July 28, 1942. F. D. LEECH ET AL 2,290,976

LOOPED TEXTILE FABRIC

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Fig. 1.

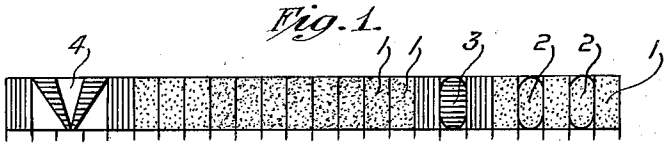
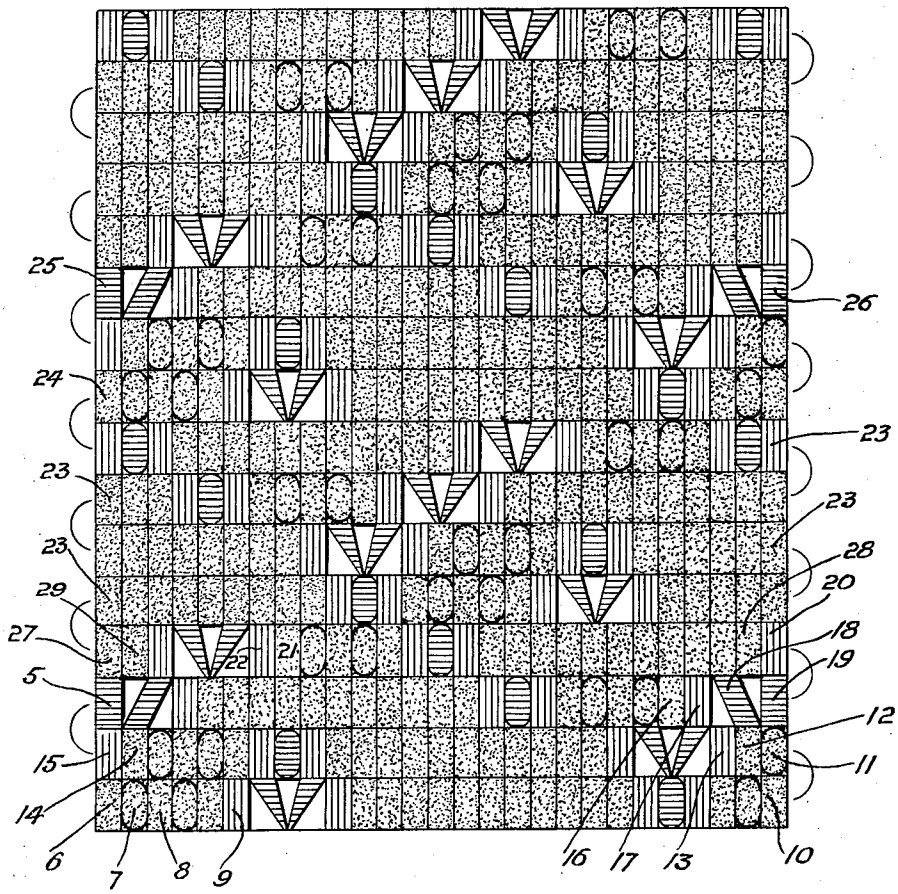


Fig. 2.



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Fig. 3.

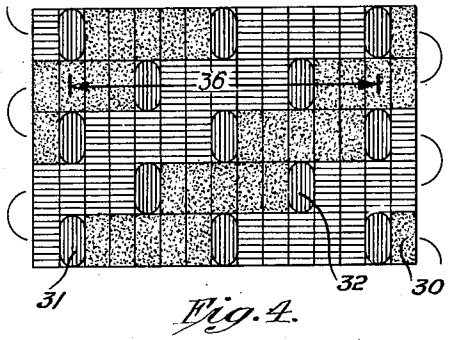


Fig. 4.

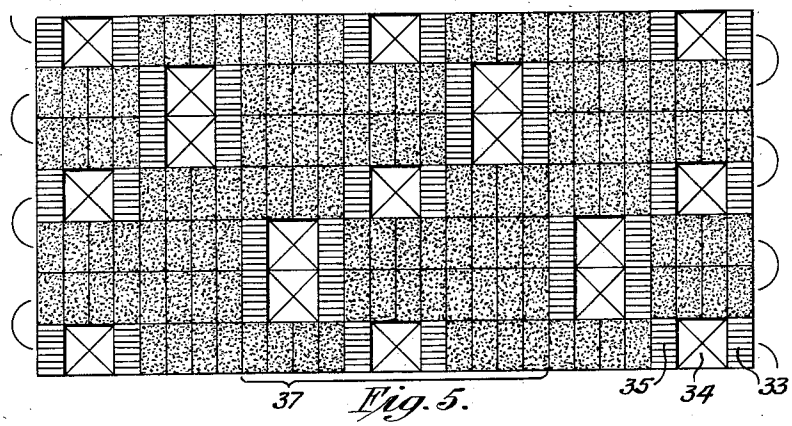
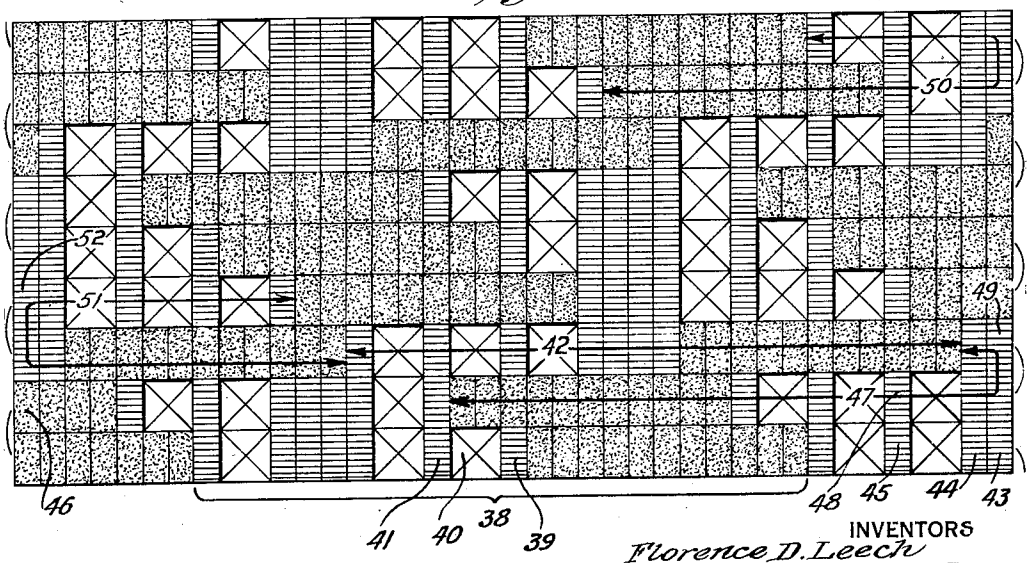


Fig. 5.



