Jan. 31, 1961 B. D. GORDON 2,969,662

KNITTED GARMENT WITH BREAST CUPS AND METHOD OF MAKING

Filed Feb. 2, 1959 4 Sheets-Sheet 1

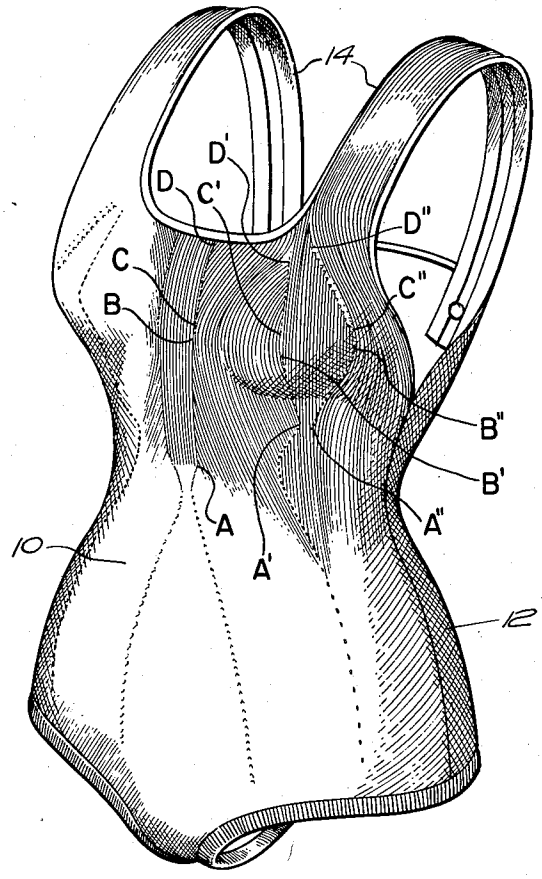


FIG. 1

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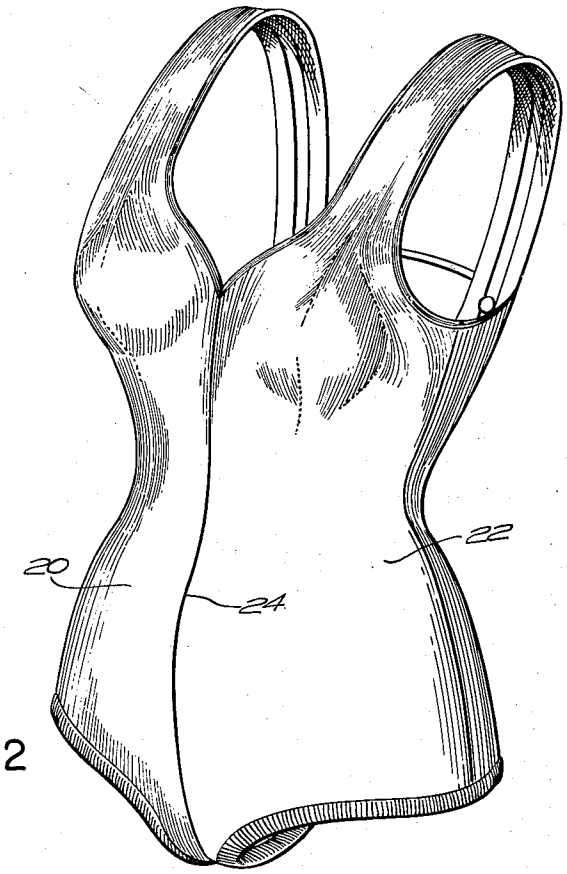


