Nov. 29, 1960 M. BERTRAND 2,962,025

PROCESS OF SHAPING AND FORMING BRASSIERE CUPS BY CHEMICAL SHRINKAGE OF THE FABRIC

Filed Sept. 13, 1956 7 Sheets-Sheet 1

Fig. 1

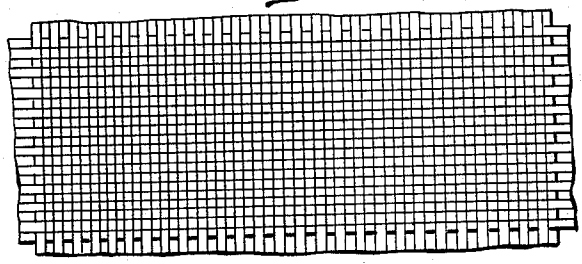


Fig. 5

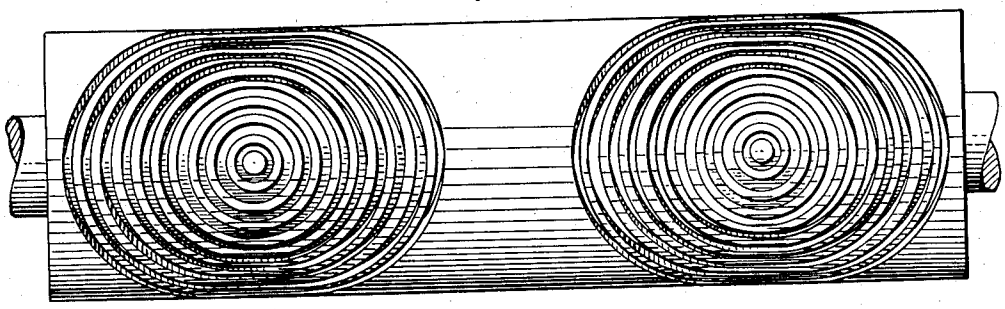


Fig. 6

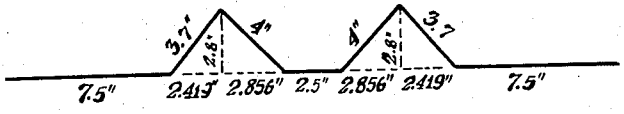


Fig. 14

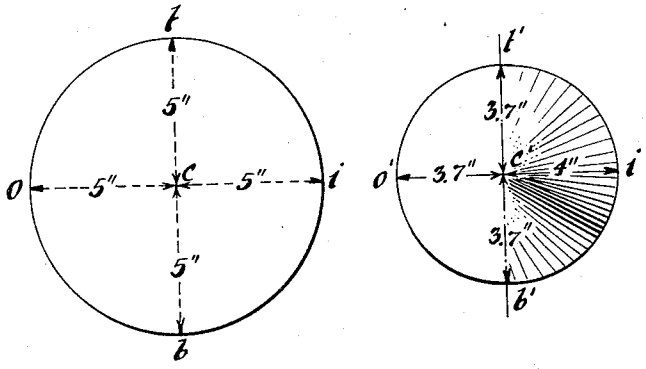
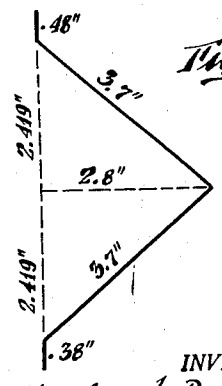


Fig. 7



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PROCESS OF SHAPING AND FORMING BRASSIERE CUPS BY CHEMICAL SHRINKAGE OF THE FABRIC

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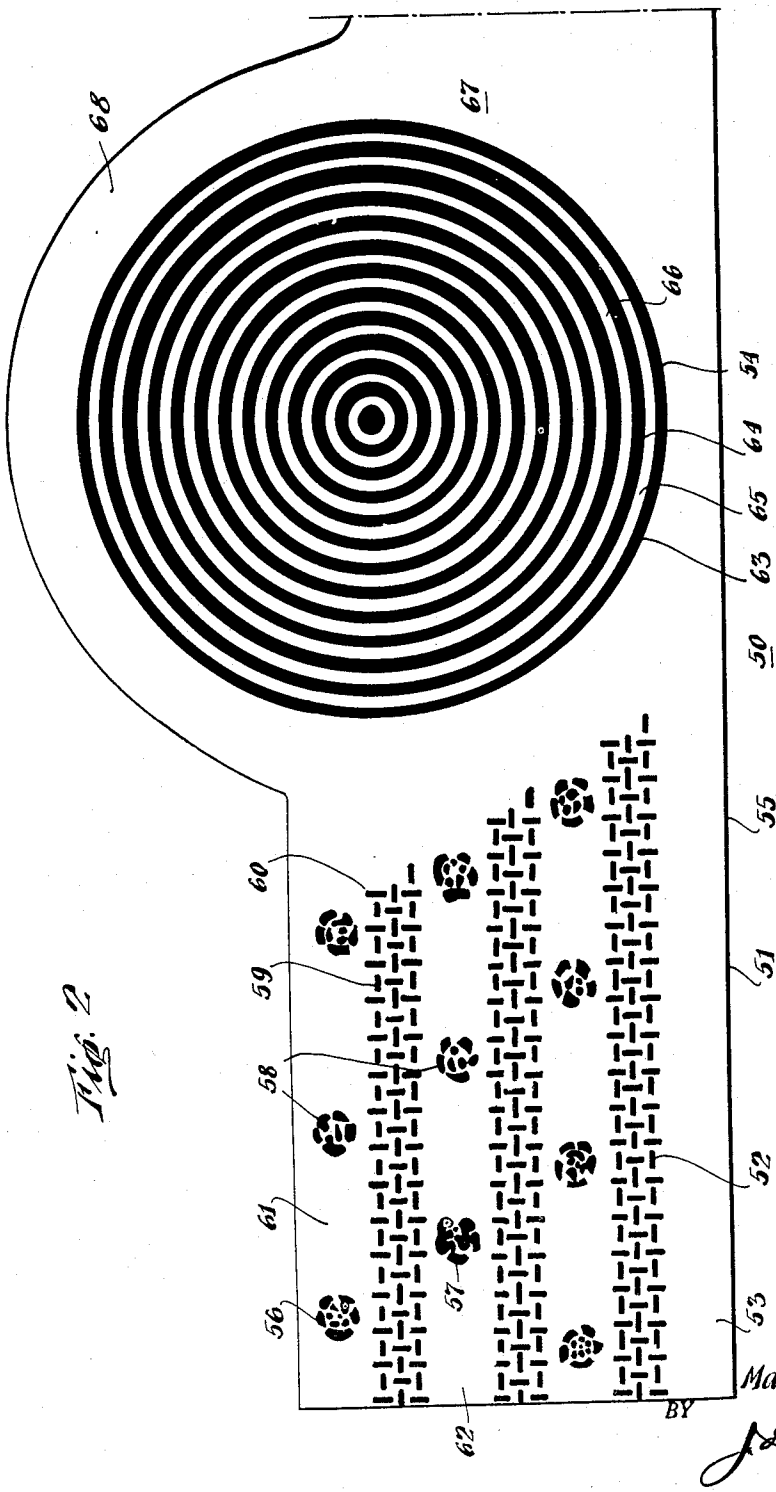

Fig. 2

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PROCESS OF SHAPING AND FORMING BRASSIERE CUPS BY CHEMICAL SHRINKAGE OF THE FABRIC

