Jan. 13, 1959 W. L. THOMPSON, JR 2,867,889

MOLDED FABRIC AND BRASSIERE CONSTRUCTION AND METHOD OF MAKING THE SAME

Filed Nov. 23, 1956 2 Sheets-Sheet 1

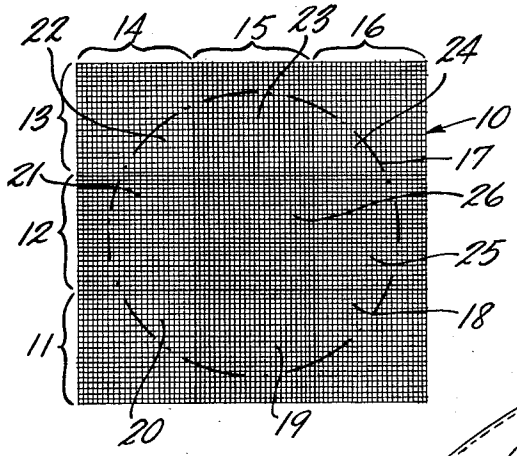

FIG. 1.

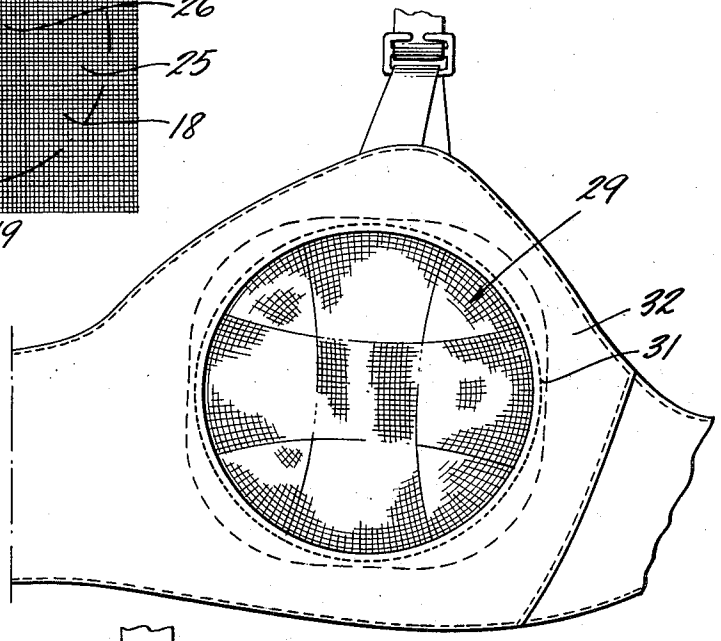

FIG. 3.

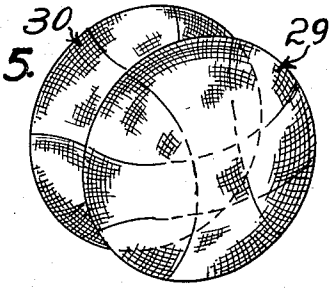

FIG. 5.

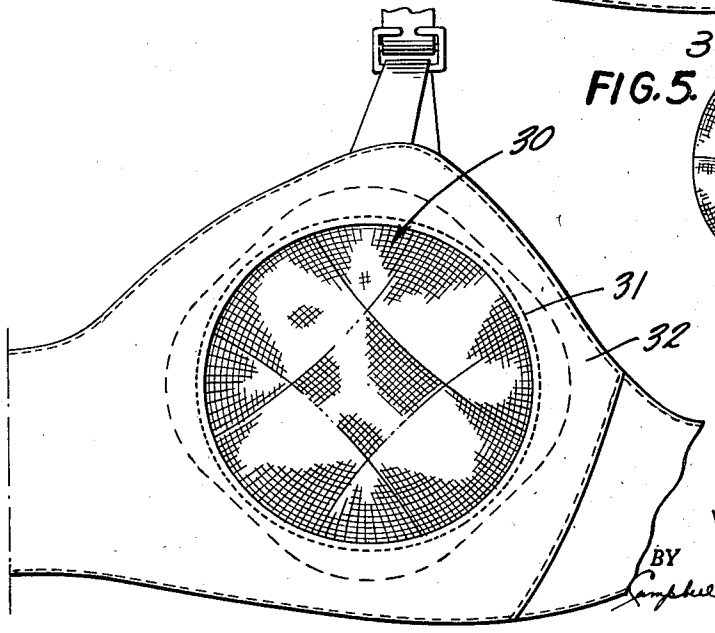

FIG. 4.

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MOLDED FABRIC AND BRASSIERE CONSTRUCTION AND METHOD OF MAKING THE SAME

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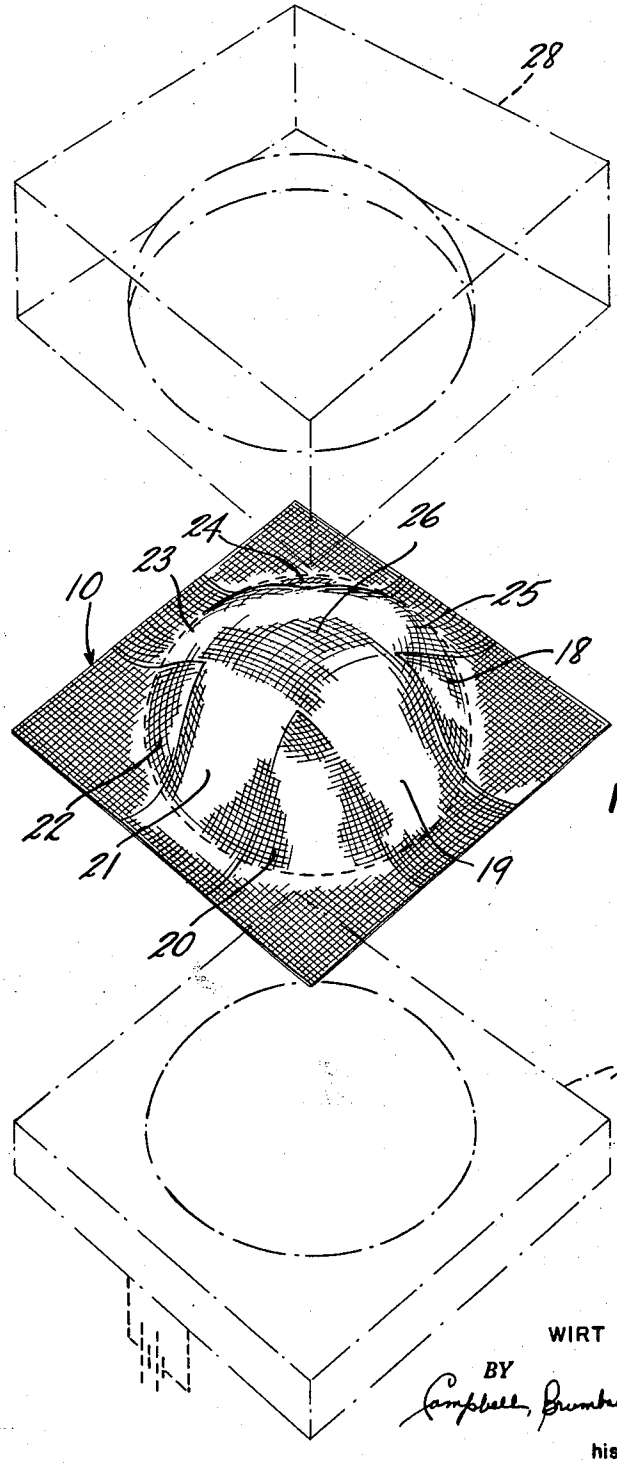

FIG. 2.

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United States Patent Office 2,867,889 Patented Jan. 13, 1959

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MOLDED FABRIC AND BRASSIERE CONSTRUCTION AND METHOD OF MAKING THE SAME

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Application November 23, 1956, Serial No. 623,869

22 Claims. (Cl. 28—72)

This invention relates to molded fabric and to brassiere constructions based thereon.

Generally speaking, two techniques have been utilized to convert textile fabrics, which are woven flat, into three-dimensional shapes for use, for example, as brassiere cups. One technique, and up to now the most widely used in the brassiere art, involves the cutting out of a series of fabric pieces which when fitted together and sewn results in the desired three-dimensional shape. The other technique involves the molding or drawing of a single piece of a flat woven fabric into the desired shape by changing the relative lengths of the various yarns in the wave, either by stretching or shrinking certain of the yarns more than others. Each technique has its own advantages and disadvantages and neither has proven satisfactory in all respects.

To cut and sew together a number of fabric sections to form the cup portion of a brassiere, for example, is costly in addition to creating rather conspicuous seams and ridges which can be not only uncomfortable to the wearer but can also set up zones of disproportionate shrinking and distortion through use. These factors have in the past stimulated activity in the molding techniques. However, molded fabrics, resulting in a simple, single piece brassiere cup construction, while often economical in fabrication and always free of seams and ridges, have not displayed adequate uniformity in weight and density over the entire cup area. Where the yarns are stretched the most in the molding process, the fabric can be skimpy and too transparent, and where it is stretched the least, it can be too bulky and, in at least one process, composed of relatively weaker yarns notwithstanding the apparent bulk. Also, some molding techniques fuse the interlaced yarns together, making the fabric stiff and unpleasant to touch, while others result in plastic flow which in some cases can fill the interstices of the weave, destroying the porosity, and in other cases can enlarge the interstices in an unsightly manner.

Certain of the foregoing disadvantages of molded three-dimensional fabrics for use in brassiere constructions have been overcome by the process of U. S. Patent No. 2,285,967. In accordance with that patent, partially drawn synthetic linear polyamide yarns are woven into a flat fabric from which flat brassiere bodies are fashioned. The fabric is composed in the vicinity of the cups, entirely of uniformly partially drawn yarns which are stretched, i. e. cold-drawn between mated mold sections, into the desired three-dimensional shape, and maintained by permanently setting the molded shape as through the application of heat. While this and other processes advanced the molded brassiere cup art, certain objections to the use of molded fabrics in brassiere constructions remain to be met. For example, no solution has been found to the problem of having the finished, molded brassiere cup composed throughout of fabric of satisfactorily uniform weight, density and hand. Also, no solution has been found to the problem of achieving a finished cup and brassiere assembly which has uniformly strong yarns overall, particularly in the areas of maximum strain.

The present invention has for one of its objects to provide a brassiere construction, using one piece molded fabric cups, which is improved in function and appearance.

Another object is to provide a brassiere construction which has maximum yarn strength at the areas of maximum stress.

Another object of the invention is to provide an improved brassiere construction in which one piece molded cup portions are used and which have weave orientations both in the body portion and in the cups which effectively carry the relatively complex stresses imposed on this type of apparel.

Another object of the invention is to provide a process for making one piece brassiere cups.

In accordance with the present invention, a molded fabric, taking the form for example of the generally paraboloid shape of a brassiere cup, is composed of weaving yarns such for example as synthetic linear polyamide, commonly known as nylon, and in which the basic flat fabric, before molding, is composed of a combination of partially and fully drawn yarns. In the case of a barssiere cup, the flat fabric includes a center portion in which the yarns running in both directions of the weave are partially drawn, say on the order of 80%, and a plurality of 8 or more marginal sections, some of which are composed entirely of fully drawn yarns and some of which are composed of fully drawn yarns in one direction and partially drawn yarns in the other. When molded, as by die pressure, into individual brassiere cup units, this single piece of molded fabric will exhibit at its edges yarns of maximum strength and capable of absorbing for example the stresses of a seam holding the cup in place, although in no cases need a seam extend into the shaped portion of the cup. In the process of forming the substantially paraboloid shape of the cup, the partially drawn yarns appear in the areas of maximum deformation and, with the values for the partially drawn yarns properly selected prior to deformation or molding, a finished product results in which the deformation tends to draw the partially drawn yarns into yarns more closely approximating the normal fully drawn yarns included in the fabric at those points at which distortion occurs to a substantially lesser degree. While theoretically, it would be possible, in accordance with the present invention, to produce a cup which is absolutely uniform throughout, it has been found that a very slight variation such as results when only two grades of yarns, i. e., fully draw and one value of partially drawn, are combined in the basic fabric in the manner described, results in a pleasing, slightly perceptible pattern on the cup surface. Overall, however, the cup is light in weight, soft and flexible.

In the event the cup units are formed as separate units, they can be integrated in a brassiere construction in accordance with the invention by stitching the cup to a brassiere body at their edges. Because the cup includes a rectangular weave pattern quite independent of that of the rest of the brassiere, the direction of the weave of the cup can be placed at angles to the brassiere both to align the yarns of the cup with the directions of the stresses imposed thereon and to achieve useful decorative effects.

Representative embodiments of the invention, from which the above and other features and objects will be readily apparent, are described below having reference to the accompanying drawing in which:

Figure 1 is a full surface view of a fabric in its flat

form prior to molding and in which the limit of the molded shape is indicated by superimposed dotted lines;

Figure 2 is a perspective view of a molded brassiere cup prior to incorporation in a brassiere construction;

Figure 3 is a fragmentary view of one portion of a brassiere construction showing one cup attached to a body portion;

Figure 4 is a view corresponding to Figure 3 but showing a different orientation of the cup; and

Figure 5 is a view showing the relative arrangement when the cups shown in Figures 3 and 4 are integrated.

Referring first to Figures 1 and 2, the invention is illustrated as embodied in a fabric section formed of thermosetting plastic yarns and indicated generally by the numeral **10**, Figure 1 illustrating the fabric in its flat stage before molding or deforming, and Figure 2 in its molded or deformed stage. The plastic yarns are of the type requiring drawing and setting in order to impart the necessary strength and toughness. Extending across the surface of the fabric to be deformed are horizontally disposed yarn groups or rows **11**, **12** and **13** and, interlaced therewith, vertically disposed yarn groups or rows **14**, **15** and **16**, one set being the warp and the other the filling.

In one example of the invention, the yarns of which the groups **11**, **13**, **14** and **16** are formed are fully or 100% drawn 70 denier, 34 filament synthetic linear polyamide yarns, commonly called nylon, and incorporated in a plain weave fabric at a count of approximately 105 ends to the inch. The yarns of the sections **11**, **13**, **14** and **16** are fully or 100% drawn in terms of standard usage in the art, meaning they are drawn to a point which leaves approximately 18% further extensibility before permanent distortion or breakage occurs. The yarns of the sections **12** and **15** are of 84 denier, 34 filament yarns of nylon and the count is approximately 105 to the inch. The yarns of the fabric sections **12** and **15** are partially drawn, having a value of about 80%, which by common usage in the art means they have approximately 38% extensibility before deformation or breakage will occur.

Within the confines of the dot-dash circle indicated by the numeral **17**, which represents the boundary of the unit to be molded, the basic flat fabric of Figure 1 includes nine different fabric sections identified by the numerals **18**, **19**, **20**, **21**, **22**, **23**, **24**, **25** and **26**, respectively. The sections **18**, **20**, **22** and **24** are composed entirely of fully drawn or normal yarns, that is to say normal yarns run both warpwise and weftwise in the weave. The sections **19**, **21**, **23** and **25** are made up 50% of partially drawn yarns and 50% of normal or fully drawn yarns. The center section **26** is made up entirely of partially drawn yarns which, therefore, run both directions in the weave.

When the flat piece is molded as between complementary die or mold sections identified by the numerals **27** and **28**, respectively, indicated in phantom lines, the fabric is molded into the generally paraboloid shape of Figure 2. It will be observed that the partially drawn strands of the sections **12** and **15** have been stretched the greater amount in the molding process. The shape of the molded form can be related to the degree of partial drawing of the yarns in the sections **12** and **15** so that those yarns which partake of the maximum extension in the molding operation are brought to a point approximating normal, fully drawn yarn characteristics. In this fashion a cup unit is attained which is composed throughout its surface area of yarns drawn to substantially the same degree and of yarns of substantially uniform denier, although as can be seen in the illustrated embodiment there can be very slight gradations in denier and, it follows, corresponding gradations in the degree of drawing in the finished product which lend aesthetic features to the brassiere construction as described below.

Preferably, the molding dies **27** and **28** are operated at an elevated temperature, in the vicinity of 350° F. for the particular thermosetting material used in the illustrated embodiment, in what amounts to a hot drawing process. While cold drawing can be used, it has been found that hot drawing is somewhat more easily accomplished and in addition serves the purpose of at least starting the heat setting step which must follow the drawing or molding step in order to stabilize the deformed or stretched yarns in their new configurations. In the event cold drawing is carried out, a separate stabilizing operation will, of course, be used, preferably by mounting the shaped fabric on a correspondingly contoured support and subjecting it to heat, all in accordance with well known procedures. In general, the finished cup units are stable and serviceable as they emerge from the molding and setting operations. It will be understood, however, that in certain cases supplemental sprays and fillers, such for example as a spray of "Genton," a water dispersion of type nylon resin, which cures on fabric at about 350° F., can be applied.

The finished cup units identified by the numerals **29** and **30** in Figures 3 and 4, respectively, can be mounted in brassieres by means of stitching **31** joining the edge of each cup unit with the body portion **32**, including means such as straps to mount on the body of a wearer. In the arrangement of Figure 3, the cup units are assembled with their weave directions running vertically and horizontally with respect to the wearer. In the arrangement of Figure 4, each cup is mounted at an angle of approximately 45°, enabling both the warp and filling yarns to contribute to vertical support. The body portion **32**, however, is constructed to withstand girthwise and vertical stresses without uncontrollable distortion and stretching. This can be accomplished, in one arrangement, by constructing the body portion with the warp and filling yarns of the fabric running generally horizontally and vertically with respect to the wearer. Because the weave of the cup units and the weave of the portion can be arranged at angles to each other, due to their independent construction, wide flexibility of design results. In this connection, it will be understood that the separate cup units in which there are but two right angularly disposed yarn directions throughout, affords the maximum latitude in the relative positioning of the cup and body portions, for the cup units can be turned, if symmetrical in form at the outset, to any desired angle without complicating the manufacturing process.

In accordance with the invention, a single cup unit having exceptional strength against stretching and distortion in use is provided by nesting one single-layer, molded fabric unit within another, with their respective weave patterns at angles. Thus, for example, the weave pattern of one layer can be disposed at an angle of 45° in the manner of Figure 4 and that of the other layer can be disposed in alignment with the vertical and horizontal in the manner of Figure 3. The two nested layers can be joined at their edges by the stitching which secures the composite cup unit to the body portion of the brassiere or, if desired, the two layers can be bonded together over the mating surfaces as by the use of "Genton" for example, or by stitching. When stitching is used over the surface of the composite cup unit, it will be understood that the lines of stitching do not constitute seams which would introduce undesirable ridges or joins between separate fabric pieces or bulk.

In the example described above and as illustrated in the drawing, a functional and at the same time decorative effect has been achieved in accordance with the invention by using in the basic flat fabric just three yarn groups or rows running in each direction in the weave for each brassiere cup unit. In the molded or finished form the centrally intersecting yarn rows or groups **12** and **15** at their junctions with the flanking rows **11**, **13**, **14** and **16** form a slightly perceptible pattern in the finished cup. This results from the fact that the yarns of the rows **12** and **15**, initially (in the flat fabric) 84 denier throughout, include in the finished product a small range

of deniers across their widths, say from 70 denier at their centers to 76 denier at their edges. The yarns of the rows **11, 13, 14** and **16** initially 70 denier throughout, range from say 65 denier at their inside edges (butting the rows **12** and **15**) to 70 denier at their edges. Junction lines of contiguous 65 and 76 denier yarns appear between adjacent rows, which is relatively more abrupt than the extremely small gradation over the yarns in any given row. As a result finely delineated lines appear between the rows, affording a pleasing pattern notwithstanding the fact that the denier is on an absolute basis substantially uniform throughout the cup unit, as are the degrees of drawing of the yarns. While the gradation pattern of yarn thicknesses across the expanse of the cups is subtily pleasing in character, neither it nor the correspondingly small gradation of degrees of drawing of the yarns adversely influence the approximate uniformity throughout of weight, hand, elasticity and toughness. Were a cup to be molded from a basic fabric having uniformly partially drawn yarns throughout, there would be areas of insufficiently drawn and hence structurally weak yarns as well as an absence of a pattern of bands traversing the cup surface. In accordance with the present invention, where the cups are secured to the brassiere body as by stitching, the yarns are the least changed by the molding operation and hence are at their original optimum condition (100% drawn) to withstand the more severe stresses imposed at that point. In this fashion the edges of the cup units are exactly balanced in elasticity and other physical parameters with the contiguous portions of the brassireré body so that hard use is less apt to result in disproportionate dimensional changes at the junction. Of course, the larger the number of groups or rows of yarns drawn to various percentages of full that are used across the expanse of the flat fabric from which the final cup shape is made, the less perceptible, if at all, will be the pattern.

While the invention has been described above in a representative form as including a molded cup portion formed from a flat fabric including rows of synthetic linear polyamide yarns which are exactly fully drawn and rows which are partially drawn, it will be understood that certain features of the invention can be attained using a base fabric of rows of two or more relatively different degrees of drawn yarn, the yarns traversing the center being the lesser drawn. Also, the yarns can be combined in slightly different patterns consistent with a general placement of the least drawn yarns in the areas of maximum distortion in the molding operation.

It will be understood that other synthetic yarns can be used in the practice of the invention which are capable of being drawn throughout a range of values with optimum physical properties occurring within the range, such for example as polyester yarns made by the condensation of dimethyl terephthalate and ethylene glycol and commonly known as Dacron. The use of the term brassiere herein is intended to include both isolated brassiere units as well as the various combination garments which incorporate brassieres such as corsets, corsellets and the like. It will be understood, therefore, that while the invention has been described herein having reference to particular preferred embodiments thereof, it should not be regarded as limited except as defined by the following claims.

I claim:

1. In a brassiere construction, a body portion, means to mount the body portion on a wearer, a pair of fabric cup portions each consisting of an integral, single piece of molded fabric having generally right angularly disposed warp and filling thermoplastic yarns, and means mounting the cup units in the body portion with their warp and filling yarns extending respectively along the horizontal and vertical.

2. In a brassiere construction, a body portion, means to mount the body portion on a wearer, a pair of fabric cup portions each consisting of an integral, single piece of molded fabric having generally right angularly disposed warp and filling thermosplastic yarns, and means mounting the cup units in the body portion with their warp and filling yarns forming angles of approximately 45° with the horizontal and vertical.

3. In a brassiere construction, a body portion including fabric having generally right angularly interlaced warp and filling yarns, means to mount the body portion on a wearer with the weave directions disposed horizontally and vertically, a pair of fabric cup portions each consisting of an integral single piece of molded fabric having generally right angularly disposed warp and filling thermoplastic yarns, and means mounting the cup units in the body portion with their warp and filling yarns extending respectively at angles to the horizontal and vertical.

4. In a brassiere construction, a body portion including fabric having right angularly interlaced warp and filling yarns, means to mount the body portion on the wearer with the yarns of the weave portion extending generally horizontally and vertically of the wearer, a pair of fabric cup portions, each formed of an integral single piece of molded fabric having a generally right angularly arranged weave pattern of interlaced warp and filling thermoplastic yarns, and means securing the cup portions in the body portion with the weave pattern disposed at angles to the weave pattern of the body portion, the warp and filling yarns of the cup portions forming approximately 45° angles with corresponding yarns of the body portion.

5. A brassiere construction as set forth in claim 4, each of said cup units including, interlaced warp and filling yarns of thermosetting plastic drawn to achieve optimum strength and toughness.

6. A brassiere construction as set forth in claim 4, each of said cup units including a plurality of rows of warp and a plurality of rows of filling yarns of thermosetting plastic drawn to achieve optimum strength and toughness, each row including a group of yarns, the yarns exhibiting a gradation of denier across the lines between successive adjacent rows.

7. A brassiere construction as set forth in claim 6, said thermosetting yarns comprising synthetic linear polyamide.

8. In a method of making a brassiere cup, the steps of weaving a flat fabric composed, over the area which is to be the cup, of a plurality of rows of warp yarns comprised successively of thermosetting plastic yarns drawn to different degrees, the warp yarns passing adjacent the margins of the area being fully drawn and those passing through the center being partially drawn, and a plurality of rows of filling yarns interlaced with the warp yarns, successive rows being formed of thermosetting yarns drawn to different degrees, the yarn of the rows adjacent the center being partially drawn, molding the fabric into a three-dimensional cup shape to stretch the partially drawn yarns, and heat setting the molded shape.

9. In a method of making a foundation garment, the steps of weaving a flat fabric composed over the area of the cup of a plurality of rows of warp yarns comprised successively of synthetic linear polyamide yarns drawn to different degrees, the warp yarns of the groups passing adjacent the margins of the area being fully drawn and those passing through the center being partially drawn, and a plurality of rows of filling yarns interlaced with the warp yarns, successive rows being formed of synthetic linear polyamide yarns drawn to different degrees, the yarn of the rows passing adjacent the margins of the area being fully drawn and those passing through the center being partially drawn, molding the fabric into a three-dimensional cup shape, and heat setting the molded shape.

10. A brassiere cup unit comprising an integral, single piece of fabric composed of interlaced rows of warp and filling thermoplastic yarns and molded to cup shape, said yarns throughout the entire area of the cup unit being substantially fully drawn.

11. A foundation garment comprising a smooth, integral, single piece of fabric composed of interlaced rows of warp and filling yarns of thermosetting plastic material and molded into cup shape, each row comprising a group of yarns, each row including across its width a small range of degrees of drawing, all in the vicinity of fully drawn.

12. A brassiere cup unit comprising a smooth, integral, single piece of fabric composed of interlaced rows of warp and filling thermoplastic yarns molded into cup shape by disproportionate stretching of the yarns over the cup area, each row including a group of yarns, the yarns of the warp and filling rows which interlace over center area of the unit being drawn to a progressively greater degree approaching the center of the cup, the yarns of the warp and filling rows which define the areas of the cup shape between the margin and the center rows being drawn to a progressively greater degree approaching the center rows, the yarns at the precise center of the cup shape and the yarns at the margin being drawn equally.

13. A brassiere cup unit as set forth in claim 12, said thermoplastic yarns comprising synthetic linear polyamide.

14. A brassiere cup unit as set forth in claim 12, the rows of yarn groups comprising three in each of the filling and warp over the area of the cup shape.

15. A unit of a foundation garment comprising an integral, single piece of fabric composed of interlaced rows of warp and filling thermoplastic yarns and molded into cup shape, said yarns throughout the cup unit being of substantially the same denier.

16. A brassiere cup unit comprising an integral, single piece of fabric of interlaced rows of warp and filling yarns of thermosetting plastic material and molded into cup shape, each row comprising a group of yarns, each row including across its width a small range of degrees of denier, contiguous parallel rows exhibiting a more abrupt change in denier at the junction line thereby to define a slightly perceptible pattern in the surface of the cup.

17. A brassiere cup unit comprising an integral, single piece of fabric composed of a plurality of rows of warp yarns and, interlaced therewith, a plurality of rows of filling yarns, each row comprising a group of yarns of thermosetting plastic material capable of being drawn, the warp and filling yarns of the two rows which interlace over the center of the cup having a slight range of denier variations, being of progressively greater denier from the precise center of the cup outwardly, the yarns of the rows which define the marginal area of the cup unit having a slight range of denier variations, being of progressively smaller denier from the margins inwardly, the yarns of the marginal and central rows at their junction lines exhibiting a more abrupt change in denier, whereby intersecting bands appear across the surface of the cup unit to define a decorative pattern therein.

18. A brassiere cup unit as set forth in claim 17, the yarns of the marginal rows having, at the junction lines between the marginal and central rows, smaller denier than the adjacent yarns of the central rows.

19. A brassiere cup unit as set forth in claim 17, the bands appearing in the filling and the bands appearing in the warp each numbering three.

20. A brassierer cup unit as set forth in claim 19, said yarns being formed of synthetic linear polyamide.

21. A brassiere cup unit comprising a first cup-shaped fabric portion in the form of an integral single piece of molded fabric having generally right angularly disposed warp and filling thermoplastic yarns and, a second cup-shaped fabric portion formed of an integral single piece of molded fabric having generally right angularly disposed warp and filling yarns nested in the first fabric portion with its weave pattern disposed at angles thereto, and means to secure the two fabric portions together.

22. A brassiere cup unit as set forth in claim 21, said first and second fabric portions having their weave patterns disposed at 45° angles to each other.

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