characteristic to the fabric to increase the resistance of the fabric to stretch or failure under stresses exerted on the fabric in particular directions or with relation to some focal area of support.

For purposes of illustration, the method of the present invention is described in connection with the weaving of fabric blanks for use in the manufacture of cheese bandages of the general type described in the copending application of Ross C. Whitman, Serial No. 507,962, filed in the United States Patent Office October 28, 1943, now Patent No. 2,396,905, for improvements in the Manufacture of textiles. In accordance with the teaching of that application, a fabric blank is woven consisting of a two-ply fabric having interwoven strip areas uniting the fabric plies to form tubular cheese bandages when severed from the blank. The strip areas are preferably formed to extend weftwise of the fabric blank and to be spaced from one another warpwise of the blank so that each cheese bandage will have its longitudinal axis extending transversely or weftwise of the blank. For the production of tapered cheese bandages, the interwoven strip areas are shaped, as by means of pattern controlled harnesses, to be placed in alternately converging and diverging relation with one another so that a series of cheese bandages of identical size are formed which, when severed from the blank, and opened out and filled, will have the surface shape of a frusto-conical section.

In accordance with the present invention, it is

2

proposed to control the angular relation of the filling and warp yarns during the process of weaving to produce a woven fabric in which predetermined areas thereof are formed with the filling yarns inclined in one or the other direction from the normal transverse axis of the fabric. In the specific embodiment shown, in which the method of the present invention has been employed for the weaving of a fabric blank for use in the manufacture of cheese bandages, the angular relation of the filling and warp yarns is controlled to permit the weaving of transversely extending interwoven strip areas which may thus be in alternately converging and diverging relation with one another without the necessity of employing the relatively complicated pattern control mechanisms of the prior art for this purpose. Provision is made for controlling the warp in the loom in such a manner as to cause a temporary skew to be imparted to the warp yarns passing through the heddles and reed supported by the lay, and thereafter when the filling yarns have been woven into the fabric, to cause the warp to be returned to its normal position so that the filling yarns appear in the finished fabric in a position inclined from the perpendicular to a line extending warpwise of the fabric. The amount and direction of the skew imparted to that portion of the warp passing through the loom is controlled to cause the warp to be skewed gradually first in one direction and then in the other direction in timed relation with the weaving and pattern control thereof so that the successive interwoven strip areas will be placed in alternately converging and diverging relation to one another.

Specifically in accordance with the invention, a novel and extremely simple apparatus is provided for carrying out the steps of applicant's method in the form of skew rods which are placed adjacent each end of the loom and are controlled in timed relation with the pattern mechanism of the loom to cause the warp to be skewed a predetermined maximum amount first in one and then in the other direction for the weaving of successive interwoven strip areas. The skew rods are shifted from one to the other position through the agency of a crank and a pawl and ratchet mechanism which serves to impart a stepped rocking movement to the skew rods during the weaving of the fabric plies forming those portions of the blank extending between the adjacent interwoven strip areas.

The several steps of applicant's method, the form of apparatus employed for practicing said

3

method and the features of a fabric blank constructed in accordance with said method will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a somewhat fragmentary view in left side elevation of a loom embodying therein apparatus adapting said loom for the weaving of a fabric blank, in accordance with applicant's method, only so much of the loom having been shown as is believed necessary to indicate the connection of the present invention therewith; Fig. 2 is a view in front elevation of the loom illustrating particularly the parts shown in Fig. 1; Fig. 3 is a somewhat diagrammatic view illustrating a portion of a fabric blank woven in accordance with applicant's method; Fig. 4 is a diagrammatic view in perspective illustrating particularly the operation of the skew rods to skew the warp; Fig. 5 is a fragmentary view in rear elevation illustrating particularly the floating skew rods and their supporting brackets located at the rear end of the loom; Fig. 6 is an enlarged detail view of a supporting bracket and associated skew rod at the front of the machine shown on a smaller scale in Fig. 1; and Fig. 7 is a view of the parts shown in Fig. 6, looking from the left, but including the connecting link and limiting stops.