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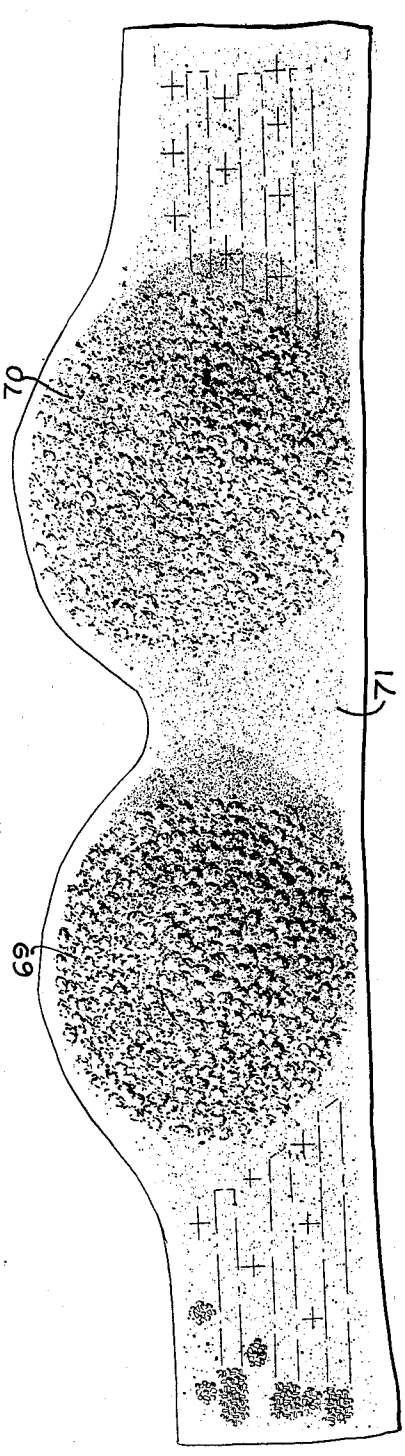

Fig. 3

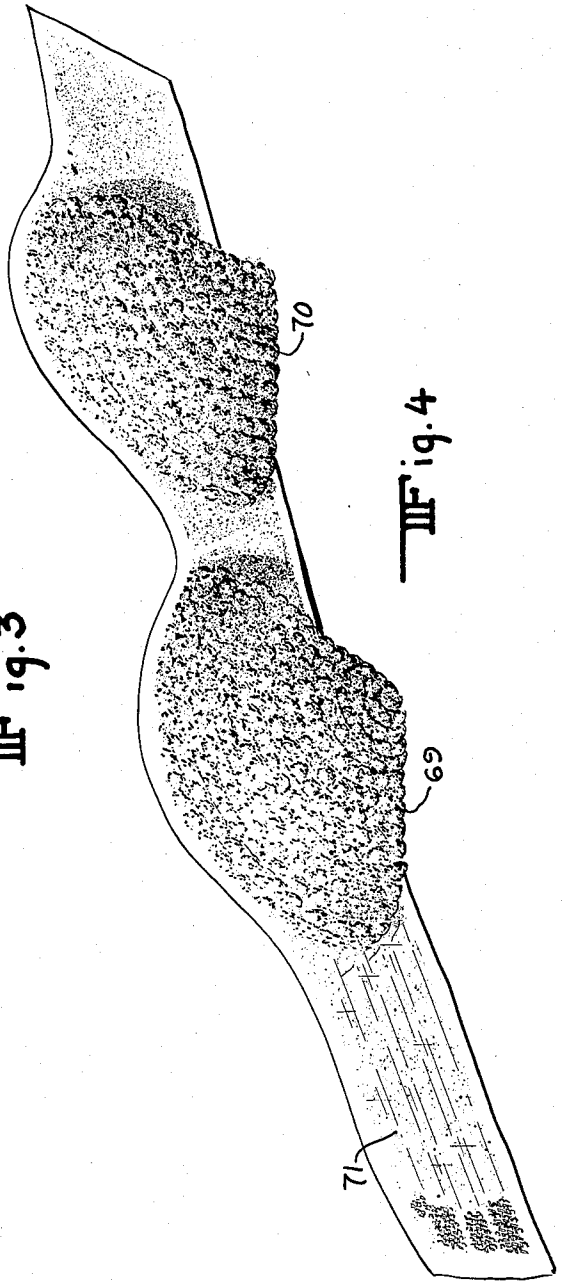

Fig. 4

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PROCESS OF SHAPING AND FORMING BRASSIERE CUPS BY CHEMICAL SHRINKAGE OF THE FABRIC

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Fig. 8

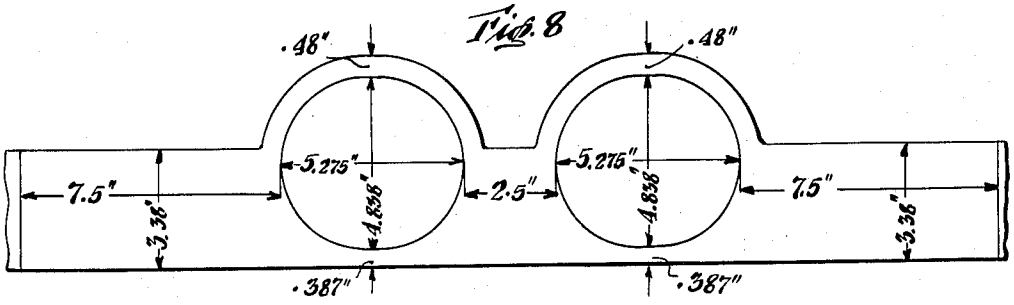


Fig. 9

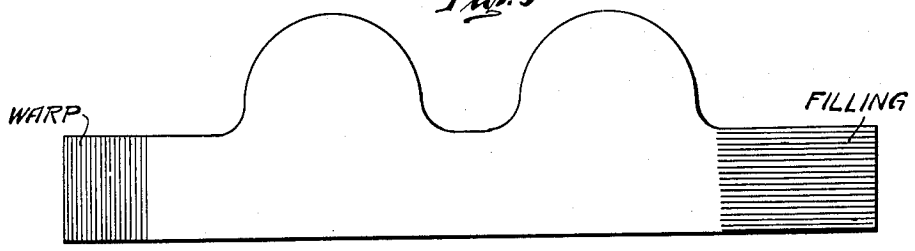


Fig. 10

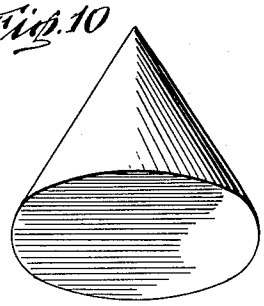


Fig. 11

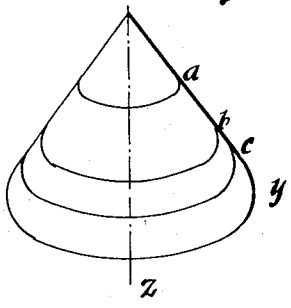


Fig. 12

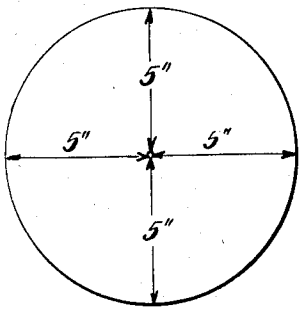
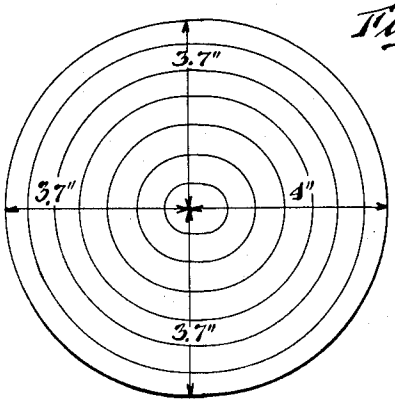


Fig. 13



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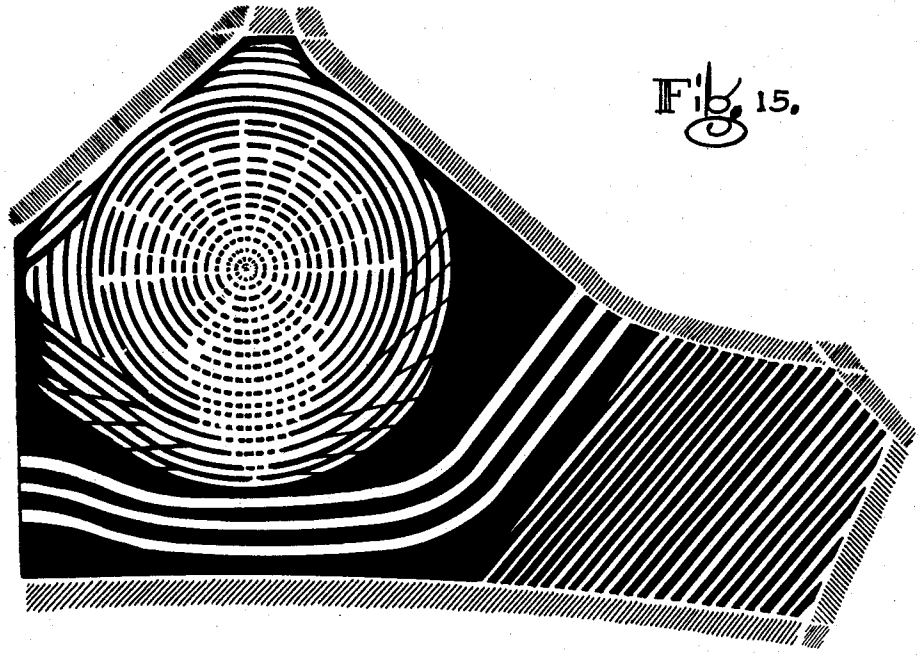

Fig. 15.