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Fig. 6.

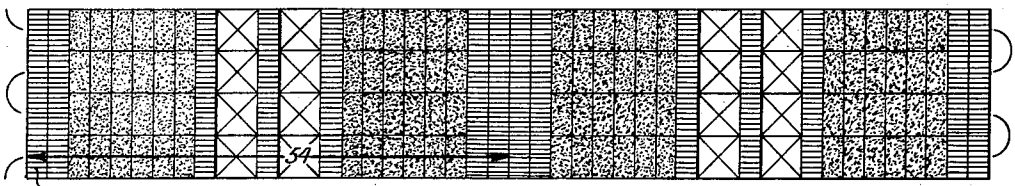


Fig. 7.

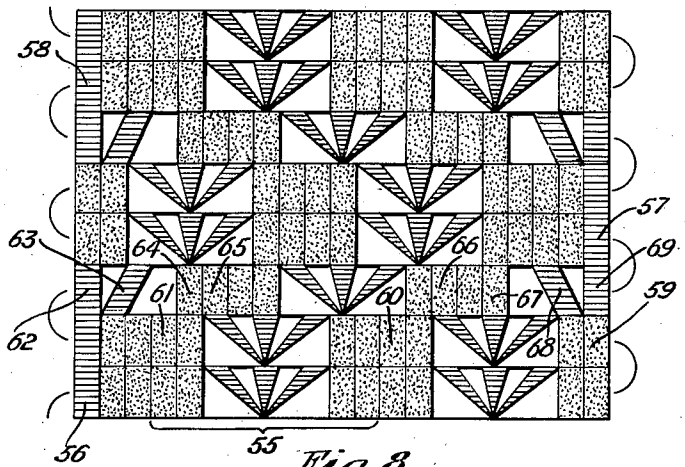
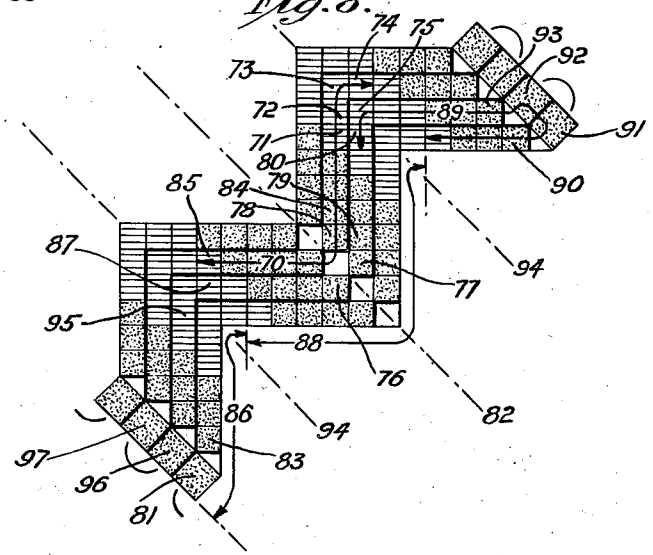


Fig. 8.



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Fig. 9.

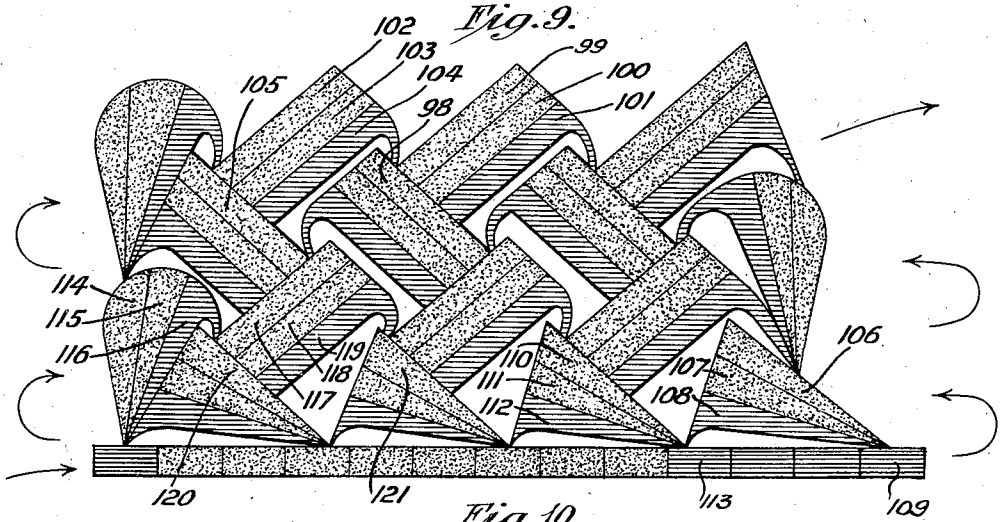


Fig. 10.