The novel method of weaving which forms the subject-matter of the present invention, is described and the steps thereof are particularly pointed out in connection with the weaving of the particular fabric blank illustrated in Fig. 3 of the drawings, which is intended for use in the manufacture of cheese bandages. The steps of the method and the advantages to be obtained thereby will be more particularly described also in connection with the preferred form of apparatus illustrated in the drawings for the practice of the invention on a power loom.

It will be understood that the method and apparatus described are not limited in their application to the production of fabric in accordance with any particular pattern, but that the method and apparatus shown may be employed with equal advantage for the weaving of other fabrics which may be single ply and that different patterns of change in the angular relation of the filling and warp yarns may be employed as may be found desirable to meet the requirements of any particular fabric or articles to be produced therefrom.

The fabric blank produced in accordance with applicant's novel method comprises a two-ply fabric 10 produced by tubular weaving, and having at spaced intervals therein interwoven strip areas 12, 14 which extend transversely of the fabric alternately converging and diverging with relation to one another, and serve to divide the blank into bag-like sections from which individual cheese bandages are severed in their finished form ready for use. Whereas, in the copending application above referred to, the interwoven strip areas extending obliquely across the blank are produced by the use of a relatively large number of harnesses and pattern means for controlling the same, the converging and diverging interwoven strip areas of the illustrated fabric blank are produced by controlling the angular relation of the warp ends and the filling picks, so that the filling picks in certain portions of the completed blank extend widthwise thereof in directions inclined from the perpendicular to a line extending warpwise of the fabric.

Fig. 3 discloses a fabric blank of which each

4

transversely extending fabric section including the interwoven strip areas at each side thereof is constructed and arranged to comprise two cheese bandages placed end-to-end widthwise of the fabric. It will be noted that the angular position of the strip areas with relation to the warp is determined by the location and direction taken by the individual filling picks of the interwoven area. Each interwoven strip area 12 is inclined leftwardly across half the width of the fabric and then rightwardly across the remaining width of the fabric in accordance with the direction taken by the included filling picks. Each alternate interwoven strip area 14 is inclined rightwardly across half the width of the fabric and then leftwardly across the remaining width of the fabric. The disposition of the filling picks contained within each section of two-ply fabric between adjacent interwoven strip areas is such that these picks are relatively crowded together in the narrower portions of the fabric section and fan outwardly to form the wide portions of the fabric section.

In the illustrated form of blank produced in accordance with the method herein described, and illustrated in Fig. 3 of the drawings, a relatively low count of filling picks, of the order of 20 to 30 to the inch, is employed in the weaving of each fabric ply contained between the interwoven strips 12, 14 and a substantially increased number of filling picks, of the order of 40 to 60 to the inch, may be employed in the weaving of the strip areas 12, 14. The blank has a relatively high count of warp ends which may be on the order of 40 ends to the inch. For purposes of illustration, it is assumed that each fabric ply will have a count of 40 warp ends to the inch and 20 filling picks to the inch. In the interwoven strip areas, the count of yarns in both directions is doubled by the inclusion of the yarns of both fabric plies so that there are 80 warp ends to the inch, and 40 filling picks to the inch. Preferably, however, the count of picks in the fill is still further increased to about 50 in the interweaves to insure a strong union of the fabric plies, although cases may arise in which a count of less than 40 picks is found desirable. The individual cheese bandages to be severed from the fabric blank are located in the blank with their longitudinal axes extending transversely thereof, so that the warp ends of the blank become the circumferentially extending yarns of the individual bandages and the filling yarns of the blank become the longitudinally extending yarns of the individual bandages.

The fabric blank herein disclosed is of advantage considered as a step product in the manufacture of cheese bandages, also in that the filling yarns forming each interwoven strip area of the fabric are all contained within the strip area throughout their length, so that the number of picks per inch within the interwoven strip area, may be substantially increased to still further strengthen the union between the fabric edges provided by the interweave without affecting the weave of the fabric plies forming the body portions of the individual bandages.

