June 18, 1963 A. F. BREITINGER 3,093,989

PLEATED KNIT FABRIC

Filed Dec. 28, 1961 2 Sheets-Sheet 1

FIG. 1.

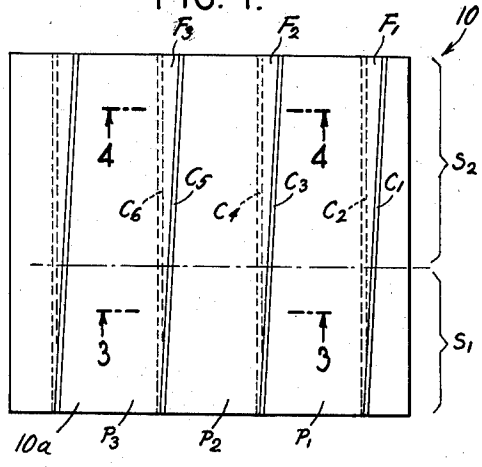


FIG. 2.

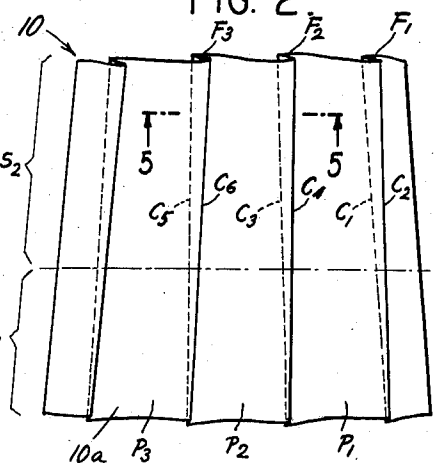


FIG. 3.

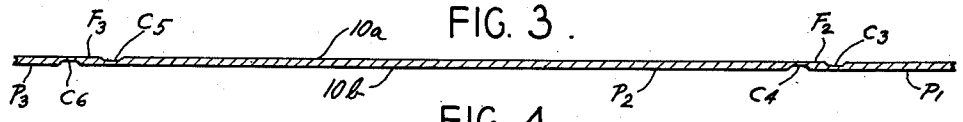


FIG. 4.

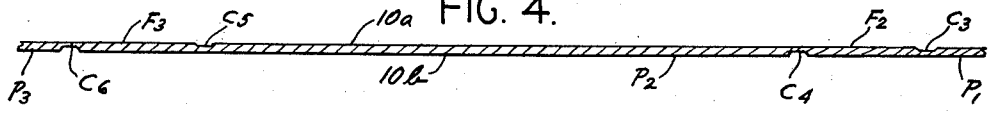
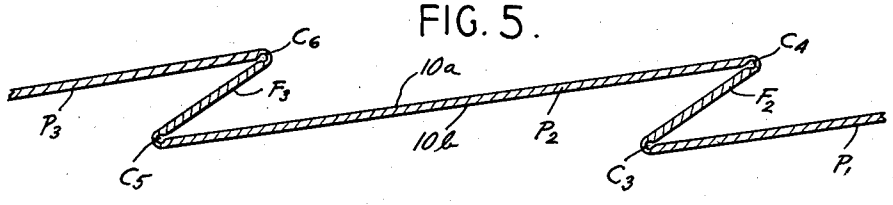


FIG. 5.



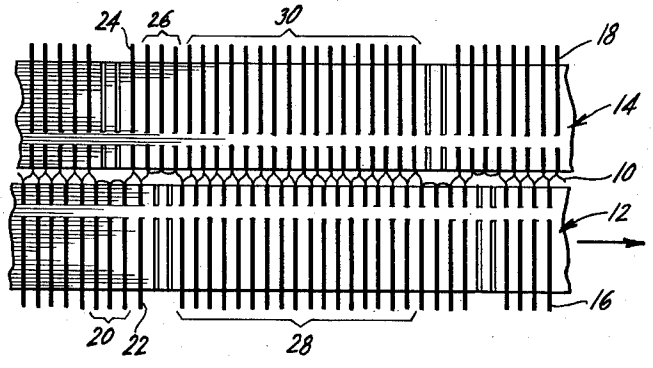


FIG. 6.