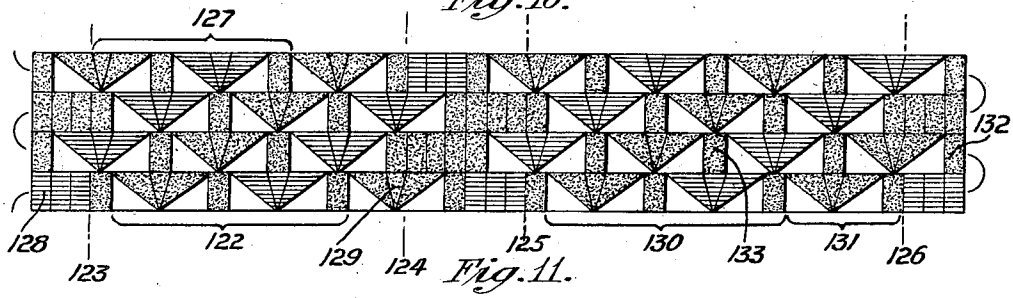
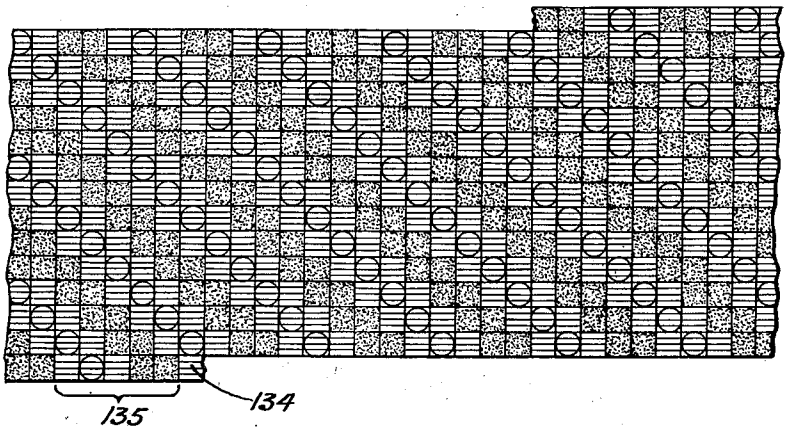


Fig. 11.



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UNITED STATES PATENT OFFICE

2,290,976

LOOPED TEXTILE FABRIC

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Application December 18, 1940, Serial No. 370,633

12 Claims. (Cl. 66—169)

This invention relates to new and useful improvements in textile fabrics and more particularly to textile fabrics knitted or crocheted from polychrome yarn.

Heretofore, fabrics have been knitted or crocheted by hand or by machine from a single polychrome yarn to form definite planned patterns but in all known instances the fabric was made up of stitches using the same length of yarn. It was thought impossible to use stitches employing varying lengths of yarn and still obtain a predetermined recognizable pattern.

In accordance with the present invention, a fabric will have a regular, recognizable and clear pattern as determined by the designer, although made up of mixed stitches which use up varying lengths of yarn or are of varying width, or both, or of stitches which are attached other than one in each consecutive stitch of the preceding row. This is accomplished by relating the sequence of the stitches to the yarn color cycle rather than to the edges of the fabric. Thus a certain pattern of stitches or cycle of stitches will become associated with a chosen color cycle of yarn, and every time the color cycle is crocheted into the fabric it will be formed into the same sequence of stitches. If it were attempted to crochet with mixed stitches a fabric of polychrome yarn by relating the stitches to the edge of the fabric and not to the yarn color cycle, then a spot of the color cycle would usually form in one part of the fabric stitches occupying a greater width than in another part of the fabric. This would usually cause an undesired irregularity of the color pattern of the fabric, which it is the object of the present invention to avoid.

The width occupied by a stitch is best measured in terms of a fundamental stitch which is used in starting the fabric, or in terms of some standard stitch such as a single crochet stitch, hereinafter designated as SC, or a double crochet stitch, hereinafter referred to as DC. One may have different color patterns in different parts of the width or length of a fabric.

A row that is used to increase or decrease the number of stitches might be assumed to correspond to the width of either the following or the preceding row. It will be considered to be of the width of the following row. This will be considered in more detail in the description of the accompanying drawings, Figs. 1–11 of which illustrate diagrammatically eleven embodiments of the invention.

First, we shall give a few definitions. A pattern unit is a sequence of certain colors of yarn formed into certain stitches, the repetition of which forms an area of fabric. Certain variations are also permissible that do not affect the general symmetry or impression. Some pattern units may run to the edge of the area and so be incomplete. When the area reaches to the edge of the fabric, a patern unit may lie in two courses, doubling back at the edge, often with slight variations in stitches.

R=the number of unit stitches in which one may express the width of pattern unit of the fabric; where the stitches making up a pattern unit are of the same width, R will be equal to the number of stitches that are formed by a color cycle.

2D=the lateral displacement between corresponding points of the pattern unit of the fabric in alternate courses, i. e., the phase displacement in alternate courses. It is considered positive when it is in the direction of the displacement that would be caused by increasing the width of the fabric. In cases where the pattern continues throughout the width of the fabric, D=the difference between the width of the fabric and a multiple of R/2.

$2S \pm n4D$=the lateral displacement between two successive courses of the center of symmetry (if any) of the pattern unit of the fabric, or between arbitrary points in the pattern unit, if the later is unsymmetrical. 2S is taken at the smallest possible value between two courses where the course above doubles back at the left to form the course below. 2S is considered positive when the center of symmetry in the course above is to the right of that in the course below. In cases where the pattern continues throughout the width of the fabric, S=the position of the center of symmetry (if any) of the pattern unit, or position of an arbitrary point thereof, relative to the left edge of the fabric.

N=the greatest common divisor of R and 2D.

A sequence of stitches of a fabric is illustrated in Fig. 1. This is crocheted from a polychrome yarn having a color cycle of red, blue, red, and white spots. 1 designates DC stitches, 2 puff stitches, 3 a bean stitch, and 4 a shell stitch. Each of the equal divisions on the under side of the bottom line represents a width that would be occupied by a chain stitch, the width of the fabric fragment illustrated being equal to twenty-four chain stitches. Note that the two DC's and two chain stitches of the shell stitch are regarded as having a width equal to only three chain stitches, although other DC's are equal to one

chain stitch each. This is customary in crocheting shell stitches. The sequence of stitches and their colors are as follows: one red DC, one two-stitch blue shell, one red DC, eleven white DC's, one red DC, one blue bean stitch, one red DC, one white DC, one white four DC puff stitch, one white DC, one white four DC puff stitch, and one white DC. The shell is made as follows: a blue DC, two blue chain stitches and a second blue DC attached in the same place, as the first one. The bean stitch is of the kind that is approximately equivalent to two DC's made in the space of one. Complex stitches such as shell stitches or puff stitches, picots, filet openings, etc., can be considered either as single independent stitches or as groups of stitches made in a certain order and attached in certain ways to each other. There is no definite law that can be set down. The shells, puffs, and bean stitches in Figs. 1 and 2 are considered as single stitches.