The several steps of applicant's method of weaving will be particularly described in connection with the manufacture on a commercial loom of the fabric blank illustrated. It is assumed that the fabric is produced on a loom having mechanism for tubular weaving for the production of two-ply fabric, and pattern controls of ordinary description for changing the

5

pattern of weaving to introduce interwoven strip areas extending weftwise across the fabric in accordance with a predetermined pattern of operation. Specifically in accordance with the invention, that portion of the warp passing through the harnesses and lay is gradually skewed or distorted during the weaving of the two-ply or tubular portion of the fabric, so that the filling yarns are interwoven across the warp with individual warp yarns which have been progressively advanced or retarded from their normal position with relation to one another. Subsequently, as the completed fabric leaves the loom, and prior to the winding onto the usual take-up roll, the fabric comprising the warp and the filling yarns interwoven therewith is skewed an equal amount in the opposite direction to cause the individual warp yarns to resume their normal positions with relation to one another. The filling yarns woven into the warp while in the skewed position, are caused by the latter return skewing operation of the warp to become inclined from the perpendicular to a line extending warpwise of the fabric. The skewing or distorting of that portion of the warp passing through the loom is gradually increased in accordance with a predetermined pattern of operation of the loom to reach a maximum amount at the same time that the pattern mechanism operates to discontinue the tubular weaving operation, and to initiate the interweaving of all of the warp yarns with the filling yarns to form an interwoven strip area across the width of the fabric. After an interwoven strip area which may, for example, be two inches in width, has been woven, the interweaving operation is discontinued, and tubular weaving is resumed. That portion of the warp passing through the loom is now gradually skewed in an opposite direction so that the individual warp yarns are returned to their normal relation. The skewing operation then continues until the warp has been skewed an equal amount in the opposite direction when the pattern mechanism again becomes operative to discontinue the tubular weaving and to start the weaving of another interwoven strip area. It will be understood that during this entire operation of skewing the warp, only that portion of the warp passing through the drop wires, harnesses and lay is skewed, and that the portion of the woven fabric leaving the loom is at all times skewed by an equal amount in the opposite direction so that the individual warp yarns are returned to their normal relation before the fabric is wound upon the take-up roll. The pattern of operation above described is repeated, the warp being gradually shifted from one to the other skewed position during the weaving of each tubular or two-ply portion of the fabric, so that during the weaving of successive interwoven strip areas, the warp will be skewed a maximum amount first in one and then in the other direction. As will be evident from an inspection of Fig. 3 of the drawings, a distinctive fabric pattern is produced in which the interwoven strip areas are placed in alternately converging and diverging relation to one another, and in which the filling yarns tend to fan out from the narrower to the wider portions of the transverse fabric sections bounded by the successive interwoven strip areas.

The method of weaving above described has in the illustrated example been employed for the weaving of a fabric blank of sufficient width so that two cheese bandages placed end-to-end

6

with relation to each other are formed from each fabric section to be severed from the blank. To this end the present method contemplates that different portions of the warp considered widthwise thereof may be skewed simultaneously in opposite directions, so that interwoven fabric strip areas will be formed which may converge with relation to each other along part of their length, and thereafter may diverge with relation to one another along another part of their length for the formation of tapered cheese bandages therefrom, which when severed from the blank will be all of the same size. In the illustrated form of the invention, it is assumed that the loom is adapted for the weaving of a fabric 32 inches in width, and that a fabric blank is to be woven therefrom from which cheese bandages 16 inches in length are to be severed. In the illustrated example, the two halves of the warp considered widthwise thereof are skewed simultaneously in opposite directions so that the central portion of the warp will be advanced when the two edges are retarded, and the center portion of the warp will be retarded at the same time that the two edges are relatively advanced.