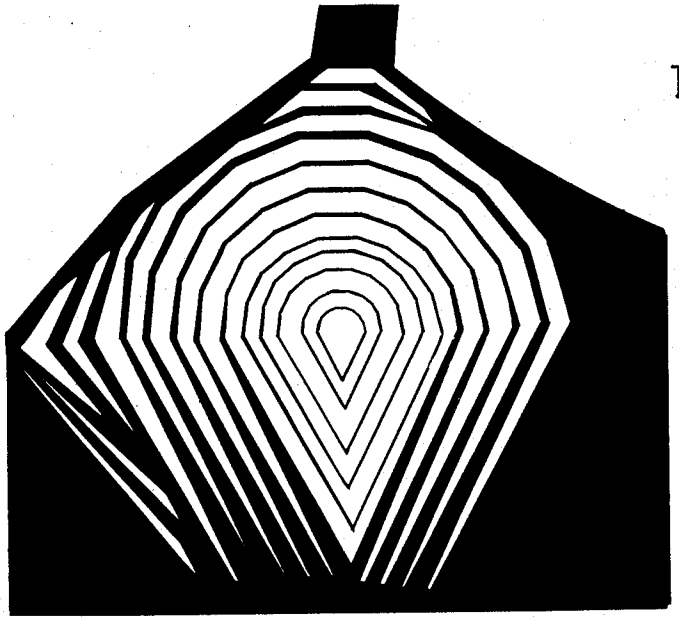

Fig. 16.

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PROCESS OF SHAPING AND FORMING BRASSIERE CUPS BY
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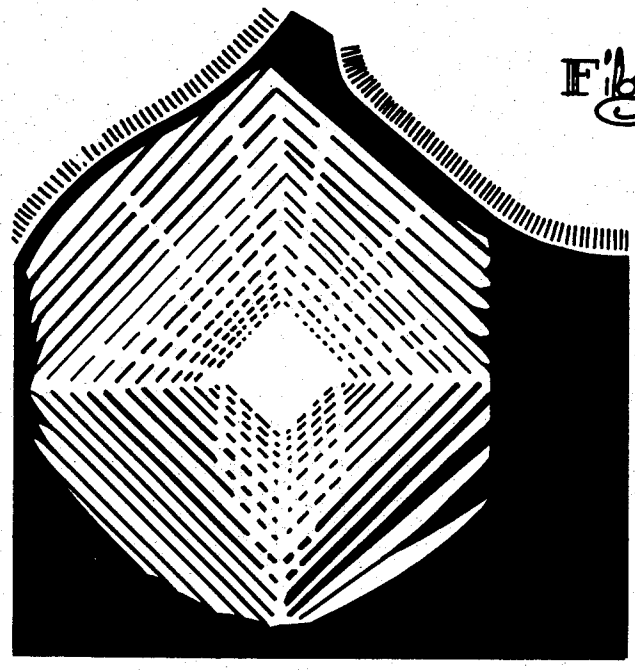

Fig. 17.

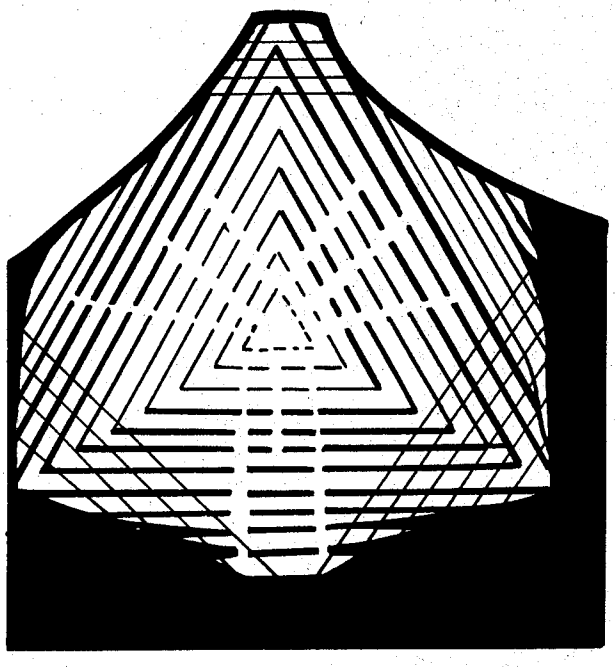

Fig. 18.

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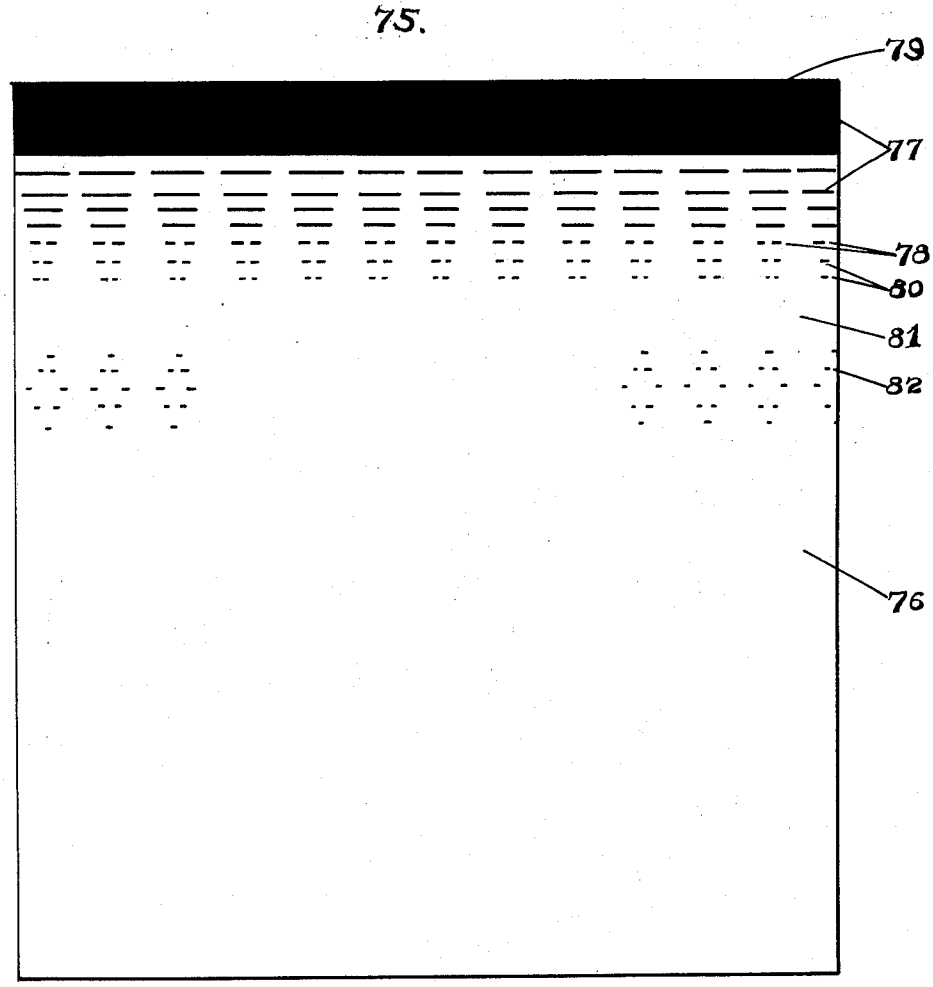

Fig. 19.