The stitches shown in Fig. 1 use up two complete color cycles of the yarn and constitute one unit of the fabric pattern. The complete fabric or an area of the fabric will be made up of repetitions of this unit, the pattern unit.

Figure 2 shows a fabric made up of the pattern unit of Fig. 1. There is a slight variation in certain of the pattern units as at **5**, **6**, and **11**, etc., which will be explained below.

The fabric shown is crocheted to and fro, starting from a row of chain stitches or piece of fabric already made. A flat crocheted fabric naturally starts with the bottom row, and later rows are added from bottom to top. The first stitch shown is a white chain stitch in the loop of a stitch of the previous row, and two more white chain stitches, the three chain stitches together being shown as **6**. This is a variation from the pattern unit as described in connection with Fig. 1, where the corresponding stitch is a white DC, the one just before the first puff stitch. The three chain stitches **6** occupy the same space and use the same length of yarn as a DC, and are shown in the same manner as a DC. The second stitch shown is **7**, a white DC-four puff which corresponds to the first white puff stitch in Fig. 1. Then comes a white DC, **8**, just as in Fig. 1 the white DC after the first puff stitch. Follow another puff and another white DC.

These stitches form an incomplete pattern unit, the last five stitches of a pattern unit. Now another pattern unit starts. The first stitch of the new pattern unit is **9**, a red DC. The pattern unit continues just as in Fig. 1, till the white DC, **10**, is completed. The last two stitches of the pattern unit still remain to be done. They would ordinarily be a white puff stitch followed by a white DC. The white puff stitch, however, is formed by making a white chain stitch in the loop of **10**, followed by two more white chain stitches. This group is treated together as the first DC of a four-DC puff stitch **11** which is indicated in the same manner as a DC.

The second row continues from right to left with a white DC **12** which completes the pattern unit. Stitches **9** to **12** inclusive are one pattern unit, which doubles back and lies in two rows, and has a minor variation in the stitches used (at **11**). The row continues from right to left with stitch **13**, a red DC. This starts a new pattern unit, which is perfectly regular, exactly like Fig. 1, and ends with **14**, a white DC. In the shell stitch which has the width of three chain stitches (see Fig. 1), three stitches are made one in each of the two DC's, and one around, not in, the two chain stitches. A new pattern unit starts with **15**, a red DC, with which the second row ends.

In Fig. 1 the first red DC of the pattern unit is followed by a blue two-DC shell stitch, but in Fig. 2 the pattern unit is slightly varied at **5**. After the red DC **15** comes a blue chain stitch in the loop of **15**, and two more blue chain stitches. This group (three chain stitches) is shown as **5**. Then come two blue chain stitches, shown only as a gap between **5** and the adjacent DC which are like a continuation of the three chain stitches of **5** but are not included in the designation **5**. When a DC is later made in the top of **5**, it is made in the third chain stitch. Then comes a blue DC in the top of **14**. Stitch **5**, the two blue chain stitches, and the blue DC together use up the same length of yarn and occupy the same space as a blue two-DC shell stitch. If **5** were a DC attached in the top of **14**, the two would form a shell stitch. The reason for **5** being attached in the loop of **15** instead of the top of **14** is to keep the edge of the fabric straight. The row continues from left to right, with a red DC, eleven white DC's, etc. White DC **16** (attached around the two chain stitches of the shell stitch of the second row) completes the pattern unit. The next pattern unit starts with a red DC **17**, and then a blue DC **18**, attached so as to skip one stitch (**13**) of the preceding row, i. e., attached in the top of **12**. So far this pattern unit is entirely regular according to Fig. 1. The DC **18** appears different in the drawings from the corresponding DC that is part of the shell stitch in Fig. 1, but the only difference is in the position of the adjacent blue DC **19**. Then come two blue chain stitches, indicated in both Figs. 1 and 2 as a gap between the adjacent DC's. There is a slightly variation in the second blue DC from a shell stitch, for instead of being attached in the top of **12**, making with **18** a shell stitch the blue DC **19** is attached in the top of **11**. The purpose of this is to keep the edge of the fabric straight.

Unlike Fig. 1, where the shell stitch is followed by a red DC, it is here followed by stitch **20** consisting of three red chain stitches, which together occupy the same space and use the same length of yarn as a DC. The fourth row continues from right to left like the pattern unit in Fig. 1. The white DC **28** is attached around the two chain stitches of the third row. The pattern unit ends with a white DC, **21** and the next pattern unit starts with a red DC, **22**. DC **29** is made around the two chain stitches to the right of **5** and DC **27** in the top of the last, or third, chain stitch included as part of **5**.

The fabric continues in this way, one pattern unit following consecutively after another, doubling back when the edge of the fabric is reached, alternate rows being crocheted in opposite directions, and the pattern unit being modified slightly from that shown in Fig. 1 as necessary at the edges to provide for doubling back from one row to another, e. g., in the stitches marked **23**, which are like **6** and **20**. This explains the structure of the fabric through the eighth row from the bottom. At the ninth row, starting with stitch **24**, which is like stitch **6**, the whole pattern starts to repeat, **25** being like **5**, and **26** like **19**.

The pattern unit of Fig. 1 is repeated practically unchanged to form the fabric in Fig. 2, although an incomplete pattern unit (only the last five stitches of the pattern unit) is used in the first or bottom row and several pattern units double back so that they lie partly in each of two rows. There will be minor variations in stitch

structure which do not change the width occupied by any colored spot, nor the general appearance and symmetry of the pattern. In other words, the pattern is essentially what it would be if pattern units like Fig. 1 were used as building blocks bodily placed one above or alongside the other, and cut so as to double back and lie in two rows. The small variations of stitch structure merely help to produce this general result without cutting the yarn and without disturbing the straight edges of the fabric.