A preferred form of apparatus adapted for the practice of the present invention on a commercial loom, is shown in Figs. 1 and 2 of the drawings. While this apparatus is here employed in the weaving of multi-layered fabric blanks for use in the manufacture of cheese bandages, it will be understood that the apparatus is equally well adapted for the weaving of single ply fabrics, in which only one or a greater number than two skew rods may be required to produce a particular pattern across the width of the fabric, and also fabrics in which the amount of skew imparted to the skew rods and thence to the filling yarns of the fabric may be substantially varied in accordance with a particular pattern.

Referring specifically to the drawings, a loom of ordinary construction is provided comprising a frame 40 and a top frame or arch 42. Much of the operating mechanism of the loom including the usual harnesses, pattern controls therefor, the lay and the shuttle mechanism have been omitted, since these mechanisms are well known in the art, and illustration of the same is believed not necessary to a full understanding of the present invention. The line of movement of the shuttle through the shed forming the warp is indicated by a dot-and-dash line in Fig. 4, and is in a direction normal to the direction of travel of the warp. A single jack lever 46 forming part of the usual control mechanism of the loom is shown in Fig. 2 of the drawings. This lever is assumed to have a periodic oscillatory movement imparted thereto in a conventional manner from a cam or dobby actuated pattern mechanism for the operation of the skew producing apparatus of the present invention as hereinafter more fully to be described.

In the illustrated machine, the ends forming the warp designated generally at 50, are arranged to be drawn from a warp beam 52, passing over an idler roller 54, around a pair of floating skew rods 56, 58, thence through the usual stop motion drop wires (not shown), through the usual harnesses (not shown) forming the shed and carried by the top frame 42, through the reed of the lay 60, over a guide roll 62, around the skew rods 64, 66, thence to the take-up roll. The floating skew rods 56, 58 and the control skew rods 64, 66 are arranged to be tiltable about transverse axes to impart a desired skew to the portions of

the warp passing around the respective rods. As shown in Fig. 5, the skew rods 56, 58 are arranged to swing on pivot pins 70, 72 carried by downward arm supports 71, 73 rigidly mounted on the U-shaped bracket 74 secured to the base frame 40 of the loom. The skew rods 56, 58 are floating in the sense that the angular position of these rods is controlled by the action of the warp ends engaged therewith. The skew rods 64, 66 are similarly supported intermediate their ends on transverse pivots provided on the overarm brackets 76, 78 carried on the breast beam 80 of the loom. In order to provide for vertical and lateral adjustment of the brackets 76, 78, the brackets are secured respectively to the plates 82 and 84 by clamping bolt and slot connections arranged to permit vertical adjustment of the brackets on the plates 82, 84 and the plates 82, 84 are in turn secured to the breast beam 80 by clamping bolt and slot connections arranged to permit lateral adjustment of the plates on the breast beam. As shown in Figs. 2 and 4 of the drawings, the skew rods 64, 66 are connected together at their adjacent ends by means of a ball and socket swivel connection 86 so designed that as cylinder rod 94 moves the outer end of control skew rod 64 upward, and hence the inner end downward, that swivel connection 86 will move the inner end of skew rod 66 downward. Conversely, as the inner end of skew rod 64 moves upward, the swivel connection 86 transmits upward.

The construction and arrangement of the skew rods 64, 66 and floating skew rods 56, 58, is such that a tilting movement imparted to skew rods 64, 66 as shown in the diagrammatic perspective view, Fig. 4, has the effect of skewing the warp. As shown in this figure, the outer ends of the skew rods 64, 66 are tilted downwardly and the inner ends upwardly, so that an increased proportion of the total length of those warp ends adjacent the edges of the fabric and extending between the warp beam 52 and take-up roll 68, is drawn over the guide roller 62, thus relatively advancing those portions of these warp ends passing through the harnesses and lay. The shortening and consequent straightening out of the length of these outer warp ends extending between the warp beam 52 and the guide roller 62, causes the outer ends of the two floating skew rods 56, 58 to be moved upwardly, and the inner ends thereof downwardly, thus relatively retarding the warp ends comprising the central or inner portion of the warp. It is evident that rocking movement of the control skew rods 64, 66 in the opposite direction from that shown, that is, so that the outer ends move upwardly and the inner ends downwardly, will have the effect of reversing the direction of skew.