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United States Patent Office 2,962,025 Patented Nov. 29, 1960

2,962,025

PROCESS OF SHAPING AND FORMING BRASSIERE CUPS BY CHEMICAL SHRINKAGE OF THE FABRIC

Margaret Bertrand, New York, N.Y., assignor to United Merchants and Manufacturers, Inc., New York, N.Y., a corporation of Delaware

Filed Sept. 13, 1956, Ser. No. 609,712

8 Claims. (Cl. 128—516)

This invention relates generally to variations of form, outline, shape, appearance and/or function in bodies and especially to alterations in the contours or outlines of such bodies.

It is here proposed to modify not only the contour or outline of such bodies, but also, if desired, simultaneously to alter other characteristics or properties therein, e.g. color, texture, feel, drape or design.

Among its other objects the present invention contemplates the application of modifying factors to raw material in the fabrication of finished articles therefrom. A further object is to apply such modification factors only to pre-selected portions of the material for the production of useful and ornamental effects.

Another object is the fabrication of contour variations in normally substantially flat surfaced material. A further purpose is a method and means of making shaped articles from web-like bodies. A still further object is to effect alterations in the contour and other features of woven or knitted textiles or the like by shrinkage means. It is also proposed to apply modifying agents only to pre-selected portions of such material to obtain special effects, and, if desired, to secure in the predetermined areas either a substantially uniform degree of shrinkage or a differential shrinkage whereby certain portions of the work piece will be shrunk to a lesser or greater extent than others.

A still further object is a method and composition for making articles of apparel such as brassieres, halters, skirts, sleeves, nightgowns, slips, blouse tops and arm bands, bathing suit tops and trunks, and apparel accessories such as handbags or purses, or other articles of commerce, whether the same be adapted for use as apparel or otherwise, and in general articles wherein outline or contour variations or departures are required or desirable; for example, objects with concave or convex surfaces or objects with conical or other shapes.

Another object of this invention is the application of a shrinkage agent to a normally substantially flat surface such as a piece of woven or knitted cloth for the purpose of altering its contour and/or otherwise modifying its characteristics or properties in a process of making finished articles from the cloth, e.g. brassieres, or skirts, thereby eliminating or reducing much of the cutting, seams, gores, inserts, or other devices ordinarily involved in fashioning such finished articles from cloth in the piece.

It is also here proposed to make the body portion of a brassiere or the like including two seamless breast receiving cones, or cup-like components, but excluding the shoulder straps and fasteners, by means of a chemical modifying agent while using conventional textile finishing equipment in either a continuous or non-continuous sequence of operations. In the present state of the art of brassiere making, the several parts thereof are as a rule sewn together after being first cut out according to a pre-selected pattern from a web-like length of cloth. The cut-out members are sewn together in such a way

as to make the desired breast conforming contours so that the outline of the sewn and finished brassiere will, in general, follow or approximate the contours of the wearer's breasts.

According to the present invention, however, the breast and body contours of brassieres may be formed not by cutting and sewing, but rather by the application of swelling agents or shrinking compositions to the cloth while the cloth is in the piece, whether the cloth be knitted, woven or otherwise fabricated into web-form textile material or the like. Thus the business of cutting and sewing many small parts together to make up each individual brassiere or the contours thereof is avoided. Moreover, the seaming is also eliminated or at least considerably reduced.

In addition to forming the outlines or contours of the major proportions of the brassiere, the invention further contemplates the production of ornamental pattern effects therein if desired, at the same time and by means of the same shrinking or swelling agent that is employed to vary or alter the contour.

With the above and other objects in view, as will be apparent, the present invention consists in the construction, combination, and arrangement of parts and/or steps, all as hereinafter more fully described, claimed and illustrated in the accompanying drawings wherein:

Fig. 1 is a plan view of a piece of woven nylon cloth of indeterminate length adapted for carrying out one embodiment of the invention, it being understood, of course, that material of other kinds, for example, the condensation product polyethylene terephthalate, also known as "Dacron," may also be utilized for the purposes and objects hereof;

Fig. 2 is a plan view in reduced scale of the left half portion of a screen stencil for printing or otherwise applying a modifying factor, for example, a shrinkage agent, and if desired a decorative pattern producing agent as well to the fabric illustrated in Fig. 1;

Fig. 3 is a photographic front view of the cloth of Fig. 1, made up as a brassiere after the application of a modifying factor by means of the stencil of Fig. 2;

Fig. 4 is a photographic side view slightly in perspective of both seamless cups of the brassiere of Fig. 3, showing the conical contours thereof after application of the modifying factor and subsequent processing, as will be hereinafter described;

Fig. 5 is a front view in reduced scale, of a roller printer also adapted to carry out the present invention whereby a modifying or shrinkage agent may be applied to the cloth or other work piece in a pre-determined design for producing contour alterations without the addition of decorative patterns. In this instance, as a matter of choice and not necessity, the application of the modification agent may be said to be substantially for a functional purpose only, viz. to alter contour or outline; whereas with the stencil of Fig. 2, a functional design plus a decorative pattern are both incorporated in the same stencil to obtain both alteration of contour and ornamental attractive effects in the work piece;

Fig. 6 represents graphically the transverse measurements along the length of a model brassiere selected for reproduction;

Fig. 7 shows the vertical dimensions of the model through the cups;

Fig. 8 gives the third and final set of dimensions taken from the model brassiere, namely, those measuring the distances vertically and horizontally across the base of bottom edges of the cones forming the cups and the widths of the band or other portions of the brassiere;

Fig. 9 illustrates the directions in which the warp yarns and filling yarns may run in the finished product;

Fig. 10 is intended to indicate the substantially conical

shape of a brassiere cup with an ellipsoid base, which the workpiece cloth assumes in the finished article;

Fig. 11 portrays a series of cross sections taken through a cone shaped body, to which further reference is hereinafter made;

Fig. 12 gives the cup outline diameter dimensions for the brassiere stencil;

Fig. 13 is a plan view of one of the model cups with dimensions as given in Figs. 6 and 7;

Fig. 14 is a plan view of a circle having the dimensions of the stencil and of a cone having the dimensions of the finished brassiere cup;

Fig. 15 is a plan view of one of the two cups of the present invention as illustrated in its brassiere embodiment, the view being somewhat similar to that of Fig. 2, which is to say, that the printing stencil comprises a plurality of circumferential lines or band-like rings, but here the stencil printing pattern is further characterized in that the continuity of the circular lines, rings or bands is interrupted or discontinued at spaced locations by which means more fullness in the cup portions of the brassieres may be obtained;

Fig. 16 illustrates another embodiment wherein the general form or design of the cup stencil is not substantially circular but rather that of a polygon, and in this particular instance, as in Fig. 2, it will be noted that the stencil pattern lines are substantially uninterrupted so as to define enclosures without the interruptions which characterize the circular printing stencil of Fig. 15;

In Fig. 17, the brassiere cup printing stencil embodiment there illustrated comprises a rectangularly shaped or square figure, and herein again the printing pattern or design is interrupted as in the circular stencil of Fig. 15;

Fig. 18 illustrates a still further modification of the brassiere embodiment of the present invention, the arrangement of the stencil printing pattern being such as to comprise a plurality of spaced diamond-like configurations, the continuity of which is interrupted as in the circle of Fig. 15 and the polygon of Fig. 17. Moreover, Fig. 18 also comprises a plurality of spaced obliquely arranged lines which intersect the lower portions of the triangular stencil configuration whereby better uplift properties have been obtained in the brassiere cups than would be the case without such intersecting lines; and

Fig. 19 is a plan view of a stencil printing pattern for a skirt or other garment instead of a brassiere, wherein the production of a curved shape outline or configuration is desired, the stencil being adapted to be placed upon or over a length of cloth in the piece for subsequent formation of the cloth into the desired shape, as will be explained more fully hereinafter.

According to one embodiment of the present invention, a normally flat surfaced shrinkable material is treated with a modifying agent only in certain portions of the material to alter its contour in the production of a useful finished garment or other article requiring such alteration. For example, a length of textile piece goods, woven, knitted, or otherwise fabricated into web-like form, and whether previously dyed or undyed, printed or unprinted, and whether of rayon, nylon, Dacron, or other synthetic or natural character of fiber, or blends or other combinations thereof, may be treated with a shrinking or swelling agent or with a combination of such agents selected with a view to the suitability thereof having regard to the specific character or composition of the goods employed as the raw material, the treating agent being applied only to selected portions of the fabric by means of a screen stencil, by roller printing or by any other known method of application of shrinkage agents to textile material or the like. Preferably the shrinking agent is applied in the form of a pre-selected design to the fabric which, after further processing such as drying without substantial tension, and scouring, will alter its plane surface contour and assume the particular pre-determined outline or shape that is desired in the finished article.