It will be noticed that a regular, recognizable pattern is obtained, although the fabric uses several different kinds of stitches, some of which (the shell stitches) are of different width than others, and some of which (the bean and puff stitches) use different lengths of yarn than others. In this pattern R=24, 2D=6, 2S=3 for the center of the shell stitch. The pattern formed by the shell stitches is a broken diagonal pattern, i. e., a pattern of broken diagonal (from upper right to lower left) stripes, with some single spots at intervals between these stripes. The red and blue spots as contrasted with the white form a figure like a V on its side, with a dot in the opening, this figure being repeated in a staggered or diaper spacing throughout the fabric.

Figure 3 shows a fabric made of a pattern unit corresponding in width to twelve chain stitches. The pattern unit is as follows: A red puff stitch, five blue DC's, a red puff stitch, and five white DC's. The fabric shown is assumed to be added to a starting row or another fabric already made.

Starting at the lower right-hand corner of the drawing, the first stitch **30**, is the last stitch of a pattern unit. Instead of being a DC as would be expected, it consists of a white chain stitch in the loop of the last stitch of the preceding row, and two more white chain stitches, all together occupying the same space and using the same length of yarn as a DC. In this and the following drawings, whenever a stitch that would be, according to the pattern unit, a DC, comes at the beginning of a row, it will be formed of three chain stitches in the loop of the last stitch. After **30** come from right to left a red puff stitch, five blue DC's, a red puff, and five white DC's, all together forming a pattern unit.

A new pattern unit starts with **31**, a red puff stitch, followed by a blue DC, ending the row and three blue chain stitches starting the next row. Then, from left to right, three blue DC's, a red puff, five white DC's, completing a pattern unit. The next pattern unit starts with **32**, a red puff stitch. Four blue DC's end the second row.

Three blue chain stitches start the third row and are followed by a red puff stitch and five white DC's completing the pattern unit.

Every pattern unit is perfectly regular, except of course the three chain stitches instead of a DC at the start of each row. This is an instance where the width of all stitches is the same, but the length of yarn used in the puff stitches is different from that used in the DC's. The pattern is a diagonal with R=12, 2D=6, and 2S=3. 2S is measured from the center of symmetry of the pattern unit. For the purpose of finding the value of 2S, one may either arbitrarily choose the center of the white or blue spot (both give 2S=3) as one must if one considers the pattern unit we have described, or choose a different pattern unit, a symmetrical one. This could be the pattern unit indicated by the double-headed arrow **36**, consisting of one-half a white DC, then two more white DC's, a red puff stitch, five blue DC's, another red puff stitch, and two and one-half more white DC's. This has a center of symmetry in the middle of the central blue DC. Another pattern unit could be chosen with the center of symmetry in the middle of the central white DC. Both give the value 2S=3.

Fig. 4 shows a fabric having DC stitches and filet openings. The pattern unit, for example **37** (which should be traced from right to left) consists of four white DC's, a blue DC, a blue filet opening bridged by two chain stitches, another blue DC, and four white DC's. Each DC is of a width equal to one chain stitch and the filet openings are of a width equal to two chain stitches. Except for having three chain stitches instead of a DC at the start of each row, the pattern unit repeats exactly without variation.

The fabric shown is assumed to be added to a starting row or to a piece of fabric already crocheted. The first stitch is a blue chain stitch in the loop of the last stitch of the preceding row, and two more blue chain stitches, all together forming the stitch **33**. Next to the left come two blue chain stitches made as a continuation of the three chain stitches of **33**, but not included in the designation **33**. A stitch is made in the top of **33** will be made in the third chain stitch. The two chain stitches following **33** are not shown but they extend across the top of the open space **34** shown with a cross. After the two blue chain stitches come, from right to left, a blue DC, **35**, then four white DC's. All the stitches up to this point form the last part of a pattern unit. **33**, the three chain stitches at the start of the row, is a variation from the regular pattern unit, for the first stitch of the pattern unit throughout most of the fabric is a DC. The first complete pattern unit is **37**. The fabric continues with the pattern unit repeating without variation except that in starting each new row three chain stitches are used instead of a DC.

The pattern formed is a herringbone pattern of blue on a white ground, with filet openings in the middle of the blue part of the pattern. R=12, 2D=4. $2S \pm n4D = 8$ or -8. Taking S at the smallest possible value, 2S=0, the pattern unit being symmetrical.

Fig. 5 shows a somewhat similar fabric, also having DC's and filet openings and having a pattern unit, but with more variations of the pattern unit.

A pattern unit is indicated by the bracket **38** (which should be followed from right to left), consists of eleven white DC's, a blue DC **39**, a blue filet opening **40**, two chain stitches in width, a blue DC **41**, a blue filet opening, four blue DC's, a blue filet opening, and a blue DC. The group of four blue DC's, however, is interchanged with one of the single blue DC's in several of the pattern units, for example the pattern unit indicated by the double-headed arrow **42**, as will be explained below.

The first stitch is a blue chain-stitch in the loop of the last stitch of the preceding row, and two more blue chain stitches, together shown as **43**. This is the usual stitch used instead of a DC at the start of a row. Then from right to left come a blue DC **44**, two blue chain stitches, then a blue DC **45** attached so as to skip a width of the preceding row equal to two chain stitches. The gap left between **44** and **45** is a filet opening, and is shown as a white square with a diagonal cross in it. After **45** comes another filet opening and then another blue DC. The stitches described so far form the last few stitches of a pat-

tern unit slightly modified from the regular pattern unit such as **38**. The exact nature of this modification will be most easily understood by comparing with the similar pattern unit **50** that will be described later. Next comes a regular pattern unit **38**, then another lying partly in the first row and partly in the second, and regular except for the usual stitch **46** instead of a DC for the first stitch of a row. Then another pattern unit in which the regular pattern unit **38** has been modified so that one DC **48** instead of four DC's is made after the second filet opening formed by the blue spot, and the equivalent of four DC's (i. e., first two DC's, then three chain stitches together, **49**, then another DC) are made after the third filet opening formed by the blue spot. The purpose of this variation from the regular pattern unit such as **38** is to prevent a filet opening falling at the edge of the fabric.