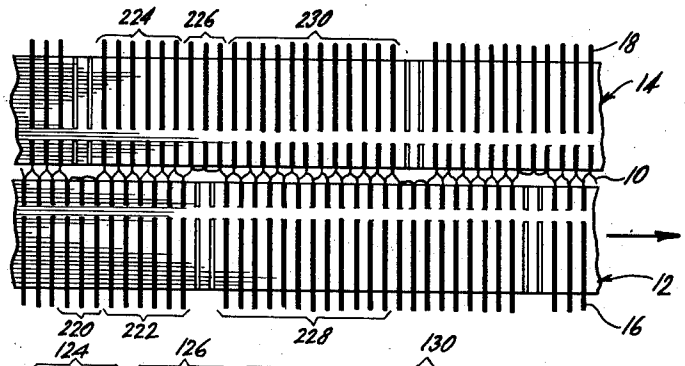
INVENTOR.
AUGUST F. BREITINGER
BY
Ametz + Levy
ATTORNEYS

June 18, 1963 A. F. BREITINGER 3,093,989

PLEATED KNIT FABRIC

Filed Dec. 28, 1961 2 Sheets-Sheet 2

FIG. 8.



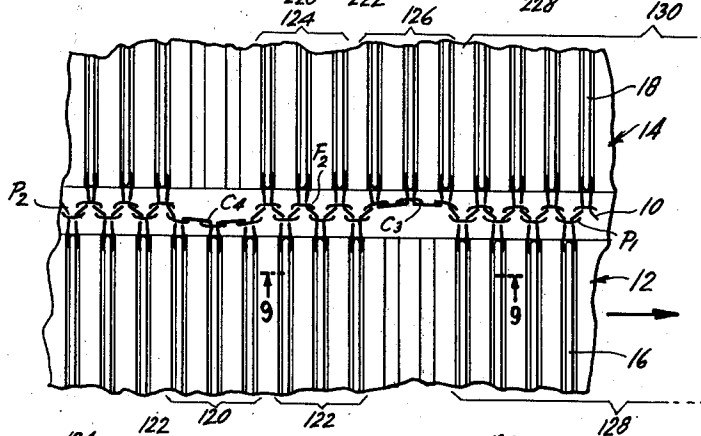


FIG. 7

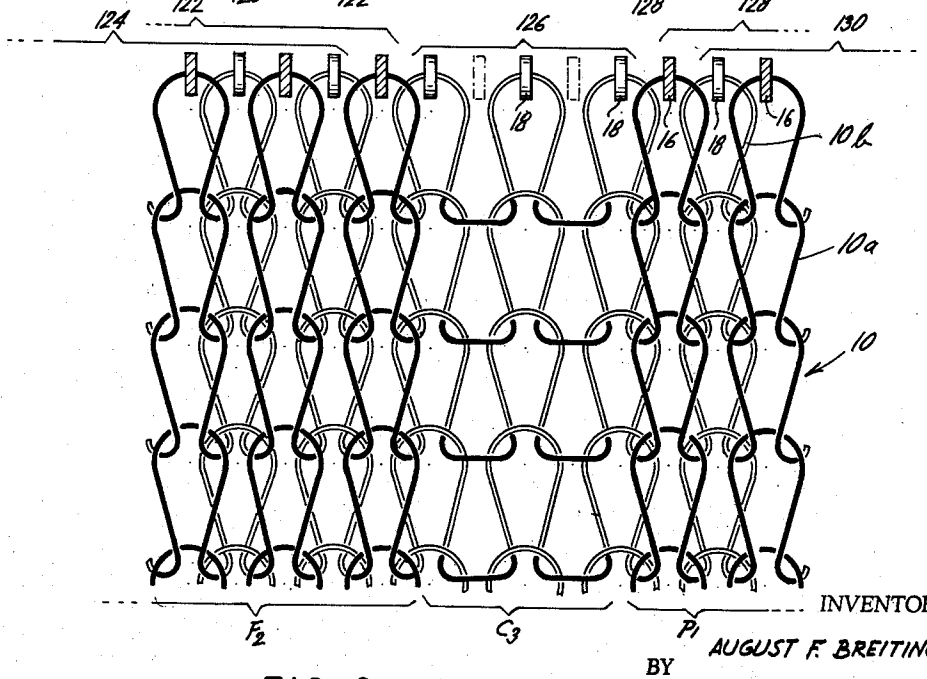


FIG. 9.

INVENTOR.
AUGUST F. BREITINGER
BY
Amster + Levy
ATTORNEYS

United States Patent Office 3,093,989 Patented June 18, 1963

3,093,989
PLEATED KNIT FABRIC

August F. Breitinger, Westport, Conn., assignor to Jared Knitting Mills, Inc., New York, N.Y., a corporation of New York

Filed Dec. 28, 1961, Ser. No. 162,646
5 Claims. (Cl. 66—200)

The present invention relates generally to knit fabrics, and in particular to a knit fabric having a plurality of longitudinally extending pleats of decreasing width separated by a plurality of longitudinally extending folds, and to such knit fabric with tapered pleats as an improved article of manufacture for use in wearing apparel.

In various articles of wearing apparel, such as pleated skirts, dresses, blouses, sweaters and the like it is particularly advantageous to provide pleats of progressively decreasing width such as to properly contour the garment for the wearer. Various techniques are available for the cutting and pleating of piece goods. However, with knitted fabrics, it has been a difficult, expensive and time-consuming operation to initially knit the fabrics with appropriate stitch configurations to fall naturally into tapered or graduated pleats. Heretofore, it has been either necessary to employ a hand process which involves the transfer of stitches to impart a natural pleating configuration to the knit fabric, or to use relatively expensive machines of the flat Jacquard type, wherein it is possible to accomplish automatic transfer to achieve the desired pleating.