FIG. 2

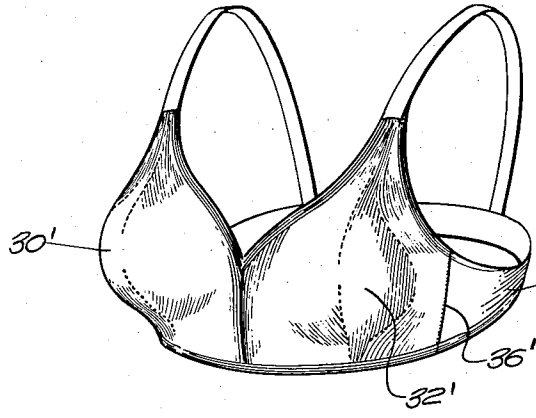


FIG. 3

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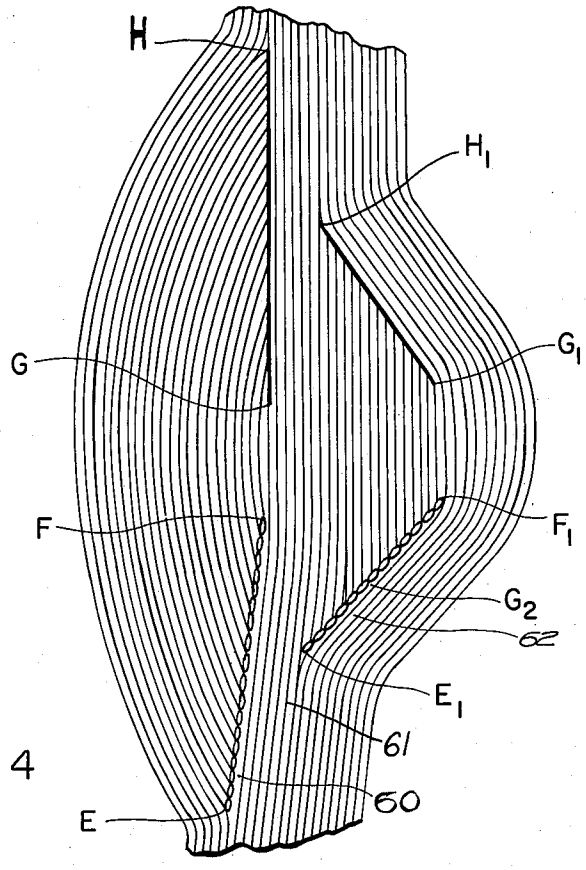


FIG. 4

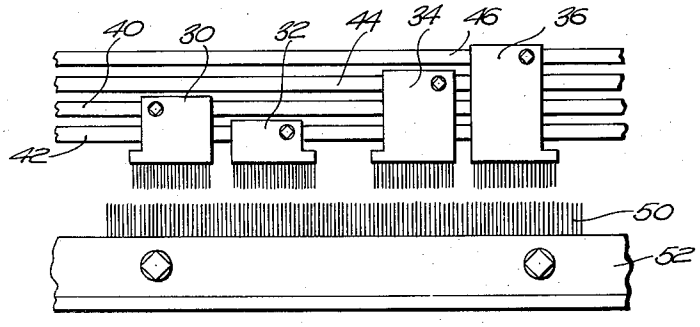


FIG. 5

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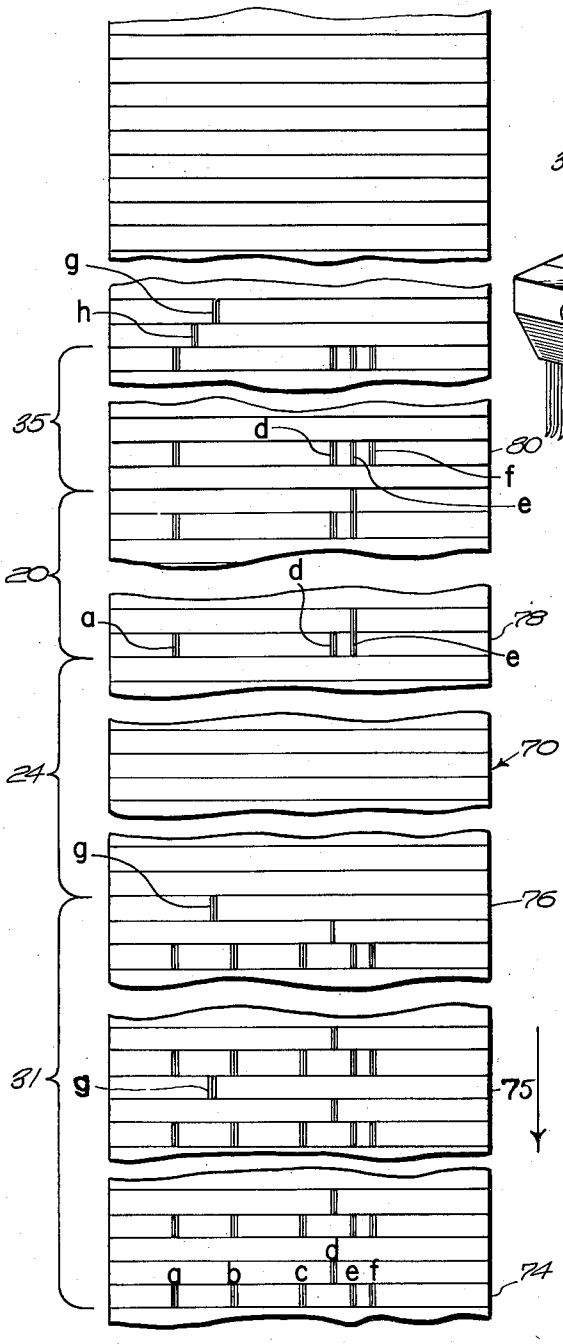
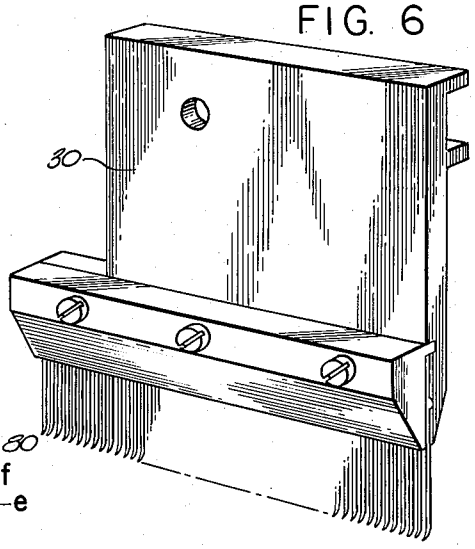