Next comes a pattern unit **42**, in which the four DC's come at the beginning of the blue spot, before the first filet opening, and a single DC is used after the second filet opening. This variation is purely esthetic, and unessential. The pattern unit could be made like **38** if desired.

Then comes a pattern unit **51** similar to the last one except, of course, the usual stitch **52** instead of a DC at the start of a row. The purpose of interchanging the positions of the four DC's and the single DC is again to prevent a filet opening falling at the edge of the fabric.

The pattern unit **50** in the last two rows has the four DC's just after the first filet opening, but with the usual stitch instead of a DC at the start of the last row. The stitches of the last row are exactly like the first row.

The variations in the pattern unit do not change the width occupied by the blue spot of the yarn but only the relative positions of DC's and filet openings all formed from, and included within, one single blue spot. The white spots form a broken diagonal pattern, and the blue DC's in combination with the filet openings also made from the blue yarn, form a broken diagonal pattern, which is not altered by the changes in the relative positions of the DC's and filet openings. The general impression and general symmetry of the fabric pattern is not changed. The purpose of these variations in the pattern unit is partly to prevent filet openings in rows one above the other, making for a neater looking fabric.

The value of R in this fabric is 25, 2D=6, 2S=−3 for the center of either the blue or white spots. These R, D, and S values give a broken diagonal pattern for either the blue or the white spots. The pattern unit being unsymmetrical, the center of the blue or the white spot is an arbitrarily chosen point in the pattern unit for determining the S value.

Fig. 6 shows another fabric containing filet openings and DC's but in which the spatial arrangement of various stitches is simply related both to the edges of the fabric and to the color cycle of the yarn, since the fabric width is an exact multiple of the pattern unit. The pattern unit is illustrated at **54**.

The first stitch is **53**, the usual stitch used instead of a DC at the start of a row. All pattern units are regular, except the variation of the stitch at the start of the row. The pattern consists of vertical stripes, with vertical rows of filet openings. R=23, 2D=0, and 2S=0.

Fig. 7 shows a fabric somewhat similar to Fig. 1. The pattern unit, one of which is indicated by the bracket **55**, consists of two white DC's, a blue three-DC shell stitch, and two more white DC's. The shell stitch corresponds to a width of five chain stitches and is made of a blue DC, a blue chain stitch, another blue DC, a second blue chain stitch, and a third blue DC, all three DC's attached in the same place, the center of the five-chain stitch width of the whole shell. A two-chain stitch width of the preceding row is, therefore, skipped between the attachment of the shell and those of the white DC's at the two sides. Starting with the first stitch **56**, which comprises three blue chain stitches instead of a DC stitch to start the row, the next two stitches are two white DC's bringing one to the bracket **55**. These three stitches are the last part of a pattern unit, with the shell stitch modified. The modification will be most easily made clear by comparison with the fourth row, starting with stitch **57** and the seventh row, starting with stitch **58**. These will be explained below.

After the first three stitches comes the pattern unit **55**. Then another pattern unit, completing the first row. The first stitch of the second row, **59**, contains three chain stitches instead of a DC. It starts a new pattern unit which ends with the DC **60** followed by another pattern unit ending with the DC **61**.

The next two stitches are white DC's, the first two of a new pattern unit. Then, instead of a blue three-DC shell stitch, there is the following variation: First, ending the second row, a blue DC. Then, starting the third row, three blue chain stitches designated together as stitch **62**, then another chain stitch not included in **62**, but shown as a gap between **62** and **63**. In making the succeeding, fourth row, the third chain just mentioned will be used as the top of stitch **62**, the fourth chain, just mentioned, will be used as the next stitch in width, and the DC **63** will be used as the third stitch. After the odd (the fourth) chain stitch comes the DC **63**. The three stitches **62**, the chain stitch, and **63**, in that order, occupy a width of three chain stitches. Then comes another chain stitch, shown as a gap one chain stitch in width between **63** and **64**. The whole group, from and including the last (blue) DC of the second row, then the stitch **62**, then the chain stitch, then **63** and finally the chain stitch (but not including the DC **64**), together use up the blue spot and are a variation of the shell stitch that is in the regular pattern unit. Together this group of stitches occupies five chain stitches in width (one chain stitch in width in the second row, and four in the third row), as would be the regular shell stitch. The purpose of the variation is to preserve the straightness of the edge of the fabric. The DC **64** and the next DC **65** complete the pattern unit.

Then comes another pattern unit, ending with the DC **66**.

The next pattern unit, starting with the white DC next after **66**, has the shell stitch modified as follows: After the white DC **67** comes a blue chain stitch between **67** and **68**, then a blue DC **68**, then another blue chain stitch between **68** and **69**, then the blue DC **69**, ending the row, then the three blue chain stitches **57**, instead of a DC, starting the fourth row. The whole group, from and including the blue chain stitch between **67** and **68**, and up to and including the three chain stitches **57**, uses up the same length of yarn (the whole blue spot) and occupies the same width (five chain stitches) as the shell stitch that is in the regular pattern unit. The

variation is for the purpose of keeping the edge of the fabric straight. The stitch 57 and the next two white DC's, completing the pattern unit, are the same as the stitch 56 and its following two white DC's in the first row. So are the stitch 58 and the following two white DC's in the seventh row. R, the width in chain stitches of the pattern unit, is 9. 2D=13 and 2S=0. This gives a herringbone pattern.