The mechanism for tilting the control skew rods 64, 66 to impart the desired skew to the warp, comprises a crank actuated yieldable link connection which extends between the rod 64 and a crank pin 90 formed in a sprocket 92 in the base of the machine, and is arranged to move the skew rods from one extreme position to the other, and to maintain the rods during a predetermined time interval in each extreme position. The link connection as best shown in Figs. 1, 2 and 7, comprises a cylinder rod 94 pivotally connected to an arm 96 rigidly mounted adjacent the outer end of the rod 64, and a piston rod 98 into which is threaded a length adjusting screw member 100 pivotally connected at its lower end to the crank pin 90. The rods 94, 98 are supported yieldably in an intermediate position with relation to one

another by means of a coiled spring 102 which is connected at its upper end to the cylinder rod 94 and at its lower end to the telescoping piston rod 98. The spring 102 is capable of being either expanded or contracted under pressure from a normal intermediate position. A spring of sufficient strength is employed so that the link connection comprised by rods 94, 98, screw member 100 and spring 102 is under normal operating conditions of fixed length during movement of the skew rods 64, 66 from one to the other limiting position. In order to provide for a definite limit of movement of the skew rods 64, 66 in each direction, a bracket 104 is mounted on the machine frame, and is adapted to support two oppositely placed stop pins 106, 108 which may be adjusted to engage with and limit movement of the skew rod 64 in each direction. The mechanism including stop screws 106, 108 may be employed to provide a lengthened dwell in the movement of the skew rods 64, 66 in each limiting position, slightly before and after the crank pin 90 reaches dead center in order to insure an exactly parallel arrangement of the filling yarns in the interwoven areas of the fabric blank above described and illustrated in Fig. 3.

The supporting sprocket 92 for the crank pin 90 is mounted to turn on a stud 110 carried on a bracket 112, and is connected by means of a sprocket chain 114 with a sprocket 116 on a jack shaft 118. A ratchet 120 secured to the sprocket 116 and also mounted on the shaft 118 is arranged to be acted upon by a pawl 122 supported on a pawl lever 124 mounted to turn coaxially with the ratchet 120. A spring 126 connected at one end to the pawl lever 124 and at its other end to the machine frame tends to move the lever in a direction to retract the pawl with relation to the ratchet. Movement of the pawl lever is controlled from the oscillatory pattern jack lever 46 above referred to, through connections which include a cord 130 which passes around a pulley 132, and is connected at one end to the pawl lever 124 and at its other end to one arm of a bell-crank 134. The other arm of the bell-crank is connected by a cord 136 with the jack lever 46. In operation, the oscillatory movement imparted to the jack lever 46 of the pattern mechanism by reciprocating the pawl lever 124 causes a slow stepped rotational movement to be imparted to the crank pin 90 to tilt the skew rod 64 and skew rod 66 connected thereto, first in one direction and then in the other direction as the crank pin moves upwardly and downwardly around its center. The construction and arrangement of the pattern mechanism and of the connections above described is such that tubular weaving takes place during the movement of the crank pin and link connection upwardly or downwardly to swing the skew rods about their pivots from one to the other limiting position, and the weaving of the interwoven strip areas takes place while the crank pin 90 is located near either of the two extreme dead center positions of the crank 90, and the skew rod 64 is engaged against one or the other of the two stop pins 106, 108.

As shown in Fig. 4, a knife 140 which may be of ordinary construction, is mounted on the loom between the skew rods 64, 66 and the take-up roll 68 in a position to split the fabric as it is wound onto the roll 68, thereby reducing the number of cutting operations which will subsequently be required to separate out the individual cheese bandages from the blank 10. This cut is shown in the fabric blank illustrated in Fig. 3.