Broadly, it is an object of the present invention to provide an improved knitted fabric which will have a natural tendency to fall into a plurality of longitudinally extending tapered pleats incident to the manufacture thereof. Specifically, it is within the contemplation of the present invention to provide an improved knitted fabric having a plurality of longitudinally extending pleats of decreasing width which are separated by a plurality of longitudinally extending folds of corresponding increasing width such that a skirt, dress, blouse, sweater or similar garment may be readily manufactured, preferably using conventional and commercially available knitting machines.

In accordance with article aspects of the present invention, there is provided a knit fabric which has a plurality of longitudinally extending pleats of decreasing width separated by a plurality of longitudinally extending folds. The fabric comprises multiple swaths, each including plural courses. Each of the swaths includes spaced first groups of wales of double-faced rib stitching providing a set of pleat segments, spaced second groups of wales of double-faced rib stitching providing a set of fold segments, and at least one wale of jersey stitching intermediate and joining successive pleat and fold segments of the first and second sets and providing cusp segments. Alternate ones of the wales of jersey stitching are formed on opposite faces of the swath such that there is a natural tendency for the set of fold segments to lie beneath the set of pleat segments. The overall width of successive pairs of pleat and fold segments in each swath is substantially equal; however, there is a greater separation between adjacent and alternately formed cusp segments in successive swaths such that the pleat segments are of decreasing widths in successive swaths and the fold segments are of corresponding increasing width. The stepwise decrease in the width of the pleat segments in successive swaths form longitudinally extending pleats, which for all practical intents and purposes, have the appearance of being uniformly tapered.

