April 4, 1961 I. CRAWFORD ET AL 2,977,783

SWIMSUIT AND METHOD OF KNITTING SAME

Filed Oct. 5, 1959

3 Sheets-Sheet 1

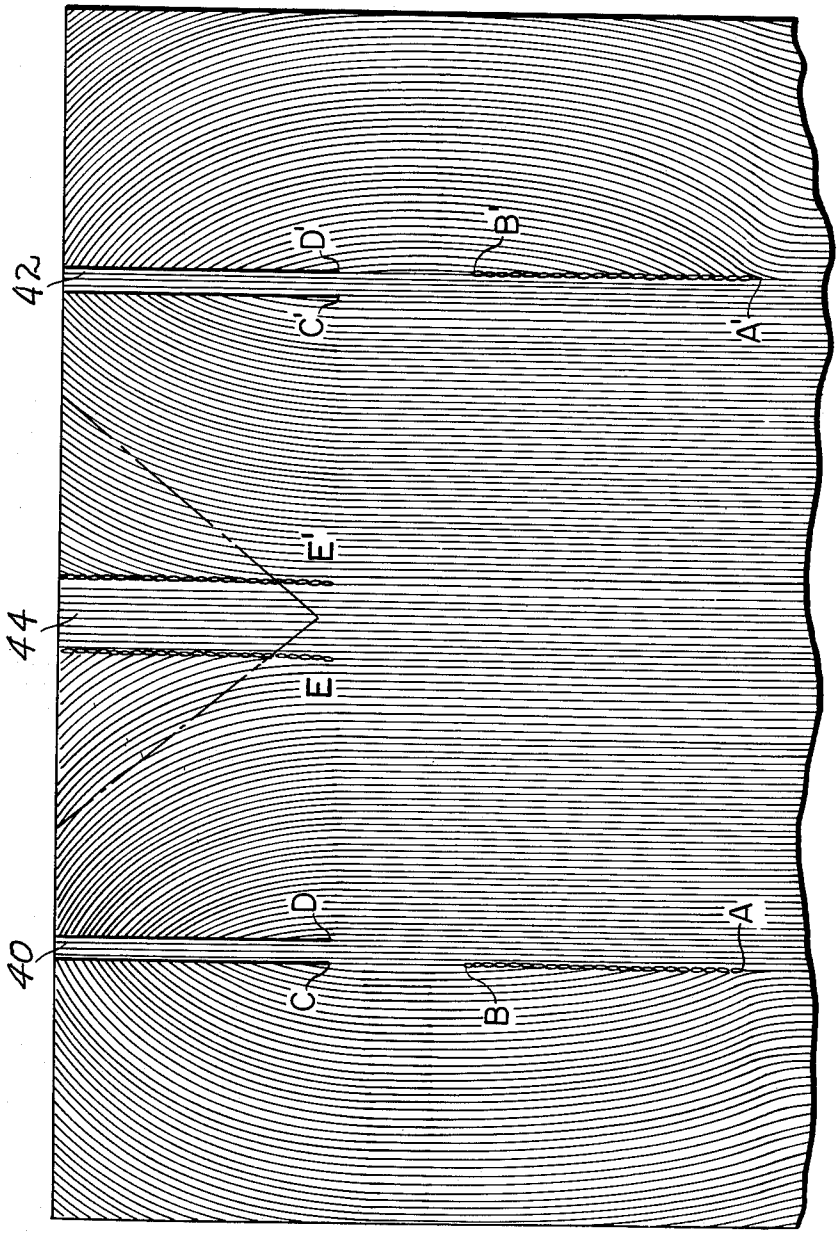


FIG. 1

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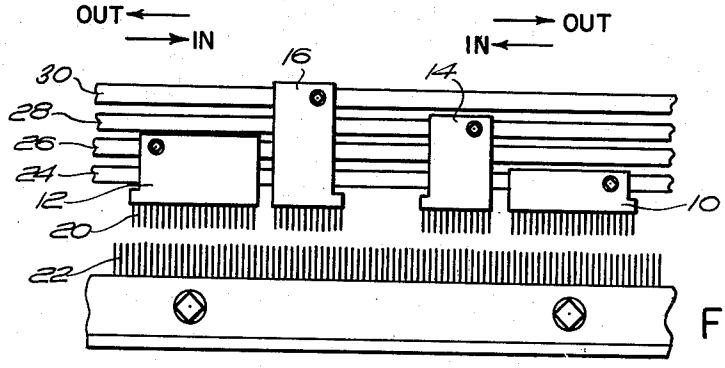