Fig. 8 shows a fabric of SC stitches. All stitches are the same width and use equal lengths of yarn, but there is a difference between them in their places of attachment in the preceding row. Previous to the present invention, fabrics have been knitted or crocheted from polychrome yarn to produce regular planned patterns, but all stitches have been of equal width and used equal lengths of yarn, and been attached consecutively in the consecutive stitches of the preceding row. In Figs. 1–7 the fabrics shown have stitches using unequal lengths of yarn and, except in Fig. 3, have stitches of unequal widths. Figs. 8 and 9 illustrate fabrics which may be considered as having all stitches of equal width and using equal lengths of yarn, but varying in their places of attachment. They also, like the fabrics in the preceding drawings, are made to give regular recognizable patterns by utilizing a pattern unit.

The pattern unit in Fig. 8 (one of which is indicated by the double-headed arrow 70) consists of a blue SC 85 and four white SC's consecutively attached in consecutive SC's of the preceding row. Then one white SC 78 attached so as to skip two SC's 76 and 77 of the preceding row, and attached in the third 79. This is followed by three more white SC's in consecutive SC's of the preceding row, then one blue SC 71 also attached consecutively (i. e., in 80), and three SC's 72, 73, 74 attached in a single SC 75 of the preceding row. This pattern unit involves a decreasing width of fabric at the line 82, and an increasing width of fabric at the line 94. In other words, two stitches are dropped at line 82, and two stitches are inserted at line 94. In the drawings 78 represents a stitch attached in the top of 79, 71 represents a stitch in the top of 80, and 85 represents a stitch in the top of 87.

The first stitch 81, consists of two white chain stitches in the loop of the last stitch of the preceding row. Then comes 83, a white SC attached so as to skip one SC width (presumably one stitch) of the preceding row, being attached in the second stitch from one in whose loop 81 was made. 83 corresponds to 84 in the pattern unit 70, and the following stitches included in the double-ended arrow 86 are the same as in the pattern unit 70. 86 forms the last part of a pattern unit. It is slightly irregular and will be referred to again. Next comes the pattern unit 88, which is exactly like 70, then the pattern unit indicated by the double-headed arrow 86 are the same as in the pattern unit 70. 86 forms the last part of a pattern unit. It is slightly irregular and will be referred to again. Next comes the pattern unit 88, which is exactly like 70, then the pattern unit indicated by the double-headed arrow 89. The first four stitches of 89 are a blue SC and four white SC's (ending with 90) exactly like the first four stitches of 70 and 88.

The next stitch 91 is a white SC attached in the preceding row so as to skip one stitch, being attached in the second stitch from the one in which 90 is attached. The next stitch, 92, is two white chain stitches in the loop of 91, exactly like 81. The next is 93, a white SC attached in the first row so as to skip one stitch, 90, of the last row, leaving it with nothing attached in it. 93 is exactly like 83 and corresponds to 84 in the pattern unit 70.

The rest of pattern unit 89 is regular, and is exactly like pattern unit 70, but, of course, going from right to left.

Pattern unit 89 differs from pattern unit 70 in the following way: In forming pattern unit 70, two stitches, 76 and 77 of the preceding row, are dropped between the 5th and 6th stitches of the pattern unit. In pattern unit 89 one stitch is dropped between the 4th and 5th stitches, i. e., between 90 and 91, and one stitch is dropped between the 6th and 7th stitches, i. e., between 92 and 93 one stitch, 90, of the first row is dropped. Pattern units 89 and 70 are of the same total width, and the same width for each spot, and drop the same number of stitches but in slightly different places in the pattern unit. A further variation is in the use of two chain stitches instead of an SC, in the loop of 91 instead of in the top of 91. This is the regular way of doubling back in crocheting planned patterns with polychrome yarn using SC's.

After pattern unit 89 comes a pattern unit exactly like 70, though of course going from right to left instead of from left to right, with stitch 76 corresponding to 78, stitch 87 corresponding to 72, and stitch 95 corresponding to 74, the last stitch of the pattern unit.

After stitch 95 comes another pattern unit exactly like 89, doubling back at the edge of the fabric, stitches 96 and 97 corresponding to 91 and 92, and the pattern unit ending (going from left to right) just to the left of 85. Then comes pattern unit 70, then another like 89, and so on.

In order to determine R, it is necessary to determine the width occupied by each stitch. Along the line 82 and the two edges of the fabric the rows are decreasing in width going from bottom to top, while in another part of the width of the rows, i. e., along the lines 94, the rows are increasing in width. The three SC's attached in one place (as 72, 73, 74) might be considered to be of the width of one SC, which is the width which they occupy along the top of the preceding row, or of the width of three SC's, which is the width they occupy along the bottom of the succeeding row. It does not seem reasonable to consider 72, 73, and 74 as occupying any width greater than three SC's of width. According to the rule that in case of doubt, the width is determined by the succeeding row rather than the preceding row, these three stitches 72, 73, 74 will be considered to be of the width of three SC's rather than one. Similarly, along the line 82 each two SC's (such as 76 and 77) could be considered to be of the width of four, by comparison with the preceding row, or of the width of two (or possibly none) by comparison with the later row. It seems unreasonable to say that these two stitches have no width, and we will consider them of the width of two, by comparison with the succeeding rather than the preceding row. The total width of R then equals 13, which is also the number of SC's used in forming the pattern unit.

2D has no value, since the lateral displacement of the colored spots varies in different parts of the width of the row. 2S also has no value. Alternatively the group of three SC's attached in one (such as 72, 73, 74) can be considered to-

gether as a single stitch, comparable to a shell stitch, and the fabrics, like Figs. 1–7, have a pattern unit containing stitches of unequal width, using unequal lengths of yarn.

It is the use of a pattern unit which makes it possible to design the fabric so as to have a regular pattern. In the usual chevron fabric, for example, the number of stitches in the slope 75—93 is made equal to the number in the slope 75—77. In the present fabric there is one less stitch in 75—93. This in order that the pattern unit 89 and those like it be essentially like 70 and those like it. It should occupy the same width for each spot as 70, and it should as closely as possible duplicate 70 in sequence of stitches, and places of attachment. An attempt to make a chevron fabric in the usual way, with the number of stitches in the two slopes equal, especially when the fabric is made wider (more points in the chevron) will illustrate the irregularity which results from designing a fabric with mixed stitches without using a pattern unit. It is one result that might naturally be obtained if no pattern unit were used.