The above brief description, as well as further objects, features, and advantages of the present invention will be more fully appreciated by reference to the following detailed description of a typical, but nonetheless illustrative process in accordance with the present invention and an improved knitted fabric resulting therefrom, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a plan view of the front face of a knit fabric manufactured in accordance with the present invention, shown in stretched-out condition;

FIG. 2 is a plan view of the front face of the fabric when relaxed and naturally falling into the tapered pleated configuration in accordance with the present invention;

FIG. 3 is a sectional view on an enlarged scale taken substantially along the line **3—3** of FIG. 1 and looking in the direction of the arrows;

FIG. 4 is a sectional view on an enlarged scale taken substantially along the line **4—4** of FIG. 1 and looking in the direction of the arrows;

FIG. 5 is a sectional view on an enlarged scale taken substantially along the line **5—5** of FIG. 2 and looking in the direction of the arrows;

FIG. 6 is a diagrammatic plan view of a section of the front and rear needle beds of a typical V-bed knitting machine set up in accordance with the present invention to knit a swath having a section similar to that shown in FIG. 3 and including double-faced rib stitching providing a set of pleat segments, double-faced rib stitching providing a set of fold segments, and at least one wale of jersey stitching intermediate and joining successive pleat and fold segments, with alternate ones of the wales of jersey stitching being formed on opposite faces of the swath;

FIG. 7 is a fragmentary plan view of the front and rear needle beds of the typical knitting machine, shown racked over or laterally shifted in accordance with the present invention to provide a knitted fabric substantially like that shown in FIG. 4;

FIG. 8 is a schematic and diagrammatic view similar to FIG. 6, showing the needle beds racked over or further laterally shifted to provide a corresponding decrease in the width of the successive pleat segments and a corresponding increase in the width of the successive fold segments; and,

FIG. 9 is a sectional and elevational view taken substantially along the line **9—9** of FIG. 7 and showing the stitch configuration of the successive wales of double-faced rib stitching providing adjacent pleat and fold segments separated by at least one or more wales of jersey stitching forming a cusp segment or fold edge.

Referring first to FIGS. 1–5 inclusive, there is shown a knit fabric, generally designated by the reference numeral **10**, which is manufactured in accordance with the present invention and has a plurality of longitudinally extending pleats P_1, P_2, P_3, etc., which are of decreasing width from the lower end to the upper end and are separated by a plurality of longitudinally extending folds F_1, F_2, F_3, which are of correspondingly increasing width. The knit fabric **10** comprises multiple swaths or sections, such as S_1, S_2, which each include plural courses or transverse lines of loops, as will be more fully described in connection with FIG. 9. Each of the swaths, S_1, S_2, etc., includes spaced first groups of wales of double-faced rib stitching providing a set of pleat segments which ultimately form the pleats P_1, P_2, P_3. Further, each of the swaths S_1, S_2 includes spaced second groups of wales of double-faced rib stitching providing a set of fold segments which ultimately provide the folds F_1, F_2, F_3. At least one wale of jersey stitching is provided intermediate and joining successive pleat and fold segments of the respective first and second groups and provide cusp segments which ultimately provide the cusps or fold lines C_1, C_2, C_3, C_4, C_5 and C_6. Alternate wales of jersey stitching are formed on opposite faces of the successive swaths S_1, S_2 such that there is a natural tendency for the folds F_1, F_2, F_3 to lie beneath successive pleats P_1,

P_2, P_3 (see FIG. 5). Specifically, the cusps or fold lines C_1, C_3, and C_5 are formed on the front face **10***a* of the fabric **10**, as seen in FIG. 1, while the cusps C_2, C_4, and C_6 are formed on the rear face **10***b* of the fabric **10**, such that when the fabric **10** is released from its stretched condition (shown for the purposes of illustration in FIGS. 1, 3, and 4) it falls into pleats (shown in FIG. 5).

The overall width of successive pairs of pleats and folds in each swath S is substantially equal, with a greater separation being provided between adjacent and alternately formed cusp segments in successive swaths S_1, S_2 such that the pleat segments are of decreasing widths and the fold segments are of increasing widths. Although the decrease in the width of the pleat segments is stepwise in successive swaths S_1, S_2, the overall appearance of successive pleats is such as to provide a substantially uniform taper for all practical intents and purposes.