FIG. 2

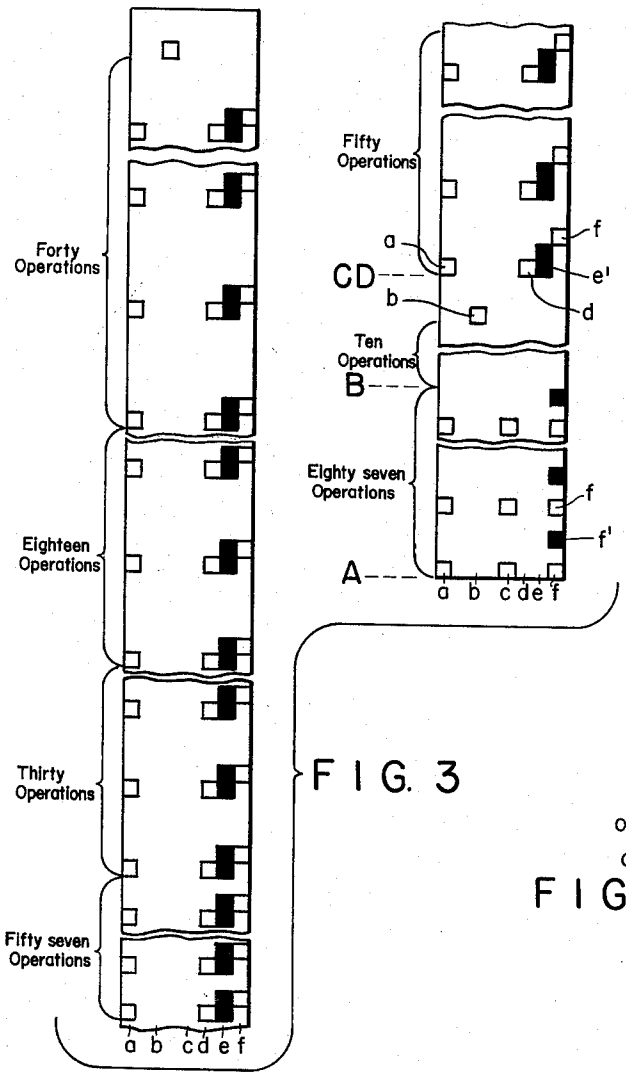


FIG. 3

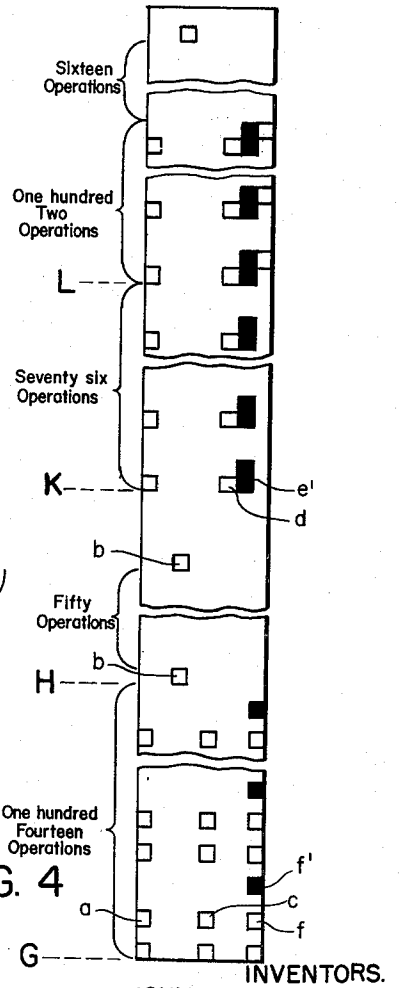


FIG. 4

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3 Sheets-Sheet 3

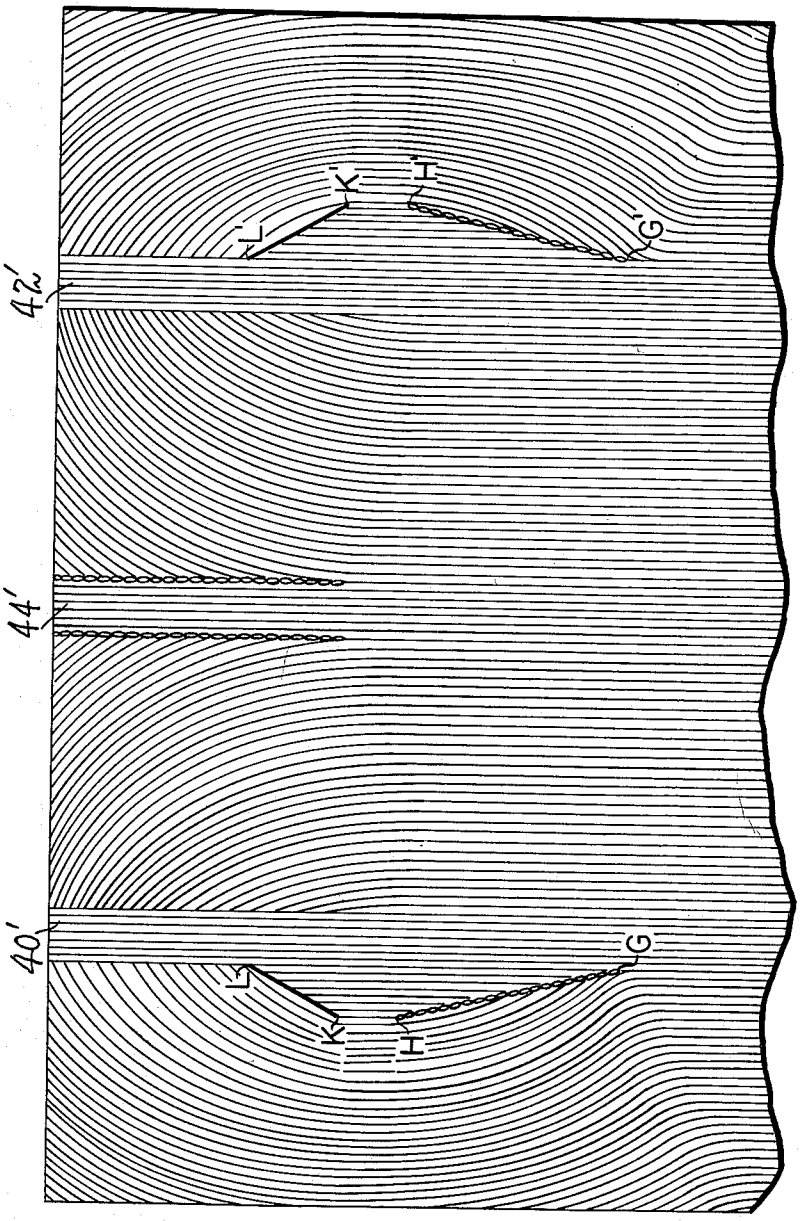


FIG. 5

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2,977,783

SWIMSUIT AND METHOD OF KNITTING SAME

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7 Claims. (Cl. 66—176)