FIG. 7

FIG. 6



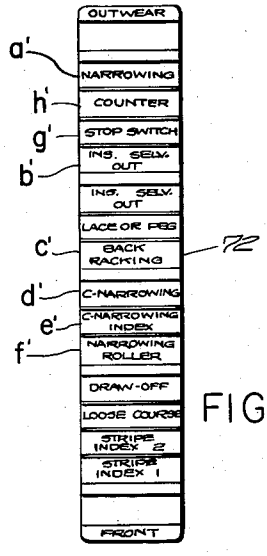


FIG. 8

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KNITTED GARMENT WITH BREAST CUPS AND METHOD OF MAKING

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Filed Feb. 2, 1959, Ser. No. 790,669

2 Claims. (Cl. 66—89)

This invention relates to garments such for example as swimsuits, brassieres and the like, for women's wear, such garments having bulged or domed portions to accommodate the breasts. Breast cups are ordinarily made by stitching together suitably shaped sectors of fabric. According to the present invention, the cups are formed integrally with the surrounding portions of the garment by suitable control of the knitting machine and more particularly by the use of long narrowing fingers to transfer loops or stitches in one direction or the other as more particularly hereinafter described.

For a more complete understanding of the invention, reference may be had to the following description thereof, and to the drawings, of which—

Figure 1 is a perspective view of a knitted swim suit embodying the invention;

Figure 2 is a perspective view of a modified swim suit embodying the invention;

Figure 3 is a perspective view of a brassiere embodying the invention;

Figure 4 is a diagrammatic representation of the arrangement of wales employed to form a breast cup in knitting a swimsuit panel;

Figure 5 is a fragmentary elevational view indicating the relation of the narrowing fingers to some of the knitting needles;

Figure 6 is a perspective view on a larger scale, of one of the narrowing fingers used in making the breast cup;

Figure 7 is a diagrammatic representation of a pattern chain having buttons thereon arranged to control the operation of the narrowing fingers; and

Figure 8 is a plan view of a gauge for adjusting the buttons on the pattern chain.

The swimsuit illustrated in Figure 1 may comprise a front panel **10** and a back panel **12** stitched at the sides and crotch and provided with suitable shoulder straps **14**. The front panel **10** can be made on a standard full-fashioning machine of the "Reading" type such as is illustrated for example in Patent No. 1,978,454, granted October 30, 1934, to G. Gastrich, or No. 2,666,311, granted June 19, 1954, to F. Lambach. The machine employed is a "sweater" machine, that is, a machine equipped with needles of a size to knit yarn suitable for ladies' sweaters, swimsuits, or equivalent garments. Such machines include a number of units simultaneously operated and controlled to knit an equal number of similar panels. Each unit is equipped with enough needles to knit the entire width of either the front panel **10** or the back panel **12** of the largest size of garment which is to be made, such as the swimsuit shown in Figure 1. By using two yarn carriers simultaneously, each limited to supply yarn to half the needles on the needle bar, the front panel can be made in two separate halves which are knitted simultaneously and are mirror images of each other. These halves **20** and **22** each have two selvages and are later stitched together as at **24** to form a front panel for a swimsuit as shown in Figure 2. In either case, the formation of the breast cups by the method of knitting is substantially the same.