In order to more fully appreciate the construction of the knit fabric **10** in accordance with the present invention to provide the tapered P_1, P_2, P_3, reference will now be made to FIGS. 6 to 9, inclusive, for a description of a typical knitting sequence in accordance with the present invention. Referring first to FIGS. 6 and 7, there is shown a schematic and diagrammatic representation of a typical section of the front and rear needle beds **12**, **14** of a conventional knitting machine, such as a flat V-bed knitting machine manufactured by Universal Machine Company. In such knitting machine, provision is inherently made for the racking or lateral displacement of the front and rear needle beds **12**, **14** relative to each other. The racking may involve maintaining the rear needle bed **14** stationary, with provision for laterally shifting the front needle bed as shown by the directional arrows in FIGS. 6 and 7; may involve maintaining the front needle bed stationary, with provision for laterally shifting the rear needle bed **14**; or may involve the shifting of both needle beds **12**, **14** relative to each other. Accordingly, in the appended claims, the reference to the shifting of the front and rear needle beds relative to each other is intended to encompass all three arrangements which are generally available for racking or laterally displacing the needle beds in a conventional knitting machine. In a typical, but nonetheless illustrative setup, as shown in FIG. 6, the needles **16** on the front needle bed **12** are arranged in successive groups each including **21** needles, with two needles between successive groups being either removed or retracted to an inoperative position. In a similar fashion, the needles **18** on the rear needle bed **14** are arranged in successive groups of 21 needles with two needles between successive groups being removed or retracted. At the needle locations where there is present both a front and rear needle, there will be formed a corresponding wale of double-faced rib stitching in accordance with the usual operation of the knitting machine. However, at the needle locations where either the front or rear needles are removed, there will be formed corresponding wales of jersey stitching. More particularly, where the needles are removed from the front needle bed, the jersey stitching will be formed at the rear face **10***b* of the knitted fabric **10**, with corresponding indentations at the front face **10***a* tending to form cusps or fold lines; and conversely, at the locations where the rear needles are removed there will be formed corresponding wales of jersey stitching at the front face **10***a* of the knitted fabric **10**, with corresponding oppositely facing indentations and cusps or fold lines. Further, in this illustrative setup, the front needle bar **12** is laterally displaced or racked over relative to the rear needle bed **14** such that the two removed or inactive needles on the front needle bed and the corresponding location of the wales of jersey stitching will be separated from the removed needles on the rear needle bed **14** and the corresponding locations of the wales of jersey stitching by one or more wales of rib stitching which ultimately will form the folds between successive pleats. For the specific example shown in FIG. 6, the group **20** of needles **16** on the front needle bed **12** opposite the removed or disabled needles on the rear needle bed **14** will provide two wales of jersey stitching on the front face **10***a* of the fabric **10** thereby providing a corresponding cusp or fold line segment (e.g., cusp segment C_1). The needle **22** on the front needle bed **12** and the corresponding needle **24** on the rear needle bed **14** will provide one wale of double-faced rib stitching and a corresponding fold segment (e.g., fold segment F_1). The group **26** of needles **18** on the rear needle bed **14** opposite the two inactive needles on the front needle bed **16** will provide two wales of jersey stitching on the rear face **10***b* of the knitted fabric **10** and a corresponding cusp segment or fold line on the rear face of the fabric (e.g., cusp or fold line segment C_2). Finally, the groups of needles **28**, **30** on the front and rear needle bed **12**, **14** respectively, will cooperate to provide a group of wales of double-face rib stitching providing a corresponding pleat segment (e.g., pleat segment P_1). The needle setup to the left and right of the described section of the front and rear needle bars **12**, **14** will repeat to form further pleat and fold segments separated by cusp segments as previously described.