More specifically, one example of carrying out the present invention is in the production of brassieres from woven or knitted cloth or the like in the piece. To that end a portion of such cloth may be treated with a shrinking agent or swelling agent by means of a printing device such as the frame stencil of Fig. 2 or the roller printer of Fig. 5, both of which bear or include a design adapted to form the cups of a brassiere. After application of the shrinking or swelling agent, the goods should be dried without tension, aged with steam or otherwise if desired, although the aging is not at all indispensible, scoured, and finally dried again without tension. After that series of steps, the treated and processed plane surface cloth will have assumed substantially the shape and contour of a brassiere including conical-shaped bust portions, to which conventional straps and fasteners may be added to make the finished article.

EXAMPLE I

A cut of plain weave, 70 denier, continuous filament, all nylon grey goods, having a thread count of 54 x 50, and having 15 turns per inch Z twist, the cloth weighing 1.10 ounces per square yard, was screen printed with a phenol printing paste using three back and forth strokes with a squeegee. The makeup of the printing composition was as follows:

24% by weight of phenol
17% by weight of polyvinyl alcohol (Grade A Du Pont)
3% by weight of glycerine
Balance—water

A diagram of part of the design-carrying portion of the stencil or screen employed in the printing operation is shown in reduced scale in Fig. 2 of the drawings. For convenience the outer portions of the stencil screen which do not embody the design that is to be reproduced, and the rectangular frame which holds the screen under tension at its four corners in the usual manner, have been omitted.

The design area of the stencil **50** comprises a woven silk mesh **51** having resist filled portions **52** and pervious or non-resist filled portions **53**. For identification purposes the resist portions **52** are shown in black and the pervious portions **53** in white. The design **50** of the brassiere to be reproduced includes, of course, two breast receiving cups; although for ease of illustration only the left half of the brassiere and only one cup **54** is shown in the stencil diagram of Fig. 2. It is to be understood, however, that the other half of the brassiere including the right hand cup which is not shown is to all intents and purposes a mirror image or reverse copy of that which is shown.

In addition to the cup **54**, the stencil design **50** contemplates a lateral extension or wing **55** which fits around the side and back of the wearer. No provision is or need be made in the stencil **50** for the conventional shoulder straps and fasteners, since these components of the brassiere may be added later after the cloth from which the final product is made has been shrunk and after-treated.

The white areas **53** of the mesh **51** of stencil **50** illustrated in Fig. 2 are open and pervious to the passage of the passage of the swelling agent therethrough; while the black areas **52** of the mesh **51** represent the masked or blocked out portions of the design **50** and are filled up with a suitable resist whereby the black areas **52** are rendered imperforate or impervious to the passage of the printing or shrinking agent.

It will be noted further that the lateral extension or wing **55** of the stencil design **50** includes masked or resist containing portions **56**, **57** arranged to form a harmonious pattern of groups of flowers **58**, spaced by short horizontal lines **59** and vertical figures **60**. The effect of these masked portions **56–60** on the finished article is

to leave the portions of the cloth that are put into contact with the resist portions 56–60 of stencil 50 substantially unaffected by the swelling agent which, when applied to the stencil 50, penetrates only through the pervious areas 53 onto the cloth to shrink those sections of the cloth in contact with or below the perforate areas 53. In terms of appearance, the flowers 58 and lines 59, 60 are reproduced on the cloth in unshrunken areas; the ornamental effect thereof being emphasized by contrast with the surrounding shrunken areas 61, 62 of the cloth which do not bear any ornamental design. It is to be understood, however, that the production of such designs of flowers and lines or of other patterns is purely optional and in no wise essential to the present invention which concerns itself more particularly with the production of contours, as exemplified by the fabrication of the cup-like breast receiving portions of a brassiere, or the production of skirts or other articles of apparel, by shrinkage means.

Referring further to the breast receiving portions 54 of the brassiere design 50 illustrated in Fig. 2, it is pointed out that the cup 54 comprises a plurality of substantially concentric resist bands 63, 64, each of the circles 63, 64 being separated from each other by intervening circles or bands 65, 66 of previous screen material. It has been found that with this arrangement of alternating bands of concentric printing and non-printing circles in the design 50 of the brassiere stencil the characteristic cone-shape contour of the breast cups may be produced in the brassiere cloth. The group or collection 67 of concentric circles consisting of alternating bands of blocked out areas 63, 64 and open work 65, 66 is surrounded by a relatively wide substantially circular border 68 of open mesh screen material. In the printing operation the border 68 is also printed with the shrinking agent and following after-treatment, the corresponding parts of the brassiere cloth are found to have a strong firm handle or feel which is desirable for support purposes.

After printing the cloth of Fig. 1 with the pattern stencil 50, as described, the fabric was dried hanging aloft in air without substantial tension for about 10 minutes. It was then scoured for 15 minutes in an aqueous solution containing .5% neutral soap, after which the goods were rinsed, and dried again without tension. Upon examination it was then found that the two portions 69, 70 of the brassiere cloth 71 printed with the left hand group 67 of substantially concentric bands 65, 66 of the stencil 50 and with a reverse copy right hand group of bands (not shown) had assumed the conical contours or outlines of two individual and spaced brassiere cups 69, 70 as illustrated in Figs. 3 and 4 of the drawings. The printed areas had shrunken 51.60% in the warp and 47.25% in the filling as compared with the unprinted portions as determined by comparing the warp and filling dimensions after treatment with the same dimensions of the cloth taken before treatment.

Moreover, the ornamental and harmonious design of masked or blocked out flowers 58 and lines 59, 60 appearing adjacent the group 67 of concentric bands 63, 65 was attractively reproduced in the brassiere cloth as shown in Figs. 3 and 4. The areas surrounding the lines and flowers having been printed with the phenol shrinkage agent and after-treated, became shrunken thereby causing complementary puckering of the adjacent unprinted areas comprising the lines and flowers as in Fig. 4. Similarly, with respect to the masked and unprinting bands 63, 64 of the stencil 50, it was found that the corresponding and unprinted concentric bands of the brassiere cloth puckered up to give a rather attractive and ornamental plisse effect as in Fig. 3.

It was further observed that the human female breast normally has a tendency to protrude not directly forward on a straight line but rather to veer toward the side of the body so as to form at the outer side in effect not a right angle but an angle of less than 90° with respect to an imaginery horizontal line drawn across the chest of the body. To compensate for or accommodate this characteristic of the breast it was found that by decreasing the width of the printing bands 65, 66 of the stencil 50 on the adjacent sides of the cups, the breast supporting areas 69, 70 of the brassiere cloth 71 closer to the medial line thereof were greater or larger than the remaining areas of the cups closer to the ends of the brassiere.

After printing, drying, scouring, and giving the printed and treated cloth a final drying as described, the goods were trimmed and hemmed and back fasteners were added to make a finished and ready-to-wear brassiere of the so-called "strapless" type, having seamless cups.

In the matter of making or preparing a stencil of suitable design and dimensions, attention must be paid first to the design and pre-determined dimensions of the brassiere that is to be made, and secondly to the amount of shrinkage in both warp and filling that a given concentration of a given shrinking agent will effect in the particular character and particular construction of cloth that is selected for the purpose as raw material. One example of the making of a suitable stencil follows:

Making the stencil pattern

In general, the desired end product, for example a brassiere, is made or designed first, as distinguished from and antecedent to the design or pattern thereof that is to be laid out on the stencil sheet. All dimensions of the brassiere as selected or designed are noted. The dimensions of the brassiere are, of course, less than those of the stencil by reason of the shrinkage which will take place in the raw material after application of the swelling agent. Next, the warp and filling shrinkage of the particular fabric or raw material chosen is calculated in advance, or pre-tested by printing on the fabric a test square of the shrinking paste selected, using a screen of the same mesh and character as will be used in manufacturing the end product. The same number of passes of the squeegee as are intended for the actual commercial product will also be adopted in making the shrinkage test. It has been found that in practice the shrinkage of the fabric should be of the order of 40% or more in both warp and filing to make a satisfactory brassiere, or more accurately perhaps, to fashion suitable cone shapes or contours for the breast receiving portions of a brassiere. After determining the shrinkage factor, the silk screen stencil itself may be designed by reproducing in larger scale the design of the model brassiere on the screen. The dimensions of the stencil design are increased proportionately over the dimensions of the model brassiere design to compensate for the amount of shrinkage that will subsequently take place in the cloth after it has been printed with the swelling composition and after-treated as described.