The apparatus herein described and illustrated is particularly adapted for carrying out the steps of applicant's method. It will be understood, however, that the invention is not limited to the particular apparatus shown, and that modified forms of said apparatus or other apparatus may be employed as may be required for the manufacture of particular fabrics in accordance with the method of the present invention. Such a fabric may be woven in which different fabric areas are formed with the filling yarns inclined in varying amounts, but in one direction only, from the perpendicular to a line extending warpwise of the fabric, or in which such variations of inclination are abrupt or are not symmetrical, and are therefore not adapted to be produced by the pattern mechanism herein shown which includes a crank motion for rocking the skew rods from one to the other limiting position. It is contemplated also that different fabric patterns may be employed widthwise of the fabric which may require variation in the number of skew rods or in the means for supporting and manipulating the rods across the width of the fabric.

Features of the invention relating particularly to the novel fabric produced with the apparatus and in accordance with the method of the present invention, form the subject-matter of a divisional application Serial No. 653,604, filed March 11, 1946, for Fabrics.

The nature and scope of the invention having been indicated and a specific embodiment of the invention having been described, what is claimed is:

1. The method of weaving which comprises inserting filling picks in a warp, and while weaving is taking place moving the yarns of the warp in relation to the path of insertion of the filling picks while maintaining the same tension on the warp yarns across the warp in accordance with a predetermined pattern of change to produce a fabric in which the angular relation of following filling picks to the perpendicular to a line extending in the direction of the warp changes in accordance with the dictation of said pattern.

2. The method of weaving which comprises inserting filling picks in a warp, and while weaving is taking place changing the relation of the yarns of the warp to the path of insertion of the filling yarns while maintaining the same tension on the warp yarns across the warp to produce a fabric in which the angular relation of following filling picks to a line extending in the direction of the warp changes in accordance with a predetermined pattern.

3. The method of weaving which comprises inserting filling picks in a warp, and while weaving is taking place changing the relative positions of the warp yarns longitudinally with relation to the path of insertion of the filling picks while maintaining the same tension on the warp yarns across the warp to produce a fabric in which the angular relation of following filling picks to a line extending lengthwise of the warp changes in accordance with a predetermined pattern.

4. The method of weaving a fabric having the filling picks thereof along the length of the fabric disposed at varying angles from the perpendicular to a line extending warpwise of the fabric in accordance with a pattern which comprises skewing that portion of the warp at which weaving is taking place variably in accordance with a pattern while maintaining the same tension on the warp yarns across the warp, and inserting fill-

ing picks in the warp to form a woven fabric.

5. The method of weaving which comprises imparting a skew in the form of a relative longitudinal displacement of the warp ends to that portion of the warp at which weaving is taking place, inserting filling picks in the warp at right angles to the warp ends to form a woven fabric, and thereafter returning the warp with the filling picks woven therein to its original condition so that the filling picks are inclined to the normal transverse axis of the warp.

6. The method of weaving which comprises variably skewing that portion of the warp at which weaving is taking place, inserting filling picks therein at right angles to the warp ends to form a woven fabric, and thereafter returning the warp with the filling picks woven therein to its original condition so that the filling picks along the length of the fabric are disposed at varying angles to a line extending warpwise of the fabric.

7. The method of weaving which comprises imparting a skew to that portion of the warp at which weaving is taking place, varying the direction and amount of the skew so imparted to the warp, inserting filling picks therein at right angles to the warp ends, and returning the warp with the filling picks woven therein to its original condition so that those filling picks inserted while the warp was skewed are inclined from the perpendicular to a line extending warpwise of the fabric.