With the needle setup as shown in FIG. 6, plural courses are knitted to provide the first swath or section S_1 which includes successive pleat segments P_1, P_2, P_3, etc. adjoining adjacent fold segments, such as F_1, F_2, F_3, etc. by the cusp segments such as C_1 to C_6 inclusive. When the desired number of courses are knitted in accordance with the design of the knitted fabric **10**, provision is made to rack over or laterally shift the needle beds **12**, **14** relative to each other to establish a greater separation between adjacent and alternately formed cusp segments (e.g. cusp segments C_1, C_2) such that the pleat segments P_1, P_2, P_3 etc. in the next successive swath S_2 are of decreased widths in accordance with the amount of lateral shift or racking and the fold segments F_1, F_2, F_3 are of corresponding increased widths.

In the typical, but nonetheless illustrative setup, as shown in FIG. 7 (which is on an enlarged scale as compared to FIG. 6 and shows the loop configuration of the fabric in greater detail), the needle setup on the front and rear needle beds **12**, **14** remains the same, including successive groups of twenty needles which are separated by groups of two needles which are either removed or retracted. However, the front needle bed **12** has been racked over relative to the rear needle bed **14** such that there will be provided three wales of double-faced rib stitching for the successive fold segments F_1, F_2, F_3, etc. between successive oppositely directed wales of rib stitching. For the specific example shown in FIG. 7 which will provide a knitted cross section approximating that shown in FIG. 4 in the swath S_2, the group **120** of needle **16** on the front needle bed **12** opposite the removed or disabled needles on the rear needle bed will once again provide two wales of jersey stitching on the front face **10***a* of the fabric thereby providing a corresponding cusp or fold line segment (e.g., cusp segment C_1). The group of needles **122** on the front needle bed **12** and the corresponding group of needles **124** on the rear needle bed **14** will provide three wales of double-faced rib stitching and a corresponding fold segment (e.g., hold segment S_1) which in this illustrative embodiment is two wales wider than the corresponding fold segment in the swath S_1. The group **126** of needles **18** on the rear needle bed **14** opposite the two inactive needles on the front needle bed will once again provide two wales of jersey stitching on the rear face **10***b* of the knitted fabric **10** and a corresponding cusp segment of or fold line on the rear face of the fabric (e.g., cusp or fold line segment C_2). Finally, the groups of needles

128, 130 (which are only partially shown but will be two less than the corresponding groups 28, 30 in FIG. 6 due to the corresponding increase in the width of the fold segments 122, 124) will cooperate to provide a group of wales of double-faced rib stitching providing a corresponding pleat segment (e.g. pleat segment P_1). The needle setup to the left and the right of the described section of the front and rear needle bars 12, 14 in FIG. 7 will repeat the form pleat and fold segments, separated by cusps segments as previously described. It is of course appreciated that respective pleat segments are decreased by two wales in the illustrative arrangement shown in FIG. 7, with a corresponding increase in the fold segments due to the racking over of the needle beds 12, 14 relative to each other. After the knitting of the plural courses which make up the section or swath S_2, which will usually be equal in numbers to the courses knitted in swath or section S_1, the needle beds are once again racked over relative to each other, to form a further swath or section (not shown) which will provide a corresponding stepwise decrease in the width of the successive pleat segments and a corresponding increase in the width of the successive fold segments.