In particular, a model to be reproduced may be selected or designed that has the following transverse dimensions: 7.5" long from each end of the brassiere to the beginning of each cup or cone shaped breast portion; 3.7" from the outer edge of each cup to the apex or highest point thereof; 4" from the apex of each cup down the other side of the cup to the edge thereof nearest the center line of the brassiere; and 2.5" of cloth separating the two cups; height, or altitude or both cups, 2.8"; distance of the base of each cup from the outer edge to the altitude perpendicular 2.419"; distance from the altitude to the inner edge of each cup 2.856". These measurements of the model brassiere as selected or designed are illustrated in Fig. 6 of the drawings.

In addition to the transverse dimensions across the length of the brassiere, its vertical dimensions, at least through the cups, are also predetermined as shown in Fig. 7.

The third and final set of dimensions to be taken from the model brassiere are those measuring the distances vertically and horizontally across the base or bottom edges of the cones forming the cups and the widths of

the band or other portions of the brassiere. These measurements appear in Fig. 8.

So much for the dimensions of the model brassiere that is to be reproduced. In setting up the required corresponding dimensions, suitably increased to compensate for the shrinking, for the stencil pattern, it will be assumed that in the final product the filling yarns, having one shrinkage factor, run in the direction of the length of the brassiere and that the warp yarns having a different shrinkage factor run in the direction of the width of the brassiere: as indicated diagrammatically in Fig. 9.

To predetermine by test the amount of shrinkage warpwise and fillingwise in the particular fabric or cloth selected for brassiere making, a silk screen having the same mesh as that to be used subsequently on a production basis was masked or blocked out except for a square of 5" x 5" which was left open for the passage of the swelling agent. A phenol paste having the same components and relative concentrations as that described above in the example was printed on a cut of the same all nylon grey goods as was used in the example and with the same squeegee. The printed test sample was then dried without tension and steamed for five minutes in the open and subsequently scoured and given a final drying, again without tension, as set forth in the example, supra. Shrinkage was then found by measurement and calculation to be 51.60% in the warp and 47.25% in the filling.

After the step of establishing the dimensions of the brassiere to be made and the further step of calculating the extent of shrinkage warpwise and fillingwise in the cloth selected when treated with the particular swelling agent chosen in the manner described, it remains to design the brassiere stencil itself to complete the business of making a stencil pattern. For convenience herein this may be termed the final and third step, although obviously the order of the other or first two steps may be reversed, or both may be carried out simultaneously.

The last step, i.e. transferring the design of the model brassiere to the screen stencil, as such, may also for convenience be subdivided into (*a*) delineating the cups, and (*b*) marking off the remainder of the brassiere body and merely the outline of the two cups. Taking these up in inverse order, it will be assumed that a rectangularly shaped screen stencil is employed and that the design of the model brassiere will be laid out transversely along the length or longer dimension of the rectangular screen. It must also be borne in mind as stated above that the filling yarns of the cloth lying underneath the stencil run in the same direction as the length of the brassiere design on the stencil, and in the same direction as the longer dimension or length of the rectangular screen. The warp yarns therefore will run in the direction of the width of the brassiere and in the direction of the width or shorter dimension of the screen as partially indicated in Fig. 9 above.

Since the shrinkage of the cloth employed was predetermined to be 51.60% warpwise and only 47.25% fillingwise, it follows that to compensate or allow for this variation in increasing proportionately the dimensions of the screen design over those of the model brassiere design, the scale of the screen design lengthwise or the amount of the increase in that direction will be a little less than the amount of increase on the screen widthwise. With these circumstances in mind the horizontal or lengthwise dimensions of the brassiere design shown in Fig. 8 are increased or multiplied by a factor of 1.895 and so increased are then transferred to the screen by any suitable means, as for example photographically, by means of a pantograph or otherwise. The factor of 1.895 is obtained as follows: The screen printing or open mesh areas of the stencil will effect a 47.25% fillingwise shrinkage as pre-determined by the test. Therefore, only 52.75% of the fillingwise dimension that is printed with the swelling agent will remain after shrinkage is complete. Then if f represents the design dimensions of the model brassiere transversely thereof and in the direction of its fillling yarns, the corresponding printing dimensions of the screen must be

$$\frac{f}{.5275}$$

or the reciprocal of .5275 which is 1.895.

The vertical dimensions of the brassiere design in Fig. 8, which in the cloth will run warpwise and in the rectangular screen will run in the direction of its width, will be transferred to the stencil increased by a factor of 2.06. This 2.06 factor is derived from the circumstance that the warp shrinkage in percent was pre-determined by test to be 51.6%, which means that after shrinkage is complete the length of the printed warp yarns in the brassiere will be only 48.4% of the length before shrinkage. If w represents the dimension desired warpwise in the finished brassiere then

$$\frac{w}{.484}$$

equals the required corresponding silk screen dimension. The reciprocal of .484 is 2.06 and the factor to compensate for warp shrinkage.

One satisfactory method of transferring the brassiere design, increased in size as described above, to the screen stencil may be noted as follows: The brassiere design of Fig. 8 was blocked off into 1" x 1" squares. Corresponding figures of larger sizes, namely 2.06" x 1.895", were then marked out on the screen, and block by block the design of the brassiere in Fig. 8 was plotted on the silk screen so that the design of each square in Fig. 8 was reproduced 2.06 times larger in the vertical dimension of the screen, and was reproduced 1.895 times larger in the horizontal direction.

After thus transferring all of the brassiere design, except the cups, to the stencil screen, the cup portions may be added. Delineating the cups on the stencil may be approached by recognition that the stencil cup pattern forms the road or avenue along or through which the swelling agent works to transform a plane surface, to wit, the unprinted cloth in the piece, into a cloth cone which is adapted to receive the breast. For purposes of this explanation, the contour of the cup may be considered a cone having an ellipsoid base such as is illustrated in Fig. 10. Further, as shown in Fig. 11, if a series of cross sections or planes *a*, *b*, and *c* is taken on lines perpendicular to the axis *xz* of the cone, each plane would have substantially the shape of an ellipse if bounded by the intersection of the cone surface and the perpendicular line. Moreover, the size or perimeter of each ellipse plane would increase, the amount of increase being proportional to or determined by the distance of the plane or section from the apex *x* of the cone in the line *x*—*y*, *y* being in the plane of the base of the cone. If the planes *a*, *b*, *c* be equi-distant from each other, the increase of *c* over *b* is proportional to the increase of *b* over *a*.

According to one embodiment of the present invention a series of spaced, concentric printing rings or bands is cut in the cup portions of the printing stencil, and after printing the stencil pattern on the flat cloth with the swelling agent, the cloth shrinks in the printed areas and simultaneously loses its plane character assuming the contour of a cone or brassiere cup. The cloth cone is elliptical in character because of the difference in the rate of shrinkage between the warp yarns and filling yarns of which the cloth is woven, knitted, or otherwise fabricated. Thus, although the cone design on the stencil may be truly circular, after printing with the stencil and shrinking, the cloth cone is not circular but rather elliptical in shape by reason of the shrinkage differential between the warp yarns and the yarns that make up the filling.

The number of rings or concentric printing bands is arbitrary and properly a matter of choice, but is to some extent dependent upon the depth of the cone required. It is necessary that the bands be separated or spaced by intervening non-printing areas: otherwise the cone contour will not be affected. It is preferable too, although not essential, to make the printing rings substantially equidistant from each other to obtain a symmetrical cone shape.