This invention relates to a swimsuit for women, and more particularly to the front portion of a swimsuit which is fashioned by the knitting thereof to form breast cups. The invention also relates to the method of knitting for producing the breast cups by shifting groups of yarn loops in one direction or the other as hereinafter described in more detail. It is an object of the invention to knit on a flat bed machine a seamless panel which will be the complete front panel of the swimsuit, the courses running across the panel from one selvage to the other. The knitting may be done on a machine of the well-known "Reading" or "Cotton patent" type such as is illustrated in United States Patent No. 1,978,454 or in United States Patent No. 2,666,311. For a more complete understanding of the present invention, reference may be had to the following description thereof and to the drawings, of which:

Figure 1 is a diagrammatic plan of the upper or breast-covering portion of a knitted front panel for a swimsuit embodying the invention, the sides of the panel which are conventional selvage edges being shown as arbitrarily trimmed away to permit a larger scale for the more significant features of the panel;

Figure 2 is a fragmentary elevational view of a bank of knitting needles and four narrowing fingers above the needles;

Figure 3 is a diagrammatic representation of a pattern chain for knitting the panel shown in Figure 1;

Figure 4 is a diagrammatic representation of a pattern chain for knitting a swimsuit panel using a bulkier yarn; and

Figure 5 is a diagrammatic plan of the upper portion of a front panel for a swimsuit knitted according to the pattern caused by the button arrangement shown in Figure 4, the sides of the panel which are conventional selvage edges being shown as arbitrarily trimmed away to permit a larger scale for the more significant features of the panel.

Knitting machines of the "Reading" or "Cotton patent" type for fashion knitting comprise a number of units arranged in a long line for simultaneous operation, each unit having a set of needles sufficient in number to knit the full width of a panel of Jersey fabric for a sweater, swimsuit or equivalent garment. The following description has to do with one such machine unit.

For shaping the panel as hereinafter described, "narrowing fingers" are employed to shift yarn loops from groups of needles, the loops on each of the needles of each such group being shifted to the next adjacent needle on one side or the other. For this purpose, the narrowing fingers are provided with "narrowing points" which have the same spacing as the knitting needles. When a narrowing finger descends, the points pick up the yarn loops from the needles directly beneath them and raise these loops clear of the needles. The finger is then shifted (usually one needle space) in one direction or the other and the points descend to deposit the loops they are holding on the needles then below them. The

fingers are then elevated clear of the needles, and knitting is resumed for one or more courses. The traverse of the yarn carriers is regulated by pattern chain buttons in the usual manner to add or subtract wales at the selvages as desired. Narrowing fingers for narrowing or widening a fabric at one or both selvages are standard equipment for machines of this kind, the fingers usually being two inches or less in width.

For knitting the front panel of a swimsuit, four narrowing fingers are employed as illustrated in Figure 2. The outside fingers **10** and **12** are much wider than the ordinary narrowing fingers, each of these fingers being of the order of eight inches or so in width so as to extend inward a considerable distance toward the median of the panel even when operating on the selvages of the panel. When these fingers shift inward, or toward each other, the effect is to narrow the fabric. When they move outward, or away from each other, the effect is to widen the fabric.

Between the outer fingers **10** and **12** are two inner fingers **14** and **16**, these each being, for example, 4½ inches wide. The fingers have narrowing points **20** each of which is directly above a knitting needle **22**. The narrowing fingers are mounted on and shifted by the usual transfer rods **24, 26, 28** and **30**. The fingers and transfer rods are carried by a frame (not shown) which is customary on machines of this kind, the frame being raised and lowered by cams which are controlled by buttons on the pattern chain. The frame, cams and pattern chain are items of standard equipment in machines of the type mentioned. The knitting needles **22** and narrowing points **20** are small so that if reduced to the scale of Figure 2, they would be hardly visible. Hence these elements as shown in Figure 2 are larger and fewer in proportion to the narrowing fingers than on the machine itself.