For the illustrative setup shown in FIG. 8, the front needle bed 12 is racked over relative to the rear needle bed 14 to create successive fold segments F_1, F_2, F_3, etc. which are increased to six wales of double-faced rib stitching, with a corresponding decrease in the number of wales of rib stitching in the pleat segments P_1, P_2, P_3. Specifically, the group 220 of needle 16 on the front needle bed 12 opposite the removed or disabled needles on the rear needle bed 14 will provide two wales of jersey stitching on the front face 10*a* of the fabric 10 thereby providing a corresponding cusp or fold line segment (e.g. cusp segment C_1). The group of six needles 222 on the front needle bed and the corresponding group of needles 224 on the rear needle bed 214 will provide six wales of double-faced rib stitching and a corresponding fold segment (e.g. fold segment F_1). The group 226 of three needles on the rear needle bed 14 opposite the two inactive needles on the front needle bed will once again provide two wales of jersey stitching on the rear face 10*b* of the knitted fabric and a corresponding cusp segment or fold line on the rear face of the fabric (e.g., cusp or fold line segment C_2). Finally, the groups of needles 228, 230 on the front and rear needle beds 12, 14, respectively will cooperate to provide a group of wales of double-faced rib stitching providing a corresponding pleat segment (e.g., pleat segment P_1). Once again the increase in the width of the fold segments is accompanied by a corresponding decrease in the width of the pleat segments. Thus as progressive swaths or sections S_1, S_2 etc. are knitted there will be provided correspondingly decreasing pleat segments which are in end to end alignment with each other. By appropriately dimensioning the vertical or longitudinal extent of the successive swaths and the degree of racking between the formation of successive swaths, it is possible to attain a pleat which has the appearance of being uniformly tapered from one end to the other.

Referring now to FIG. 9, there is shown the setup of the front and rear needle 16, 18 for the illustrative condition of FIG. 7, with a typical piece of knitted fabric 10 depending therefrom. For the purposes of illustration, the knitted loops which appear on the front face 10*a* of the knitted fabric 10 has been illustrated by the heavy solid line while the knitted loops which appear on the rear face 10*b* have been illustrated by the light open lines. Considering the illustrative portion of the knitted fabric 10 from right to left, it will be seen that the plural wales and courses in the region of the needle groups 128, 130 are of double-faced rib stitching which will define a pleat segment, such as a pleat segment P_1. The next three wales are of single faced jersey stitching on the rear face 10*b* of the fabric 10 (the corresponding front needles

having been disabled) thus providing a fold line or cusp segment, such as the cusp segment C_3. The next group of wales is once again of double-faced rib stitching corresponding generally to the needle groups 122, 124 and provides a fold segment, such as the fold segment F_2. Since the specific formation of the respective courses and wales of the rib and jersey stitching are generally known to those skilled in the art, a detailed description of the stitch configurations are omitted in the interests of simplicity and clarity. It will suffice to point out that these well known stitching arrangements can be formed on conventional knitting machines.

From the foregoing, it will be appreciated that there has been provided in accordance with the present invention a relatively simple method for the manufacture of naturally formed graduated knitted pleats, employing essentially conventional knitting machinery with the novel and improved processing techniques in accordance with the present invention. A wide variety of patterns for the tapered pleat configurations may be manufactured in accordance with the present invention and the laterally shifting or racking over of the needle beds relative to each other may be achieved either manually, or automatically by appropriately programming the associated automatic controls of a conventional knitting machine. Although the invention has been described in connection with the use of a flat V-bed knitting machine, it will be appreciated that the invention finds application on circular knitting machines, such as the Jacquard TJ machine manufactured by Wildman-Jacquard Machine Company. By appropriate setup of the knitting machine, the stepwise decreases in the width of successive pleat segments along any one pleat may be such as to impart a visual appearance which suggests a uniformly tapered pleat from one end to the other, notwithstanding the fact that the actual reductions in width occur at successive longitudinal locations along the length of each pleat. Any lateral discontinuities which occur due to the racking over the needle beds relative to each other during the intermediate successive swaths or sections may be employed as a design feature for the garment. For example, at such successive transverse locations, the color and/or texture of the fabric may be changed such as to obscure the racking line or course.

A latitude of modification, change and substitution is intended in the foregoing disclosure, and in some instances some features of the invention will be used without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

What I claim is:

1. A knit fabric having a plurality of longitudinally extending pleats of decreasing width separated by a plurality of longitudinally extending folds comprising multiple swaths each including plural courses, each of said swaths including spaced first groups of wales of double-faced rib stitching providing a set of pleat segments, spaced second groups of wales of double-faced rib stitching providing a set of fold segments, at least one wale of jersey stitching intermediate and joining successive pleat and fold segments of said first and second groups and providing cusp segments, alternate ones of said wales of jersey stitching being formed on opposite faces of said swath such that there is a natural tendency for said set of fold segments to lie beneath said pleat segments, there being a greater separation between adjacent and alternately formed cusp segments in successive swaths such that said pleat segments are of decreasing widths and said fold segments are of increasing widths, the stepwise decrease in the width of pleat segments in successive swaths forming longitudinally extending tapered pleats.