8. The method of weaving which comprises variably skewing that portion of the warp at which weaving is taking place to impart a skew in one direction and then alternately in the other direction to the warp, inserting filling picks therein at right angles to the warp ends to form a continuous length of woven fabric, and thereafter returning the warp to its original condition so that the filling picks along the length of fabric are inclined first in one direction and then in the other direction from the perpendicular to a line extending warpwise of the fabric.

9. The method of weaving a two-ply fabric blank having the fabric plies united at intervals by transversely extending interwoven strip areas for the manufacture of tapered tubular articles therefrom which comprises skewing that portion of the warp at which weaving is taking place gradually first in one and then in the other direction, inserting filling picks in the warp at right angles to the warp ends to form a two-ply fabric and at each limit of the skew position of the warp to form an interwoven strip area extending across the warp, and thereafter returning the warp to its original condition so that the interwoven strip areas appear in the completed fabric in alternately converging and diverging relation with one another.

10. For use in a loom having a warp beam and a take-up roll, an apparatus adapting the loom for the weaving of fabric having the filling picks in the woven fabric at an inclination from the perpendicular to a line extending warpwise of the fabric which comprises skew rods tiltable to skew that portion of the warp between said warp beam and take-up roll at which weaving is taking place while maintaining the same tension on the warp yarns across the warp, and means for controlling the position of said skew rods.

11. For use in a loom having a warp beam and a take-up roll, an apparatus adapting the loom for the weaving of fabric having filling picks in the woven fabric at an inclination from the per-

11

pendicular to a line extending warpwise of the fabric which comprises tiltable skew rods interposed between said warp beam and take-up roll and at opposite sides of the point at which weaving is taking place, and means controlling the angular position of said rods to impart a variable skew to the warp.

12. For use in a loom having a warp beam and a take-up roll, an apparatus adapting the loom for the weaving of fabric having filling picks in the woven fabric at an inclination from the perpendicular to a line extending warpwise of the fabric, which comprises tiltable skew rods interposed between said warp beam and take-up roll and at opposite sides of the point at which weaving is taking place, a crank and a yieldable link connection therefrom with one of said rods, stops for limiting the tilting movement of said skew rod in each direction under the influence of the yieldable link connection, and pattern controlled means for imparting rotational movement to the crank.

13. For use in a loom having a warp beam and a take-up roll, an apparatus adapting the loom for the weaving of fabric having filling picks in the woven fabric at an inclination from the perpendicular to a line extending warpwise of the fabric, which comprises tiltable skew rods interposed between said warp beam and take-up roll and at opposite sides of the point at which weaving is taking place, power operated means for controlling the angular position of one of said skew rods, and a pivotal support on which the other of said skew rods is freely tiltable under the influence of the warp yarns engaged therewith.

12

14. In a loom, a warp beam, a take-up roll, and apparatus for skewing that portion of the warp between said beam and roll at which weaving is taking place which comprises a tiltable skew rod adjacent the take-up roll, means for controlling the angular position of said skew rod, and a floating tiltable skew rod adjacent the warp beam.

15. In a loom, a warp beam, a take-up roll, and apparatus for skewing that portion of the warp between said beam and roll at which weaving is taking place which comprises tiltable skew rods located between said beam and roll and at opposite sides of the point at which weaving is taking place, a crank and a connection therefrom for imparting a tilting movement to one of said rods, and a pattern control pawl and ratchet mechanism for imparting a stepped advancing movement to the crank.

16. In a loom, a warp beam, a take-up roll, and apparatus for skewing that portion of the warp between said beam and roll at which weaving is taking place which comprises a plurality of tiltable skew rods placed end-to-end across the warp adjacent the take-up roll, each pivotally supported at its center point, means connecting the adjacent ends of said skew rods, a like number of floating tiltable skew rods placed end-to-end across the warp adjacent the warp beam, each of said latter rods being pivotally supported at its middle point and having a floating engagement with the warp, and control means acting to vary the angular position of said first-mentioned skew rods in accordance with a predetermined pattern of weaving.

LAWRENCE ALEXANDER SAVAGE.

35