The arrangement of buttons on the pattern chain to produce the knitted panel illustrated in Figure 1 is indicated by the diagram in Figure 3. As therein shown, the chain is supposed to move downward toward the bottom of the page so that the lowermost buttons in the diagram are the first to reach and actuate the stationary levers (not shown) which control the cams for operating the narrowing fingers. The function of each button depends on its spacing from the side edges of the pattern chain since such spacing determines which of the ten or more levers (not shown) mounted over the chain will be actuated by such button as it passes. In making the fabric illustrated in Figure 1, six of the cam-actuating levers are employed, these being operated by buttons located as indicated in columns *a*, *b*, *c*, *d*, *e* and *f* in Figure 3, the buttons being labelled accordingly. In Figures 3 and 4, buttons of regular height are indicated by light squares. In columns *e* and *f* some of the buttons are low buttons, these being indicated in the drawings by dark squares and by letters *e'* and *f'* in the text.

The fingers **12** and **16** as shown in Figure 2 are at the limiting position of mutual approach so that there are a few needles which are between them and are not touched by either of these fingers. These needles thus knit a vertical band **40** of continuous wales which extend along or near to the vertical center line of one of the breast cup areas from the bottom of the panel to the top. Similarly, the fingers **10** and **14** get no closer to each other than indicated in Figure 2, the needles between them knitting a band **42** of continuous wales along or near to the vertical center line of the other breast cup area.

The inner fingers **14** and **16** during the operation of the machine are not moved more than one needle space from the positions shown in Figure 2. Every time they are shifted in order to transfer yarn loops, they are

promptly returned to their original positions. Hence there is a group of needles between them which are not touched by them. These needles knit a central band 44 of continuous wales from the bottom to the top of the panel.

The positions of the four narrowing fingers 10, 12, 14, 16 on their respective transfer rods for knitting any particular size of garment are empirically determined so that in the finished article the vertical bands 40, 42 of continuous wales will be spaced apart the same distance as the nipples of the wearer for whom the swimsuit is designed.

The buttons, acting through the various cams, operate the narrowing fingers as follows:

Each *a* button causes the narrowing fingers to descend to pick up loops from the needles directly below the narrowing points. Unless modified by the action of buttons in other columns, the *a* button causes the outer fingers 10, 12 to shift inward or toward each other one needle space. When a button *a* operates simultaneously with buttons *c* and *f*, the cams are moved so that the outer narrowing fingers 10 and 12 are moved away from each other. The *f* button by itself causes the outer fingers 10 and 12 to shift inward or toward each other, during the knitting of a course, without transferring any loops of yarn.

The lower part of the swimsuit front panel is made by plain knitting which may include widening or narrowing the fabric as a whole at the selvages or the formation of ornamental designs in the fabric. After the lower part has thus been knitted up to the breast cup areas diagrammatically shown in Figure 1, the *a, c, f,* buttons operate as indicated in Figure 3 to move the outer narrowing fingers 10 and 12 outward, starting new wales at or near the vertical center lines of the respective breast cup areas as indicated at AB and A'B' in Figure 1, these lines being on the center lines of the respective cups. The new wales branch off to the left from the band 40 and to the right from the band 42. Then three courses are knitted, accompanied by a return shift of the outer fingers 10 and 12 by a button *f'*. This sequence is repeated for 87 operations of the machine which bring the fabric to the points B, B' (Fig. 1), just below the horizontal center line of the breast cup areas. Then follows the knitting of 10 consecutive courses, whereupon the machine is stopped by a *b* button (Fig. 3). This gives the attendant an opportunity to inspect the fabric before proceeding further. This *b* button may be omitted if desired.

After the machine is restarted, a couple of courses are knitted, then *a, d, e'* buttons cause the outer fingers 10, 12 to shift loops inward one needle space, and the inner fingers 14, 16 to shift loops outward one needle space. Then four courses are knitted while an *e'* button shifts the inner fingers 14, 16 inward one needle space and an *f* button shifts the outer fingers 10, 12 outward one needle space to their initial positions. This cycle of movements is thereupon repeated until fifty operations of the machine have been completed. These movements of the fingers begin at the points C, D, C', D' (Fig. 1) and cause the wales to terminate by merging into both sides of the vertical bands 40, 42 above these points at or near the vertical center lines of the breast cup areas. This results in two series of wales merging with the band 40, one on each side thereof, these wales converging with respect to the vertical center line of the corresponding breast cup. In like manner, two series of wales merge with the band 42, one on each side thereof, the wales in these series converging with respect to the vertical center line of the corresponding breast cup. At the same time, the outward shifting of yarn loops by the inner fingers 14, 16 causes the diverging of wales near the central band 44 from the points E, E' upward.

After the fifty operations of the machine where each dipping of the narrowing fingers is followed by the knitting of four courses, the machine continues a similar operation of the narrowing fingers but with only two courses being knitted after each shifting of yarn loops, these cycles continuing for 57 operations of the machine. Then the yarn loop shifting movements alternate with four courses of knitting for the next 30 operations, with five courses for the next 18 operations, and with six courses for the next 40 operations, after which the machine is stopped by a *b* button.

It should be understood that the figures given for operations of the machine are by way of example only and may be varied according to desired changes in size or shape of the swimsuit.

The pattern of knitting of the swimsuit panel diagrammatically illustrated in Figure 1 and hereinbefore described is particularly suitable for nylon-covered rubber yarn. For those who prefer a non-rubber swimsuit, a multiply yarn consisting of five ends of yarn consisting of a blend of crimped and uncrimped nylon fibers may be employed. This makes a comparatively bulky yarn for which the knitting pattern diagrammatically shown in Figure 5 has been found to be particularly suited, such pattern resulting from the arrangement of pattern chain buttons shown in Figure 4. As in the panel shown in Figure 1, the panel shown in Figure 5 has a central band 44' of continuous wales, and two parallel bands 40' and 42' of continuous wales resulting from the minimum spacing between the fingers 10, 12, 14 and 16. After the lower part of the panel has been made by plain knitting which may include narrowing or widening at the selvages and the formation of ornamental figures in the fabric, fashioning for the formation of breast cups begins at a first predetermined level indicated by the points G, G' (Figure 5). According to the diagram in Figure 4, the outer fingers 12 are dipped by an *a* button to take yarn loops from the needles beneath them. The *c* and *f* buttons which act at the same time cause the outer fingers to shift outward one space. A single course is then knitted. The outer fingers are again caused to shift yarn loops outward, this being followed by the knitting of three courses during which time a button *f'* shifts the outer fingers inward one space and this sequence is repeated until 114 machine operations have been completed at a second level indicated by the points H, H' just below the horizontal center line of the breast cup areas, whereupon the machine may be stopped by a *b* button if desired. As a result of this mode of operation, instead of forming a succession of new wales which branch off outwardly from a continuous wale as from A to B in Figure 1, the wales from G to H in Figure 5 branch off in both directions, i.e., to right as well as to the left, the transfer line GH being on the vertical center line of one of the breast cup areas. Similarly the transfer line G' H' represents a line along which new wales branch alternately to the left and right from the vertical center line of the other breast cup area. While the lines GH and G'H' in this example appear on the flat diagram to slant outward, in the actual knitted panel they lie on the vertical center lines of the breast cup areas. When the points H, H' have been reached, each of the outer fingers 10, 12 has completed a net outward movement of 19 needle spaces.

Then follows the knitting of 50 or more consecutive courses to a third level indicated by the points K, K'. From points K, K' to a fourth level at L, L', buttons *a, d, e'* cause all the fingers to dip and shift loops in the narrowing direction (outer fingers move inward and inner fingers move outward). Each loop shifting movement is followed by the knitting of three courses during which the inner fingers are moved back to their initial positions by a button *e'* but the outer fingers are not reset. This cycle is repeated for 76 operations of the machine so that the outer fingers thus move progressively inward 19 spaces and return to the positions they occupied at the points G, G'. As a result of this progres-

sive inward movement of the outer fingers, the wales to the right of the line KL merge with a continuous wale immediately to the left of the line KL. In like manner the wales to the left of the line K'L' merge with a continuous wale to the right of the line K'L'.

From the fourth level at the points L, L' upward the narrowing by all the fingers continues, each narrowing shift being followed by the knitting of three courses during which all the fingers are reset to their initial positions. This results in the termination of wales by merging at or near the vertical center lines of the breast cup areas. The narrowing or outward shifting of loops by the inner fingers is necessarily accompanied by divergence of wales from the central band 44' at the same levels. This cycle may be repeated for 102 operations of the machine after which some consecutive courses are knitted and the machine is stopped.

In the diagram of wales shown in Figure 5, in the upper half of each breast cup area, each of the outwardly curving wales which merge with the band 40' or the band 42' appears to be longer from the KK' level to the merging point than the vertical wales in the band from the same level to the same merging point, but actually the lengths are the same. This results in the bulge or 3-dimensional curvature of the inner upper portion of each cup. In the diagram illustrated in Figures 1 and 5 the outwardly curving wales which merge at the sides of the bands 40, 42 or 40', 42' are wales which come up without interruption from below the breast cup areas. The central band 44' provides fabric between the outwardly curving wales which is flat and serves to prevent the bands 40' and 42' from being drawn toward each other when the knitting is continous from selvage to selvage.

The numbers of operations of the knitting machine indicated in Figure 4 are by way of example and may be varied to produce swimsuits of other sizes.

When the panels which have been knitted as hereinbefore described are removed from the machine, the relaxed fashioned portions naturally assume bulging shapes suitable for breast cups.

We claim:

1. A method of making a one-piece knitted seamless selvaged front panel for a woman's swimsuit, which comprises knitting the panel from the bottom thereof upward to the breast cup areas, adding new wales along transfer lines which are near the vertical center line of each cup as the knitting progresses toward the horizontal center line of the cups, such new wales diverging with respect to said vertical center lines and being started by shifting outward all the loops from near the vertical center line of each cup to the adjacent selvage, and thereafter shifting the loops toward the center line of each cup from both sides thereof so as to converge wales with respect to the vertical center line of each cup from both sides thereof and to terminate said converging wales near each said vertical center line, all the knitted courses of said panel being continuous from selvage to selvage.

2. A method of making a one-piece knitted seamless selvaged front panel for a woman's swimsuit as set forth in claim 1, said new wales being added in such a way that they all diverge outward with respect to said vertical center lines of the cups.

3. A method of making a one-piece knitted seamless selvaged front panel for a woman's swimsuit as set forth in claim 1, said new wales being added in such a way that they diverge some to the left and some to the right from said transfer lines.

4. A one-piece knitted selvaged front panel for a woman's swimsuit, said panel having a two-dimensional lower body portion and an upper body portion with two three-dimensional breast cups free from distortion of the surrounding fabric and free from seams, the wales of said panel extending up from the bottom with successive additional wales starting near and diverging with respect to the vertical center line of each said cup in the lower half of each breast cup area, said panel having in the upper half of each breast cup area two series of wales merging near the vertical center line of that cup, which wales converge with respect to the vertical center line from both sides thereof, each course of knitting in the panel being continuous from selvage to selvage.

5. A swimsuit panel as described in claim 4, in which all the said new wales branch outward from the vertical center lines of the cups.

6. A swimsuit panel as described in claim 4, in which the said new wales branch some to the left and some to the right.

7. A one-piece Jersey knitted selvaged front panel for a woman's swimsuit, said panel having a two-dimensional lower body portion and an upper body portion with two three-dimensional breast cups free from distortion of the surrounding fabric and free from seams, the wales of said panel extending up from the bottom thereof with successive additional wales starting near and diverging from near the vertical center line of each breast cup in the lower half of the breast cup areas, said panel having two series of wales in the upper half of the breast cup areas converging toward the vertical center lines of the breast cups and merging near said center lines, the wales of one said series curving inward from outside of said vertical center lines, the wales of the other series curving outward from the central portion of the panel, a substantial portion of said outward curving wales originating below the bottom of the breast cup areas.

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