Referring back to the cup outline diameter dimensions of the model brassiere of Fig. 8, viz. 5.275" and 4.838", and multiplying these by their respective shrinkage factors, to wit, 1.895 and 2.06, respectively, the corresponding cup dimensions on the stencil will be seen to be substantially 10" and 10", as shown in Fig. 12; or a radius of five inches for each of the four segments of the cup circle.

Referring now to the model cup dimensions, as previously shown in Figs. 6 and 7, a plan view of one of the cups is represented by Fig. 13.

In making the brassiere from the stencil, the dimensions of Fig. 12 must be reduced to the dimensions of Fig. 13, respectively, as indicated in Fig. 14 of the drawings.

Having fixed arbitrarily the number of concentric printing bands for the stencil at twelve, the shrinkage per band of the cloth of the radius *ci* will be 5" minus 4" or 1" divided by 12 or .083" per band. Since this loss will be by way of filling shrinkage at the rate of 47.25%, each band on the stencil circle or within the cup periphery on the stencil must have a width on the radius *ci* of:

$$\frac{.083\times 100}{47.25} \text{ or } .176'' \text{ wide}$$

Radius *ct* of the stencil is reduced in the brassiere from 5" to 3.7" or by 1.3"; or .108" per each of the 12 printing bands. This will be a warp shrinkage at the rate of 51.6%, and therefore each ring or band of the stencil circle radius *ct* must have a width of:

$$\frac{.108\times 100}{51.6} \text{ or } .209'' \text{ wide}$$

Radius *cb* must lose in shrinkage (5"—3.7") 1.3 inches. Since this will also be a warp shrinkage, the bands on the stencil, as in the case of radius *ct*, will also be .209" wide.

Radius *co* must lose in shrinkage (5"—3.7") 1.3 inches. Therefore, each of the twelve printing rings or bands must shrink the cloth in that area

$$\frac{1.3}{12}$$

or .108 inch. The width of each of the twelve printing bands or rings on this radius *co* may be calculated as follows:

$$\frac{.108\times 100}{47.25} \text{ or } .218'' \text{ wide}$$

Turning now to a consideration of the spaced and concentric non-printing bands or rings for the stencil which space and intervene between the concentric printing rings thereon, it is advisable to have the first or innermost ring masked or non-printing so that a high apex or cone center will result in the cloth, the cloth remaining unshrunken in the area covered thereby. It is also preferable to have the last or outermost ring masked so as not to shrink the portion of the brassiere cloth covered by that band. Thus there are twelve printing bands, each separated by an intervening non-printing band, or eleven non-printing bands plus an innermost non-printing band and an outermost non-printing band, making an overall total of thirteen non-printing bands and twenty-five bands altogether, all of the bands being concentrically arranged.

This width of the non-printing bands may be calculated according to the following table:

TABLE I

Radius	*ci*	*ct*	*cb*	*co*
Stencil Length—Fig. 14...inches..	5	5	5	5
Reduce to—Fig. 14.....do....	4.0	3.7	3.7	3.7
Amount of Reduction.....do....	1.0	1.3	1.3	1.3
Unit Shrinkage per Printing Band.....do....	.083	.108	.108	.108
Shrinkage Percent (Warp and Filling).....	47.25% (filling)	51.6% (warp)	51.6% (warp)	47.25% (filling)
Width of Printing Bands inches..	.176	.209	.209	.218
Total Width, 12 Printing Bands inches..	2.112	2.508	2.508	2.616
Remaining Width of Stencil Dimension (5"—width of 12 printing bands).....inches..	2.888	2.492	2.492	2.384
Width per Band of Non-printing Bands.....inches..	.222	.191	.191	.183

On each of the four radii, *ci*, *ct*, *cb*, and *co*, the alternating band widths are marked off starting at the points *i*, *t*, *a*, and *b*. There may be measured off first on the several radii the width of a non-printing ring or band, then a shrinking or printing band width, and so on until the final distance is marked off to the non-shrinking circle center or core. Each radius will now contain 24 points, and starting with the four outside points of each of the four radii, the band perimeters or peripheries are drawn by joining the four points with parabolic arcs so as to give a smooth sweeping curve between each of the points.

As previously pointed out, material other than nylon may also be utilized in practicing the present invention. However, nylon and Dacron have been found especially adapted for that purpose, perhaps because of their ability to withstand a substantial amount of shrinkage without significant loss of tensile strength, it being observed that substantial shrinkage is necessary in order to obtain breast receiving cups of the desired depth or conical shape. Furthermore, it is desirable whether nylon or Dacron is employed, that the fabric be of the open weave type, or at least be woven loosely enough to permit a shrinkage of about 40% or more in both warp and filling, and still retain adequate tensile strength after the shrinkage treatment.

It is also desirable, of course, that the shrinking composition or paste be of a viscosity suitable for screen printing, roller printing, or for whatever method of application is adopted in practice. The limits of concentration of the shrinkage or swelling agent will vary, necessarily, being dependent upon the character of the material being subjected to treatment, and the amount of shrinkage required and obtainable without appreciable loss of tensile strength. Thus, for example, if nylon is the work piece material a range of about 20% to about 30% by weight of phenol is satisfactory. If resorcinol is the swelling agent for nylon a suitable range of concentration is from about 25% to about 35% by weight of resorcinol.

The drying temperatures in the initial drying of the cloth after application of the swelling agent thereto, and also for the final drying after scouring, may be of the order of from room temperature to about 200° F.

In some cases, the step of ageing, mentioned previously herein, is desirable, but it is not always essential. For example, ageing was found unnecessary after printing an all nylon fabric with a 24% by weight phenol paste. When printing with resorcinol paste, however, it is quite desirable to steam age, if not actually necessary. Additively, in steam ageing fabrics previously printed with resorcinol, a five minute steaming in the open without pressure is preferred to autoclaves or cottage steamers, and results in a more favorable and smooth handle in the goods. The autoclave or cottage steamer on the other hand, tends to produce a stiff handle at least in the shrunken areas.

In respect of the step of scouring, heretofore described, ordinarily any scouring method which will remove the

swelling agent employed is satisfactory. In view of the fact that both phenol and resorcinol tend to form a discoloration of nylon by oxidation products, it was found of value after a soap scouring of nylon to run the fabric through an aqueous bath containing Igepon T and sodium hydrosulphite to remove such discoloration.

The drying steps, both intermediate and final, should be under such conditions that the cloth is not subject to any appreciable tension either widthwise or lengthwise. To the extent that the material is subjected to such tension the shrinking effect will be retarded and result generally in an unsatisfactory product. It is also observed that the steps of drying prevent smearing of the printing composition during handling of the goods. If the optional step of ageing is included in the process, the effect thereof will be to accelerate the swelling and shrinking action of the printing pastes, although as previously set forth, the utilization of the ageing step is not at all indispensable in many instances. The purpose of the scouring is to remove harmful chemicals and it is believed that at the same time during the scouring operation the printed material shrinks further.

In addition to phenol and resorcinol as swelling or shrinking agents for nylon and/or Dacron according to the present invention, other swelling agents having a substantial shrinkage effect thereon may be substituted therefor, as for example, formic acid, nitric acid, and/or cresylic acid.

It is to be understood that in practicing the present invention the stencil designs or printing patterns need not be continuous and uninterrupted as seen in Figs. 2 and 5 herein, but may be interrupted or spaced, that is, discontinuous, as illustrated in Figs. 15 and 17 to 19 inclusive. Moreover, in the brassiere embodiment, the stencil patterns need not be rings, bands, or circles as per Figs. 2 and 5; on the contrary, they may be varied in shape, as shown by the polygons of Fig. 16, the rectangles or squares of Fig. 17, and the diamonds of Fig. 18.

It should also be noted that in Figs. 15 to 19 inclusive hereof, the black portions of these stencil designs are the pervious areas through which the shrinkage agent passes, and the white portions are the impervious areas which block the passage of the shrinkage agent. This situation is the reverse of that obtaining with respect to Fig. 2, where the black portions are impervious and non-printing, while the white areas are pervious and printing.