The standard "Reading" knitting machine is customarily equipped with "narrowing fingers" consisting of blocks on which are secured a number of "narrowing points" for transferring the yarn loops from each of a group of consecutive knitting needles to the next adjacent needles. These narrowing fingers operate on the needles which are knitting one or both side margins of a blank for the purpose of narrowing or widening the blank. If the loops on such a group of needles are shifted one needle space in either direction, the loop on the leading needle of the group will be transferred to the next adjacent needle. If the latter already has a loop thereon, it will then have two loops. Thus when the next course is knitted, the two wales represented by the two loops will be merged into one wale. If the narrowing finger is operated to shift loops in a direction away from other needles which carry loops, the trailing needle will be denuded, but when the yarn carrier makes a pass for knitting the next course the denuded needle will pick up a new loop, thus starting a new wale. This has the appearance of dividing the original wale into two wales.

The panel **10** is symmetrical with respect to its vertical median so that a description of the knitting of one half of the panel will serve for the other half which is a mirror image thereof. Considering the panel as it appears in Figure 1, the knitting starts at the bottom and the panel is suitably fashioned by the narrowing fingers during the knitting of the panel from the bottom up to the breast cup areas.

Referring to the right-hand half of the upper or thorax-covering portion of the panel as it appears in Figure 1, the fine lines indicate the approximate arrangement of the wales in this portion of the garment. For the formation of the breast cup in this portion of the garment, the loops in a course extending from A to A′ are shifted to the left after each course is knitted, vacating a needle so that the wales along the line from A′ to B′ divide, a new wale being formed each time. At the same time, the loops along the course from A″ to the selvage of the panel are shifted to the right after each course is knit. As a result of this shifting of loops to the right, the wales along the line from A″ to B″ divide. No loops are shifted while the knitting proceeds from BB′B″ to CC′C″. The loops along the course from C to C′ are shifted to the right after each course is knit, and the loops along the course from C″ to the selvage are shifted to the left. As a result of these shiftings, the wales merge along the line from C′ to D′ and merge along the line from C″ to D″. As a result of the dividing and merging of wales as described and as indicated in Figure 1, a fullness is produced to accommodate one of the breasts. By loop-shifting in the other half of the panel **10**, a fullness symmetrical to the one described above is produced, these results being obtained entirely by means of the narrowing fingers shifting groups of loops as described and the operation of the yarn carriers.

The formation of the breast cups in the swimsuit shown in Figure 2 is somewhat similar to that hereinbefore described, and is shown in detail in Fig. 4.

According to the present invention, narrowing fingers are provided of sufficient length to carry the number of narrowing points necessary to span approximately half the needles employed in knitting a half-panel at its widest point. For the knitting of the two halves of a front panel with the formation of a breast cup in each half, four narrowing fingers preferably of equal size are employed, one such narrowing finger being illustrated in Figure 6. In any particular case, the actual length of the narrowing finger, and the number of points carried thereby, will depend on the size of the garment of which the panel is

to be a part, and the kind and size of yarn to be knit. For example, a unit of the knitting machine may have on its needle bar approximately 500 needles. Of these, two spaced groups of 188 needles each may be employed for the simultaneous knitting of the two halves of a front panel of a swimsuit. For the loop-shifting operations hereinafter described, the narrowing fingers should each be five inches long and carry 80 narrowing points, this being sufficient to reach from near the center line of the breast cup area to the adjacent selvage. These figures are illustrative only and will be different for knitting different sizes of swimsuits.

The relationship of the narrowing fingers of a unit to some of the knitting needles of the unit is diagrammatically illustrated in Figure 5. Four narrowing fingers **30**, **32**, **34** and **36** are mounted respectively on transfer rods **40**, **42**, **44** and **46**. The narrowing fingers carry narrowing points **48** which are directly above some of the knitting needles **50** mounted on the needle bar **52**. The rods are slidably mounted in brackets (not shown) which are moved down and up to enable the points **48** to pick up loops from the needles below them or to deposit loops thereon. When the machine is in operation in making halves **20**, **22** of the front panel of a swimsuit, the outer narrowing fingers **30**, **36** are simultaneously shifted in opposite directions so that they move either "inward" or toward each other, or "outward" or away from each other. In like manner, the shifting movements of the inner narrowing fingers are always simultaneous and are either inward toward each other or outward away from each other, but the inner fingers **32**, **34** never move more than one needle space from their original positions. By using two yarn carriers which are respectively limited in range to half the needles on the needle bar **52** and are made to move symmetrically with respect to the center of the needle bar, the two halves **20**, **22** of the front panel of a swimsuit are knitted simultaneously as mirror images of each other. A description of the movements of the fingers **34** and **36** in making a half-panel **22** will also serve for the movements of the fingers **30** and **32** which form the other half **20** of the panel.

When the knitting of a front panel is started, the outer fingers **30** and **36** are first racked outward so that they can be used for fashioning the outer selvages of the panel. The machine then does plain knitting up to the point E (Figure 4), the half-panels being narrowed at the selvages from the bottom to the waist line. At this point the narrowing finger **34** starts shifting loops inward from near the vertical center line of the breast cup area, which center line may be defined as following the wale which is midway between the wales through the points E and E_1, that is, toward the left, one needle space at a time, the narrowing finger returning to its original position at once after each such shift. A course is knitted after each shift, thus starting a new wale which branches toward the left from the continuous wale **60** knitted by the needle next to the outermost needle from which a loop is taken by the narrowing finger **34**. This operation is repeated with the formation of successive new wales branching toward the left from the continuous wale **60** until a point F is reached. Meanwhile, after a few such new wales (e.g. eleven) are started, the machine stops and the outer fingers **30**, **36** are manually racked inward until the innermost point of the finger **36** is over the needle then at the point E_1 (Figure 4). Knitting is then resumed and the outer finger **36** shifts loops one needle space at a time outward or toward the right while the finger **34** continues to shift loops inward as before, but instead of returning to its original position after each shift, the finger **36** keeps moving progressively toward the right, a course being knitted after each shift. As a result, the new wales branch to the left from the continuous wale **62** formed by the successive needles to which the innermost point of the finger **36** shifts a loop. The simultaneous operation of the fingers **34**, **36** continues until the points F and F_1 are reached, whereupon the machine stops. The attendant then temporarily disables the mechanism for changing the travel of the yarn carriers, and plain knitting is resumed until the points GG_1 are reached. Then the fingers **34**, **36** start moving simultaneously in reverse directions to reverse the previous loop-shifting process. The inner finger **34** shifts loops outward (to the right) one needle space at a time and returns to its original position after each shift. The outer finger **36** shifts loops inward (to the left) one needle space at a time but its movements are progressive. As before, a course is knitted after each shift. These simultaneous movements of the fingers **34**, **36** continue until a point H_1 is reached when the outer finger **36** is back to the position it had when it started shifting movements at the point E_1. These reverse shifting movements of the fingers **34**, **36** result in the merging of wales as indicated in Figure 4. After the reverse shifting movements of the finger **36** are concluded at the point H_1, the shifting movements of the finger **34** are preferably continued, and may be continued until the upper end of the half panel is reached.

As indicated in Figure 4, the breast cup of a half-panel comprises a narrow medial band of continuous wales of which the innermost wale is the wale **60** and the outermost is **61**. The inner group of continuous wales to the left of this band diverges from it at E and rejoins it at H, leaving a space which is filled by a series of new wales which branch off to the left successively from the continuous wale **60** and later merge with it in reverse order between G and H.

The outer group of continuous wales to the right of the medial band diverges from it at E_1 and later rejoins it at H_1, leaving a space which is filled by a second series of new wales which are alongside of the points E_1 and H_1 and which branch to the left successively from a continuous wale **62** which is next to the wale **61** and merges again with it in reverse order; after the halves of the front panel are completed, they are sewed together along the vertical median of the panel to complete the panel.

As one or both of the fingers **34**, **36** are operating to shift loops, the fingers **32** and **30** are being similarly but oppositely operated to form in the other half of the panel a counterpart of the arrangement of wales illustrated in Figure 4. The cups in the brassiere shown in Figure 3 may be knitted in a similar manner. The parts **30'** and **32'** of the front panel may be separately or integrally knitted. The chest band **34'** is preferably stitched to the front panel as at **36'**, and shoulder straps may be made and attached as desired.

Figure 7 shows an arrangement of buttons on a standard pattern chain **70** such as is commonly a part of a Reading full-fashioned knitting machine. As shown on the drawing, the chain proceeds downward so that the lowermost buttons are the first to reach the levers which they rock to control the operation of the narrowing fingers. The buttons are carefully located widthwise of the chain by the use of a gauge **72** such as is illustrated in Figure 8. The length of this gauge is equal to the width of the chain **70** so that when the gauge is applied transversely to the chain, the correct position of a button can be found. The buttons *a*, *b*, *c*, *d*, *e*, *f*, *g* and *h* are located by the corresponding spaces *a'*, *b'*, *c'*, *d'*, *d'*, *f'*, *g'* and *h'* on the gauge **72**.

The buttons *a* cause the narrowing fingers to drop so as to pick up loops from the needles beneath the narrowing points. An *a* button, unless modified by the presence of buttons *c* and *f*, causes a narrowing shift of the narrowing fingers. The buttons *c* and *f*, however, cause certain cams to be displaced so that the outside fingers **30** and **36** shift outward. The button *e* in conjunction with the button *a* causes the inner fingers **32** and **34** to move inward. Such movements are widening movements with respect to the half-panels **20** and **22** which are being knitted. The button *b* changes the travel of the yarn car-

riers by one needle space when a widening of the half-panel at the selvages is desired. The buttons *a, b, c, e* and *f* on link **74** of the pattern chain **70** operate to cause outward shifting of the outer fingers **30** and **36** and inward shifting of the inner fingers **32** and **34**, while the travel of the yarn carriers is increased to widen the blank. The button *d* operates to return the inner fingers **32** and **34** to their original position after each inward shift. These buttons start operating when the knitting has reached the point E (Figure 4). At this time the outer fingers **30** and **36** are widely separated so that only a few of their innermost points operate on the selvages to widen the half-panels. When the link **75** on the pattern chain reaches the operating levers, a button *g* stops the machine to enable the attendant to rack in the outer fingers so that the innermost point on the finger **36** is over the needle at the point E_1 (Figure 4). The machine is then started again and after a predetermined number of additional alternate shifting and knitting operations, the machine is stopped by a button *g* on link **76** to permit an attendant to disable temporarily the mechanism which changes the travel of the yarn carriers so that there will be no change during the rest of the knitting operation. Plain knitting is then resumed for a predetermined number of courses until the link **78** reaches the operating levers. The buttons *a, d, e,* cause inward movement of the outer fingers and outward movement of the inner fingers, the latter being restored to their initial position by a button *e* after each such shift.

After a predetermined number of such shifts, alternating with the knitting of single courses, buttons *a, d, e, f* on link **80** continue the shifting movements of the inner fingers outward with a return to the original position after each shift, while the outer fingers remain inactive. After this goes on for a predetermined number of operations, the button *h* operates a counter to add one to the tally, then the machine is stopped by a button *g*. The panel halves are pressed from the needles and a new panel is started after the outer fingers have been racked to their starting positions and the mechanism for changing the throw of the yarn carriers has been made operative.

I claim:

1. A method of knitting a front half-panel for a swimsuit having an unstressed bulge, which comprises knitting a series of plain courses on a full-fashioning machine to form the half-panel from the bottom to the breast cup areas, starting a first loop-shifting operation by shifting in the widening direction the loops on a substantial number of marginal needles at one side of the fabric to the next adjacent needles, knitting a course, shifting the loops from the same marginal needles to the same next adjacent needles, knitting a course, alternately shifting loops and knitting as described, whereby successive new wales are started by the inmost needle from which loops are shifted, starting a second loop-shifting operation while the first loop-shifting operation is in progress by shifting in the widening direction the loops on a substantial number of marginal needles at the outer side of the fabric to the next adjacent needles, knitting a course, shifting the loops on said next adjacent needles in the same direction to the then next adjacent needles, continuing both shifting and knitting operations simultaneously for a predetermined number of courses, resuming plain knitting for a predetermined number of courses, reversing both shifting operations by simultaneously shifting loops in the opposite directions from both sides of the fabric whereby wales are merged, discontinuing the reversed second loop-shifting operation, and subsequently discontinuing the reversed first loop-shifting operation.

2. A method of making a front panel for a woman's swimsuit which comprises knitting on a full fashion machine two halves which are symmetrical to the vertical median and are each formed with two selvages, the knitting starting at the bottom of said halves and proceeding upward to the breast cup areas, shifting on both sides of the vertical centerline of each breast cup all the loops from near the vertical centerline of each breast cup to the adjacent selvage one needle away from said centerline, thus vacating on each side of each cup centerline a needle from which a new wale is started, continuing the formation of successive new wales in this manner as far as necessary to produce the particular size and shape of breast cup desired up to the horizontal centerline of the cups, so as to achieve a smooth transition from the 2-dimensional lower body portion to the 3-dimensional cup structure free from distortion of the surrounding fabric and free from any seams, and thereafter reversing the process to reduce the number of wales being knitted, and finally sewing together the two knitted halves along the vertical median to complete the panel.

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