2. A knit fabric having a plurality of longitudinally extending pleats of decreasing width separated by a plurality of longitudinally extending folds comprising multiple

swaths each including plural courses, each of said swaths including spaced first groups of wales of double-faced rib stitching providing a set of pleat segments, spaced second groups of wales of double-faced rib stitching providing a set of fold segments, at least one wale of jersey stitching intermediate and joining successive pleat and fold segments of said first and second groups and providing cusp segments, alternate ones of said wales of jersey stitching being formed on opposite faces of said swath such that there is a natural tendency for said set of fold segments to lie beneath said pleat segments, the overall width of successive pairs of pleat and fold segments in each swath being substantially equal, there being a greater separation between adjacent and alternately formed cusp segments in successive swaths such that said pleat segments are of decreasing widths and said fold segments are of increasing widths, the stepwise decrease in the width of pleat segments in successive swaths forming longitudinally extending tapered pleats.

3. In a knit fabric having a plurality of longitudinally extending natural pleats of decreasing width separately by a plurality of longitudinally extending folds of increasing width, a section of a plurality of transverse courses including a first group of longitudinal wales of double-faced rib stitching providing a pleat segment, at least one longitudinal wale of jersey stitching on one face of said section providing a first cusp segment, a second group of longitudinal wales of double-faced rib stitching providing a fold segment, and at least one longitudinal wale of jersey stitching on the other face of said section providing a second cusp segment, said cusp segments causing said fold segment to fold beneath said pleat segment, said fold segment being of lesser width than said pleat segment and being disposed beneath said pleat segment.

4. In a knit fabric having a plurality of longitudinally extending natural pleats of decreasing width separately by a plurality of longitudinally extending folds of increasing width, at least two sections each having a plurality of transverse courses and each including a first group of longitudinal wales of double-faced rib stitching providing a pleat segment, one longitudinal wale of jersey stitching on one face of each of said sections providing a first cusp segment, a second group of longitudinal wales of double-faced rib stitching providing a fold segment, and one longitudinal wale of jersey stitching on the other face of each of said sections providing a second cusp segment, said cusp segments causing said fold segment to fold beneath sail pleat segment, said fold segment being of lesser width than said pleat segment and being disposed beneath said pleat segment.

5. A knit fabric having a plurality of longitudinally extending pleats of decreasing width separated by a plurality of longitudinally extending folds comprising multiple swaths each including plural courses, each of said swaths including spaced first groups of wales of double-faced rib stitching providing a set of pleat segments, spaced second groups of wales of double-faced rib stitching providing a set of fold segments, at least one wale of jersey stitching intermediate and joining successive pleat and fold segments of said first and second groups and providing cusp segments, alternate ones of said wales of jersey stitching being formed on opposite faces of said swath such that there is a natural tendency for said set of fold segments to lie beneath said pleat segments, the overall width of successive pairs of pleat and fold segments in each swath being substantially equal, the fold segments in each of said pair being of lesser width than the pleat segment thereof, there being a greater separation between adjacent and alternately formed cusp segments in successive swaths such that said pleat segments are of decreasing widths and said fold segments are of increasing widths, the stepwise decrease in the width of pleat segments in successive swaths forming longitudinally extending tapered pleats.

References Cited in the file of this patent

UNITED STATES PATENTS

2,132,512	Villette	Oct. 11, 1938
2,201,980	Artzt et al.	May 28, 1940
2,599,168	Feldman	June 3, 1952
2,619,819	Feldman	Dec. 2, 1952
2,622,423	Feldman	Dec. 23, 1952
2,643,532	Sandri	June 30, 1953