In Fig. 19, stencil pattern means are illustrated for imparting skirt contours to a piece of flat cloth. Such means may comprise a silk screen **75** having imperforate portions **76** and a plurality of substantially parallel printing or perforated areas **77**, the latter being either spaced from each other as at **78**, or continuous and uninterrupted as at **79**. Preferably, the continuous portion **79** will effect or give the greatest amount of shrinkage because the cloth to which the stencil **75** is applied will receive the greatest quantity of the shrinkage agent in the area of the cloth which is juxtaposed to the uninterrupted portion or strip **79** of the stencil **75**. Thereby a skirt waistband contour of restricted length or circumference is fashioned by shrinkage means.

To shape the remaining portions of the cloth goods that are to form the skirt, the pervious portions **77** of the skirt stencil **75** may be spaced as at **78** and successively reduced in size as at **80**. A substantial area **81** may be left entirely imperforate so as to give maximum fullness in the cloth over the hips of the skirt wearer; and if desired, a subsequent and further very slight constriction may be imparted immediately below the hips as by means of the relatively small or minor spaced perforations **82** of the skirt stencil **75**.

Thus the instant invention further contemplates and proposes a process and method for the production of contoured skirts from shrinkable textile fabrics which includes the steps of pre-selecting a contoured skirt model, delineating a pattern of the skirt model on a stencil in enlarged scale, said pattern comprising a plurality of spaced, substantially parallel printing areas, reproducing the stencil pattern of the skirt comprising a plurality of spaced, substantially parallel printed areas on a shrinkable textile fabric by applying a chemical shrinkage agent to the fabric in the form of the stencil pattern, allowing the fabric to shrink until the fabric is reduced to the size and contour of the skirt model, and removing the shrinkage agent after the fabric has been reduced to the size and contour of the model.

Just as the present invention may be utilized to shape or to impart contours in the manufacture of brassieres or skirts, it may with equal force and effect be employed to give contours or shaping to other articles of manufacture, as previously enunciated herein. That is to say, by the application of a suitable shrinkage agent to a pre-designed stencil and a pre-selected cloth having a single plane, that is, a non-contoured surface, a variety of configurations and contours may be imparted thereto in the production of such a variety of articles as halters, sleeves, nightgowns, slips, blouses and arm bands, bathing suit tops and trunks, and also apparel accessories such as handbags or purses. In general, articles may be manufactured according to the present invention wherever such articles involve or require outline or contour variations or departures.

So far as the use of the shrinkage agent is concerned, of course, differential shrinkage effects may be obtained, at least theoretically, by using varying concentrations of the same shrinkage agent, or by utilization of a plurality of different shrinkage agents of non-uniform shrinkage effect. Nevertheless, practical considerations virtually dictate the employment of a single shrinkage agent of uniform concentration. By so doing, the portions of the fabric to which the shrinkage agent is applied are allowed to shrink uniformly and to the same degree until the fabric is reduced to the size and shape of the model, after which the shrinkage agent is removed.

The term "nylon" as used herein, and in the claims following, means, and is intended to mean, a fiber forming linear polycarbonamide which has recurring amide groups as integral parts of the polymer chain.

This application is a continuation-in-part of co-pending application Serial No. 257,122, filed November 19, 1951.

What is claimed is:

1. Method of making shaped brassiere cups from shrinkable textile fabrics, which includes the steps of pre-selecting a brassiere model including breast cups, delineating a pattern of the cups of the brassiere model on a stencil in enlarged scale, the stencil delineation being of the order of about at least 40% larger than the model and said pattern comprising a plurality of substantially concentric spaced rings, reproducing the stencil delineation of the cups on a shrinkable textile fabric by applying a chemical shrinking agent to a plurality of substantially concentric spaced ring-shaped portions of the fabric in the form of the pattern, allowing the portions of the fabric to which the shrinking agent has been applied to shrink until the fabric is reduced to the size and shape of the cups of the model, and removing the shrinkage agent after the fabric has been reduced to the size and shape of the cups of the model.

2. Method of making shaped brassiere cups from shrinkable textile fabric which includes the steps of preselecting a brassiere model including breast cups, making a pattern of the cups of the model brassiere in enlarged scale, the pattern being at least about 40% larger than the model and comprising a plurality of substantially concentric spaced rings, reproducing the pattern of the cups on a shrinkable textile fabric by applying a chemical shrinkage agent to a plurality of substantially concentric spaced ring-shaped portions of the fabric in the form of the pattern, allowing the portions of the fabric to which the shrinkage agent has been applied to shrink until the fabric is reduced to the shape and size of the cups of the

model, and removing the shrinkage agent after the fabric has been reduced to the size and shape of the cups of the model.

3. Method of making brassiere cups from woven nylon piece goods composed of a fiber-forming linear polycarbonamide which has recurring amide groups as integral parts of the polymer chain, which includes the steps of pre-selecting a model brassiere having breast cup portions, delineating the breast cup portions of the model brassiere on a flat stencil, the size of the delineation on the stencil being of the order of about 40% greater than the size of the model and said delineation comprising a plurality of substantially concentric spaced ring-shaped portions, reproducing the ring-shaped portions of the stencil delineation on the goods with a stencil printing shrinking composition containing phenol and allowing the printed goods to shrink until the goods are reduced to the shape and size of the breast cup portions of the model brassiere, and subsequently removing the shrinkage agent and drying the printed goods without substantial tension and scouring the same.

4. Method of making shaped brassiere cups from shrinkable textile fabrics in the piece which includes the steps of pre-selecting a brassiere model including breast cups, delineating a pattern of the cups of the brassiere model on a stencil in enlarged scale, said pattern comprising a plurality of substantially concentric spaced rings, reproducing the stencil pattern of the cups comprising a plurality of substantially concentric spaced rings on a shrinkable textile fabric by applying a chemical shrinkage agent to the fabric in the form of the cups of the stencil pattern, allowing the fabric to shrink until the fabric is reduced to the size and shape of the cups of the model, and removing the shrinkage agent after the fabric has been reduced to the size and shape of the cups of the model.

5. Method of making brassiere cups from woven nylon piece goods composed of a fiber-forming linear polycarbonamide which has recurring amide groups as integral parts of the polymer chain, which includes the steps of pre-selecting a model brassiere having breast cup portions, delineating the breast cup portions of the model brassiere on a flat stencil, the size of the delineation on the stencil being of the order of about 40% greater than the size of the model and said delineation comprising a plurality of substantially concentric spaced ring-shaped portions, reproducing the ring-shaped portions of the stencil delineation on the goods with a stencil printing shrinking composition containing phenol and allowing the printed goods to shrink until the goods are reduced to the shape and size of the breast cup portions of the model brassiere, and subsequently removing the shrinkage agent from the printed goods.

6. Method of making brassiere cups from woven nylon piece goods composed of a fiber-forming linear polycarbonamide which has recurring amide groups as integral parts of the polymer chain, which includes the steps of pre-selecting a model brassiere having breast cup portions, delineating the breast cup portions of the model brassiere on a flat stencil, the size of the delineation on the stencil being of the order of about 40% greater than the size of the model and said delineation comprising a plurality of substantially concentric spaced ring-shaped portions, reproducing the ring-shaped portions of the stencil delineation on the goods with a stencil printing shrinking composition containing phenol and allowing the printed goods to shrink until the goods are reduced to the shape and size of the breast cup portions of the model brassiere, and subsequently removing the shrinkage agent and drying the printed goods without substantial tension.

7. Method of making shaped brassiere cups from shrinkable textile fabrics in the piece which includes the steps of pre-selecting a brassiere model including breast cups, delineating a pattern of the cups of the brassiere model on a stencil in enlarged scale, said pattern comprising a plurality of parallel substantially concentric endless printing bands, reproducing the stencil pattern of the cups comprising a plurality of parallel substantially concentric endless printed bands on a shrinkable textile fabric by applying a chemical shrinkage agent to the fabric in the form of the cups of the stencil pattern, allowing the fabric to shrink until the fabric is reduced to the size and shape of the cups of the model, and removing the shrinkage agent after the fabric has been reduced to the size and shape of the cups of the model.

8. The method of claim 7 wherein the endless bands are broken widthwise at spaced intervals, there being sufficient shrinkage areas remaining in the bands to produce said cups.

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UNITED STATES PATENT OFFICE

CERTIFICATION OF CORRECTION

Patent No. 2,962,025 November 29, 1960

Margaret Bertrand

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 64, strike out "the passage of"; column 5, line 25, for "previous" read -- pervious --.

Signed and sealed this 9th day of May 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents