Nov. 4, 1952 H. E. SHEARER 2,616,084

SEAMLESS BUST SUPPORTER

Filed Dec. 5, 1947 2 SHEETS—SHEET 1

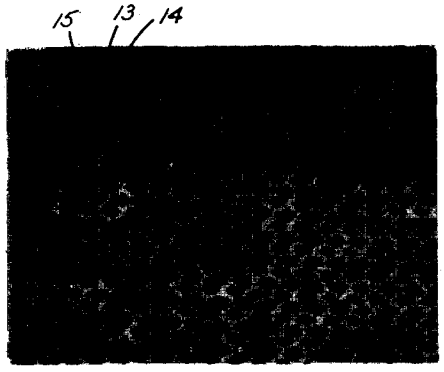


Fig. 1

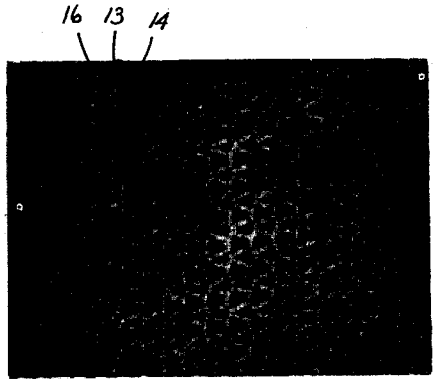


Fig. 2

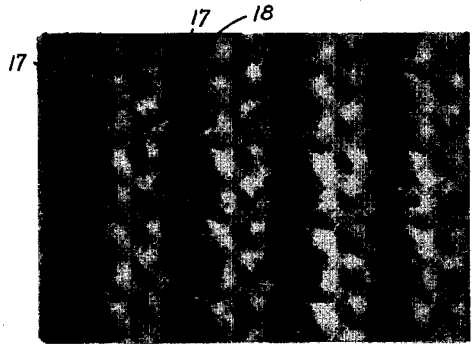


Fig. 3

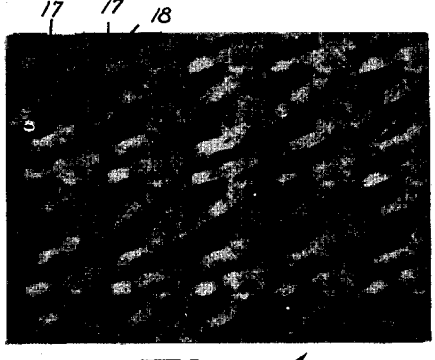


Fig. 4

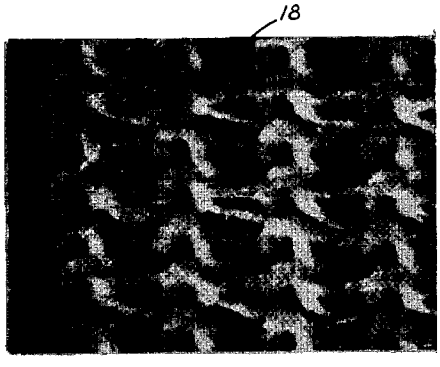


Fig. 5

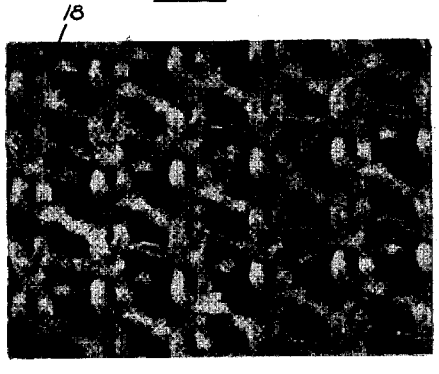


Fig. 6

INVENTOR.
HOWARD E. SHEARER
BY Thomas R. O'Malley
ATTORNEY

Nov. 4, 1952 H. E. SHEARER 2,616,084

SEAMLESS BUST SUPPORTER

Filed Dec. 5, 1947 2 SHEETS—SHEET 2

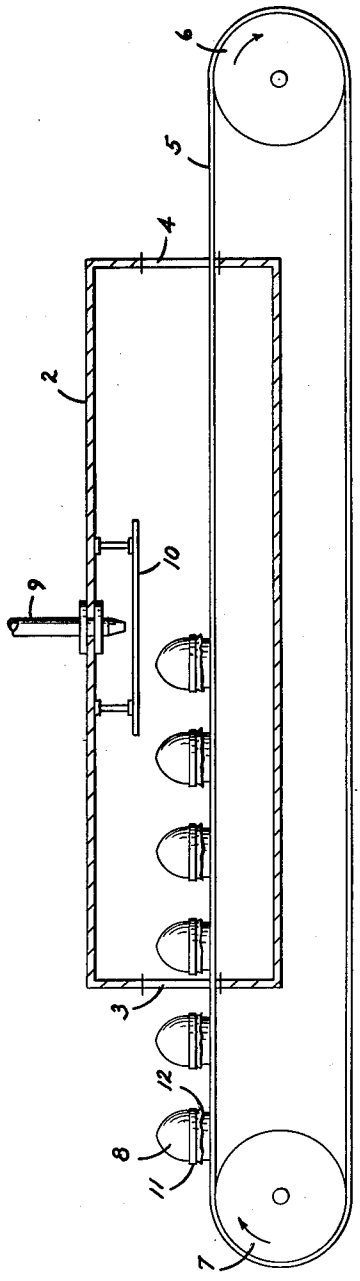


Fig. 7

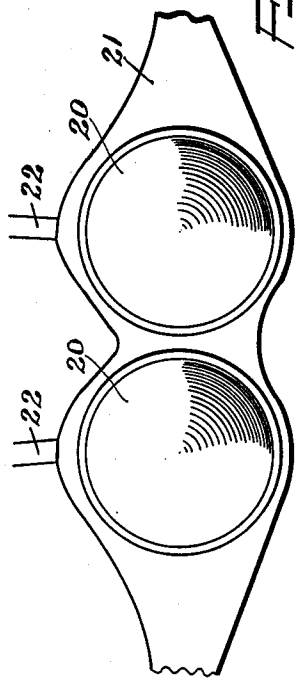


Fig. 8

INVENTOR.
HOWARD E. SHEARER
BY
Thomas R. O'Malley

Patented Nov. 4, 1952

2,616,084

UNITED STATES PATENT OFFICE

2,616,084

SEAMLESS BUST SUPPORTER

Howard E. Shearer, Swarthmore, Pa., assignor to American Viscose Corporation, Wilmington, Del., a corporation of Delaware

Application December 5, 1947, Serial No. 789,872

11 Claims. (Cl. 2—42)

1

This invention relates to bust-receiving and supporting pockets for brassières and the like.

Conventionally, such pockets are made by cutting a fabric to pieces of predetermined small size and shape and then sewing the pieces together to form the pockets. The seams in the pockets so made have long been considered undesirable, and it has been one of the objectives of the art to eliminate them.

It has been proposed, in the past, to make seamless brassière pockets from fabrics formed of thermoplastic yarns by stretching the fabric to the three-dimensional shape, and then setting it in the stretched condition. Pockets which satisfy the demands of the trade, in essence, retention of shape in use, coupled with a smooth and pleasing hand or feel, cannot be molded from a flat fabric by stretching it to the desired shape on a mold or between mold members.

Brassière pockets are usually made from knitted fabrics. In a knitted fabric, as it leaves the knitting machine, the yarn comprising each of the stitches is in a relatively loose or slack condition, and the fabric is characterized by a certain elasticity. In order to stabilize a knitted fabric in a given shape, it is necessary to remove the slack from the yarn comprising each of the stitches, so that none of the stitches can stretch or "give" when the shaped article is subjected to stresses or strains in use.

All of the proposals advanced heretofore for the manufacture of seamless brassière pockets from flat knitted fabrics comprising thermoplastic yarns have depended upon removal of the slack from the yarn comprising the stitches, by stretching of the fabric to the contours of the mold. However, although a knitted fabric can be smoothed or pulled out from a curled or contracted condition to a condition in which it has its full or normal machine dimensions, without any appreciable distortion of the stitches, such a fabric cannot be actually stretched, that is, extended beyond its full or normal machine dimensions, without more or less severe stitch distortion. It is impossible to remove the slack from the yarn comprising each of the stitches of a knitted fabric uniformly by stretching the fabric on a mold or between mold members. If sufficient stretching tension is applied to the fabric on the mold to remove slack from all of the stitches, the portion of the fabric at the apex of the mold is strained substantially to the rupture point, and even then, the slack is not removed uniformly at all portions of the fabric unless the stitch-distortion is prohibitive. For example,

2

when a heat-softened fabric knitted from cellulose acetate or similar yarns is stretched over a mold or between mold members, as heretofore proposed for the manufacture of brassière pockets, the slack may be removed from the yarn comprising the stitches in the portion of the fabric at the apex of the mold, but is not removed uniformly from the yarn comprising the stitches in the portions of the fabric which occur at the sides and in the vicinity of the periphery of the mold. This condition will exist, even when the stretching tension to which the fabric is subjected is such that the portion of the fabric stretched over the apex or tip of the mold is strained practically to the rupture point. The result is that when the heat-softened knitted cellulose acetate fabric which has been stretched to the contours of the mold is cooled to set it in the stretched condition, the yarn in some of the stitches is found to be comparatively taut and free of slack, while the yarn in the remaining stitches still possesses considerable slack. The fabric is non-uniform, and those portions which comprise the slack yarn will stretch and "give" in use. The brassière pockets lose their shape in use, due to the stretchability or "give" of the yarn in the stitches at some portions of the fabric. This non-uniformity and stretchability of some portions of the fabric, resulting from residual slack in the stitches, are critical in the case of brassière pockets, particularly because the stitches comprising the slack yarn occur at the sides and in the vicinity of the periphery of the pocket. It is just those portions which must be comprised of slack-free yarn, since those portions receive the weight of the bust when the pockets are worn. The pockets made by stretching the heat-softened knitted fabric at any stage in their manufacture are unsatisfactory because they sag in use and do not provide the required firm body support. In addition, as a result of the stretching, the fabric comprising the pockets is characterized by a sleazy touch and a spotty appearance.

The object of the present invention is to provide seamless molded fabric bust-receiving and supporting pockets for brassières or the like which substantially permanently retain their shape in use. Another object is to provide seamless molded knitted fabric brassière pockets in which the yarn comprising each of the stitches at all portions of the fabric comprising the pockets is substantially completely and uniformly free of slack, and stabilized in the slack-free condition. A further specific object is to provide, in a preferred embodiment, brassière pockets

molded from a knitted fabric, the transverse dimensions of the molded and shaped fabric comprising the pockets being substantially the same as the dimensions of the fabric prior to molding and shaping thereof. Another object is to provide seamless molded fabric brassière pockets which provide firm support while possessing a smooth, slick and pleasing hand or feel. A further object is to provide seamless brassière pockets comprising a molded knitted fabric which is more porous and translucent than the unmolded knitted fabric, the porosity and translucency of the molded fabric being uniform at all portions of the seamless pocket.

These and other objects of the invention are accomplished by fitting a fabric comprising heat-shrinkable thermoplastic yarns, in the non-softened, non-plastic condition, to the contours of a single member comprising a three-dimensional, generally pocket-shaped mold, heating the fabric in contact with the mold uniformly to effect shrinkage of the individual heat-shrinkable yarns, and setting the yarns in their individually heat-shrunk state, to thereby stabilize the fabric in the shape of the mold. By "fitting" the fabric to the contours of the mold is meant placing the fabric on the mold and smoothing it or pulling it out to conform to the mold and so that it is substantially free of wrinkles or folds, without subjecting it to a tension greater than the tension to which a knitted fabric is subjected when it is pulled out to its normal, full machine dimensions.

Knitted fabrics of all types may be molded to three-dimensional shape and stabilized in that shape, in accordance with this invention. As an example, the fabric may be of the circular knit type, the stitches of which are formed by interlocking loops. In the normal condition of such fabrics, each of the loops making up the stitches is comprised of two straight sides and a round, relatively slack, bottom. As a result of shrinkage and compaction of the yarn comprising each of the loops, which takes place when the fabric is heated on the single mold member, the slack is removed from the round bottom of each of the loops, with straightening and tautening thereof, so that in the shaped and stabilized fabric, each of the loops comprises two straight sides and a straight bottom, joined by substantially straight or angular corners.

Again, the fabric may be of the warp-knit type, that is, a multiple warp fabric in which the warps form an interlocking system. In fabrics of that type, each wale, in each course, is joined to a wale in another course, by yarns extending diagonally of the wales. In the normal condition of warp-knit fabrics, the yarn forming the loops comprising the wales or ribs of the fabric is comparatively soft and full, and the loops are comparatively loose and slack. The yarn extending diagonally of the wales is also comparatively full and slack, and, upon close examination, the diagonally extending yarns appear to lie in a loose somewhat curved condition on the back of the fabric, the individual filaments of the yarns being spread out and discernible. Such warp-knit fabrics are characterized by a very high degree of stretchability. When such a fabric is fitted to a single member comprising a three-dimensional mold, in accordance with this invention, the yarn comprising the loops forming the ribs or wales, and the yarn extending diagonally of the wales and joining the courses, are individually shrunk and compacted, with reduction in their diameter.

The loops forming the wales or ribs in the shaped and stabilized fabric appear to be elongated, and with their opposite sides drawn closer together, while the yarns extending diagonally of the wales are drawn taut and lie flat on the back of the fabric. The yarns are set in the shrunk, compacted condition and, thereafter, the fabrics do not possess stretchability but remain permanently in the three-dimensional shape of the single mold member even when they are subjected to stresses and strains in use. The stitches of the knit fabrics may slip relatively to each other, as, for instance, when they are handled during laundering, but since the yarn at all portions of the fabric is free of slack, the stitches cannot "give" and hence the fabric remains in the shaped condition.

The invention is illustrated in the accompanying drawings in which,

Figure 1 is a photograph (magnification: 6.5X) of a circular knit fabric knitted from heat-shrinkable yarns comprising a copolymer of vinyl chloride and vinyl acetate, taken after fitting of the fabric to the single mold member, and prior to the heat treatment;

Figure 2 is a photograph (magnification: 6.5X) of the fabric of Figure 1 after heat treatment and stabilization thereof;

Figure 3 is a photograph (magnification: 50X) of a warp (tricot) knit fabric knitted from heat-shrinkable yarns comprising a copolymer of vinyl chloride and vinyl acetate, taken after fitting of the fabric to the single mold member, and prior to the heat treatment, and showing the face of the fabric;

Figure 4 is a photograph (magnification: 50X) of the fabric of Figure 3 after heat treatment and stabilization thereof;

Figure 5 is a photograph of the fabric of Figure 3, but showing the back of the fabric;

Figure 6 is a photograph of the fabric of Figure 5, after heat treatment and stabilization thereof;

Figure 7 is an elevation of means for practicing the invention; and

Figure 8 is a front view illustrating a brassière comprising pockets or cups made in accordance with the present invention.

As shown in Figure 1, after the circular knit fabric is fitted to the mold member, the condition of the loops comprising the stitches corresponds approximately to the condition of the lops in a knitted fabric having its normal or full machine dimensions, each of the stitches comprising two straight or substantially straight sides **13** and **14** joined by a round bottom **15**. Each of the stitches is comparatively slack.

In the stabilized fabric resulting from heat treatment of the fitted fabric, the condition of the stitches is altered, as clearly shown in Figure 2. As is apparent, as a result of the heat treatment and spontaneous shrinkage of the individual yarns, the loops are tautened and slack-free, the bottoms are drawn taut and straight, so that each of the stitches is constituted by two straight sides **13** and **14**, and a straight bottom **16** joined by straight corners. The heat-treated fabric is translucent and more porous than is the fabric fitted to the mold and prior to heat treatment. As noted above, and shown in Figure 2, each of the stitches in the molded and stabilized knitted fabric comprises two straight sides, and a straight flat bottom joined together by straight corners. The yarns are interlocked at these corners, which serve as aids to relocation of the yarns in the

event of any stitch slippage in use, or during the working to which the pockets are subjected during laundering.

The fabric shown in Figures 3 and 4 is a multiple warp fabric in which the warps are interlocked. The front warp comprises a stitch pattern of 1–0, 2–3, (sometimes referred to as "under 2, over 1") using a yarn in every guide of the machine, while the back warp comprises a stitch pattern of 1–0, 1–2 (sometimes referred to as "under 1, over 1"), using a yarn in every guide. It will be understood, of course, that the warps of the fabric may comprise different combinations of stitch patterns, as is well known in the art.

As is apparent from Figure 3, in the fabric fitted to the mold, and prior to heating thereof, the yarns 17 comprising the loops forming the wales of the fabric are full and soft, the sides of the loops being spaced apart a relatively great distance, and the yarns 18 extending diagonally of the wales and joining them, (Figures 5 and 6) are also full and soft. On close inspection, individual elements of the yarns are discernible, and the diagonally extending yarns 18 appear to lie loosely and to bulk up on the back of the fabric. In this condition, the fabric possesses considerable "give," due to the bulky, comparatively slack condition of the yarns. After the heat treatment, as seen in Figure 4, the yarns 17 comprising the loops which form the wales or ribs of the warp fabric are shrunk and compacted, and reduced in diameter, with apparent elongation of the individual loops, the opposite sides of each of which are drawn more closely together. As seen more fully in Figure 6, the yarns 18 extending diagonally of and joining the wales are also shrunk and compacted, and reduced in diameter. After the heat treatment, the diagonally extending yarns 18 no longer appear to bulk up on the back of the fabric, as they do in Figure 5, but lie flat and taut in the compacted condition. The slack is removed from the yarn at all portions of the fabric, and the individual elements or filaments of the yarns are no longer discernible in the magnified fabric.

The removal of slack from the yarns of the knit fabrics is substantially the same at all portions of the bust-supporting member, which is thus stabilized against giving or stretching in use, this effect being uniform at both the portions of the fabric which, on the mold, occur at the apex, and those portions occurring at the sides and in the vicinity of the periphery of the mold. This uniformly taut and slack-free condition of the yarns is of outstanding advantage, since it insures that the portions of the brassière pockets which must support the greatest weight in use, are capable of doing so without sagging. The shaping takes place primarily as a result of shrinkage and tautening of the individual yarns in response to the heat treatment. The fabric as such, in the preferred embodiment, is shrunk only peripherally, the transverse dimensions of the shaped heat-treated fabric, in this case, as measured from one side of the periphery of the member to the other, over the apex, being the same as those of the fabric prior to the heating step. In the new members, also, the yarns are individually shrunk and compacted but retain their identity as such, so that the shaped, stabilized fabrics have a pleasing, smooth, slick hand and are entirely free of a harsh feel and sleazy appearance.

The three-dimensional shape of the molded fabric is permanent. As has been noted, in the case of knitted fabrics, the stitches may slip relative to each other during handling of the shaped fabric, as for instance during the working to which the fabric may be subjected when it is laundered. However, as soon as the garment comprising the bust receiving and supporting members is worn, the stitches again assume their original relative positions. The same cannot be said for any known bust-supporting members comprising a knitted fabric. The fabric as such does not lose its shape and, due to the removal of slack from all of the yarns uniformly, the fabric cannot stretch in use.

Outstanding advantages of the bust-receiving and supporting members of the invention are the uniformity of support which they provide for the bust, their ability to withstand stress and strain without stretching and loss of firm support for the wearer, and the appearance and feel of the fabric, which render the bust receiving and supporting members particularly suitable for use in articles of intimate apparel.

Another advantage of the invention is that, although the pockets may comprise laminated fabrics when they are intended for special use, the pocket shaped from a single layer of fabric, in accordance with this invention, provides a sufficiently firm support for all ordinary needs, thus dispensing with the necessity for using expensive laminated fabric structures.

Referring now to Figure 7, there is shown a chamber 2 having an inlet 3 and outlet 4 for accommodating an endless band 5 which travels around the pulleys 6 and 7 positively driven (by means not shown) for rotation in the direction of the arrows. Band 5 is adapted to support a plurality of molds 8a and carry the molds through the chamber 2. Steam is injected into the chamber through a pipe 9 and projected against plate 10 suspended in the chamber, the steam being thus diffused throughout the chamber. Each of the molds 8a is provided with a slip fit ring 11. The fabric 8 comprising the heat-shrinkable thermoplastic yarns, for example, a fabric knitted from yarns of a copolymer of vinyl chloride and vinyl acetate, containing about 90% vinyl chloride in the polymer molecule or a copolymer of vinyl chloride and acrylonitrile containing about 55% vinyl chloride in the copolymer molecule, is fitted to the mold, and the ring 11 is slipped over the fabric to hold it in general conformity to the mold except for the depending excess skirt 12 which is later trimmed off. As the molds supported on band 5 are carried through chamber 2 and subjected to the action of the steam diffused through the chamber, the yarns of the fabric shrink, while remaining intact, and the loops of the fabric are straightened to the slack-free condition. On leaving the chamber, the fabric on the mold is cooled to set it in the shaped condition. The fabric on the mold may be subjected to a stream of cold air.

Instead of heating the fabric fitted to the mold in the manner described, other means for applying a controlled amount of heat, either wet or dry, uniformly to all portions of the fabric may be used. For example, the molds may be heated internally, by means of hot water, steam, heating coils, etc., the heat being transmitted to the fabric through the metal shell of the mold. The temperature to which the fabric is subjected, and the duration of the heat treatment are controlled so that the yarns or filaments shrink spontaneously without undue softening or coalescence,

the conditions of the heat treatment depending upon the particular heat-shrinkable yarns or filaments comprising the fabric.

After removal of the pockets or cups from the molds, excess fabric, as at 12, is trimmed off, and the pockets 20 are then ready for joining to a body-encircling member 21 provided with suitable straps 22 and fastenings, in the usual manner to form brassières, such as shown in Figure 8.

The flat fabrics may comprise any filaments or yarns including yarns comprising discontinuous fibers formed from a thermoplastic material and having the capacity to shrink spontaneously while remaining intact, when the fabric is heated to a temperature below the melting and decomposition temperatures for the thermoplastic material. In a preferred embodiment of the invention, the yarns or filaments are formed from fiber-forming resins resulting from the polymerization of one or more substances comprising the vinyl radical. Examples of such materials are the acrylate and alkacrylate resins, polymers of vinyl esters such as vinyl acetate, polymers of vinyl ethers such as vinyl acetals, methacrylate polymers, and copolymers or interpolymers of vinyl halides with other polymerizable materials containing the vinyl radical. In a specifically preferred embodiment, the yarns or filaments comprise a copolymer of vinyl chloride with vinyl acetate, or with acrylonitrile. Such filaments and yarns may be rendered heat-shrinkable by subjecting them to a stretch of from 100% to 1200% or more during their production, or subsequently to their production but prior to their fabrication, and while in a cold, unsoftened state, or in somewhat softened and plastic condition. Generally, the filaments or yarns so stretched have, prior to their fabrication, a residual shrinkage capacity of at least 50% at temperatures below the melting and decomposition temperatures for the resin. As an example, such prestretched yarns comprising a copolymer of vinyl acetate and vinyl chloride have a residual shrinkage capacity of at least 50% at temperatures of from 85 to 95° C.

Because all stretching is restricted to the filaments or yarns as such, and prior to their fabrication, it is possible to control the per cent stretch imparted to each of the yarns, and to all portions along the lengths of the individual yarns, thereby controlling the residual shrinkage capacity, which is uniform. This insures that, during heating of the fabric fitted to the mold, all of the yarns shrink to the same extent, to produce a uniform fabric. The same effects cannot be obtained by stretching a fabric over a mold and then attempting to shrink it back to conform to the mold.

Although the invention has been described in detail in connection with knitted fabrics, it is not limited to the use of fabrics of that construction. Brassière pockets may also be molded from flat fabrics woven from the heat-shrinkable yarns or filaments by fitting the woven fabric to the contours of the single mold member, and applying heat to the fabric to uniformly shrink the yarns or filaments and stabilize the fabric in the shape of the mold. If a fabric of woven construction is to be shaped, however, the fabric should be of comparatively open or mesh-like construction to permit shaping and stabilization of the fabric, with accompanying shrinkage and reduction in diameter of the yarns, while avoiding buckling of the yarns.

By "flat fabrics" as used herein, is meant any fabric which when laid upon a support will assume a flat position, including circular-knit fabrics.

Since changes and modifications may be made in practicing the invention without departing from the spirit and scope thereof, it is to be understood that the invention is not to be limited except as defined by the appended claims.

I claim:

1. As an article of manufacture, a seamless fabric bust-receiving and supporting member which substantially permanently retains its shape in use, has a slick, smooth texture, and is free from sleaziness, said member comprising a shrunk fabric formed exclusively from yarns consisting of a fiber-forming thermoplastic resin having the capacity to shrink spontaneously while remaining intact at an elevated temperature below the melting and decomposition temperatures for the thermoplastic resin, the yarns in the member being shrunk, intact, and of reduced diameter as compared to the diameter of the yarns in the unshrunk fabric as the result of substantially uniform shrinkage of the yarns in the fabric.

2. An article as defined in claim 1 comprising a shrunk fabric formed exclusively of vinyl resin yarns.

3. An article as defined in claim 1 comprising a shrunk fabric formed exclusively of yarns of a copolymer of vinyl chloride and vinyl acetate.

4. An article as defined in claim 1 comprising a shrunk fabric formed exclusively of yarns of a copolymer of vinyl chloride and acrylonitrile.

5. An article as defined in claim 1 which comprises a shrunk fabric formed exclusively from yarns consisting of a fiber-forming thermoplastic resin having, prior to shaping of the fabric to form the bust-receiving and supporting member, a residual shrinkage capacity of at least 50%.

6. As an article of manufacture, a seamless bust-receiving and supporting member which substantially permanently retains its shape in use, has a slick, smooth texture, and is free from sleaziness, said member comprising a shrunk circular-knit fabric knitted exclusively of yarns consisting of a fiber-forming thermoplastic resin having, prior to shaping of the fabric to form the bust-receiving and supporting member, a residual shrinkage capacity of at least 50% and which shrink spontaneously while remaining intact at an elevated temperature below the melting and decomposition temperatures for the thermoplastic resin, the yarns in the fabric being shrunk, intact and of reduced diameter as compared to the diameter of the yarns of the unshrunk fabric as a result of substantially uniform shrinkage of the yarns in the fabric, and said member being characterized in that, in the fabric comprising them, the stitches are free of slack and defined by two straight sides joined by angular corners to a straight bottom.

7. An article as defined in claim 6 comprising a shrunk fabric formed exclusively of yarns of a copolymer of vinyl chloride and vinyl acetate.

8. An article as defined in claim 6 comprising a shrunk fabric formed exclusively of yarns of a copolymer of vinyl chloride and acrylonitrile.

9. As an article of manufacture, a seamless bust-receiving and supporting member which substantially permanently retains its shape in use, has a slick, smooth texture, and is free from sleaziness, said member comprising a shrunk

warp-knit fabric knitted exclusively of yarns consisting of a fiber-forming thermoplastic resin having, prior to shaping the fabric to form the bust-receiving and supporting member, a residual shrinkage capacity of at least 50% and which shrink spontaneously at elevated temperatures below the melting and decomposition temperatures for the thermoplastic resin, the yarns in the fabric being shrunk, intact and of reduced diameter as compared to the diameter of the yarns in the unshrunk fabric, the member being characterized in that the fabric comprising them and as a result of substantially uniform shrinkage of the yarns in the fabric, the opposite sides of the loops forming the wales of the fabric are closer together than the sides of the loops in a normal warp-knit fabric and the diagonally extending yarns joining the wales lie flat against the fabric.

10. An article as defined in claim 9 comprising a shrunk fabric formed exclusively of yarns of a copolymer of vinyl chloride and vinyl acetate.

11. An article as defined in claim 9 comprising a shrunk fabric formed exclusively of yarns of a copolymer of vinyl chloride and acrylonitrile.

HOWARD E. SHEARER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,047,230	Schneider	July 14, 1936
2,191,545	Schneider	Feb. 27, 1940
2,262,861	Rugeley	Nov. 18, 1941
2,285,967	Hardy	June 9, 1942
2,420,565	Rugeley et al.	May 13, 1947
2,460,566	Brown et al.	Feb. 1, 1949
2,474,375	Shearer et al.	June 28, 1949
2,484,293	Hinchliff	Oct. 11, 1949