Fig. 9 shows a fabric of DC's and of stitches comprising a slip stitch and three chain stitches which occupy the same width and use the same length of yarn as a DC. As in Fig. 8, there is a difference between the stitches in their places of attachment, for they are not attached consecutively in consecutive stitches of the preceding row.

The fabric is assumed to be crocheted from a starting row of chain stitches shown in the drawings, and made from the same polychrome yarn.

The pattern unit (one of which is formed by the stitches 99, 100, 101) consists of a white slip stitch and three white chain stitches such as are shown together as the single stitch 99, then a white DC such as 100, and then a blue DC such as 101, all this group of stitches being attached in the same place (i. e., around a stitch such as 98). Moreover, the attachments of all such groups of three stitches in all pattern units are in similar places in the pattern units of the preceding row, that is, always around the first stitch of the pattern unit of the preceding row. The width occupied by a pattern unit will be seen by comparison with the drawing to correspond to three chain stitches in the starting row. The pattern unit can therefore be described as a white slip stitch and three white chain stitches, a white DC, and a blue DC, all attached in the same place and at a distance equal to three chain stitches from the place of attachment of the last pattern unit. When the attachment is made to a chain stitch of the starting chain, it is made in the top of the stitch. When it is made to another pattern unit it is made around the first stitch.

The fabric starts with a blue stitch at the lower left hand corner. Then come eight white chain stitches (using up the white spot), then four blue chain stitches (using up the blue spot). The first of the four blue ones is 113 and the last 109. The pattern then begins with the first pattern unit 106, 107, 108. The 106 which is slightly modified and consists of three white chain stitches. 107 is a white DC, 108 a blue DC and all are attached in the chain stitch 109 of the starting row. The second pattern unit is 110, 111, 112. 110 is a white slip stitch and three white chain stitches, 111 is a white DC, 112 is a blue DC and all are attached in the third chain stitch 113, counting from the end of the starting chain. The two chain stitches 109 and 113 are at a distance from each other equal to three chain stitches, i. e., there are two chain stitches between them. The pattern unit repeats regularly till the pattern unit 114, 115, 116, has been made in the first chain stitch of the starting chain and it may be considered as lying partly in the first row and partly in the second but it contains no variations from the regular pattern. The next pattern unit 117, 118, 119 is attached around the stitch 120 which is the first stitch of a pattern unit in the first row. This place of attachment is irregular in its relation to the place of attachment of the preceding pattern unit 114, 115, 116. The next pattern unit after 117, 118, 119, is attached around 121 and is perfectly regular. The slight variation from the regular rule of the place of attachment of 117, 118, 119 in relation to the place of attachment of 114, 115, 116, is in order to make possible doubling back at the edge of the fabric. It does not change the general symmetry or general impression of the fabric from what it would be if the pattern units could be used as building blocks, and cut and place one above another. Alternatively, if the variation at the edges is considered to affect the general symmetry or impression of the pattern, the fabric may be considered to have a patterned area in the middle composed of a repetition of the pattern unit, and at the edges to have a different pattern.

The fabric of Fig. 9, with the same variation taking place at the beginning of each row, is an ordinary three-DC side shell fabric. Alternatively, each pattern unit can be considered as a single side shell stitch and the coloring of each stitch will be the same as that of every other stitch. Considered this way, therefore, the color pattern cannot be planned by stitches. It is only by considering the three stitches of each group separately as combining to form a pattern unit that the color effect can be planned.

In this fabric, R equals 3 (chain stitches), 2D equals 0, for the pattern units correspond exactly in lateral position in alternate rows, making the pattern a vertical or zig-zag, 2S is indeterminate, for there is no clearly recognizable correspondence by which to measure the lateral displacement of any one colored spot in relation to the row above or below.

Fig. 10 shows a fabric having in each of two areas a pattern made up of the repetition of a pattern unit containing shell stitches and DC's, and having in other areas than these two a different arrangement of stitches, e. g., a strip at each edge and one in the middle.

The pattern unit, one of which is indicated by the bracket 122, consists of a white three-DC shell stitch, a white DC, a blue three-DC shell stitch, and another white DC. The shell stitches are each made up simply of three DC stitches attached in the same place. The width to be skipped between the attachment of each shell stitch and the attachments of the single DC's on each side of it is whatever width was skipped in making the first row. A suitable width would be two chain stitches of width (assuming the fabric is crocheted from a starting chain). An area included between the dotted lines 123 and 124, and another between the dotted lines 125 and 126, is made up entirely of repetitions of this pattern unit and when the pattern units run to the edge of the patterned area of incomplete pattern units as indicated by the bracket 127.

The remaining areas, the two edges of the fab-

ric and the area between dotted lines 124 and 125, are at least partly not composed of pattern units.

The exact stitch structure of the fabric is as follows: the first stitch 128 is three blue chain stitches made in the top of a stitch of the preceding row. Then come two blue DC's and one white DC, the last stitch of a pattern unit, in the tops of consecutive stitches of the preceding row. The new pattern unit 122 starts with a white three-DC shell stitch, attached in the preceding row so as to skip two chain stitches of width of the preceding row. Then a white DC attached so as to skip two more chain stitches of width of the preceding row, followed by another similar shell stitch of blue, and finally another similar white DC completes the pattern unit 122. The next stitch is a similar white shell 129, part of which falls within the area 123—124, beginning an incomplete pattern unit like 127 part of which falls outside the area 123—124. After 129 comes a white DC, attached so as to skip two chain stitches of width of the preceding row, then three blue DC's in consecutive one-chain stitch widths of the preceding row. Within the area 125—126, there will be a white DC which is an incomplete pattern unit like 127. A regular pattern unit 130 follows, and another incomplete pattern unit 131, then, outside the area 125—126, from 126 to the edge of the fabric, three blue DC's in consecutive one-chain stitch widths of the preceding row, the three blue DC's completing the first row of the fabric.

The second row starts with three white chain stitches 132 in the loop of the last DC of the preceding row followed by a white shell stitch attached so as to skip two DC's of the preceding row. This shell stitch falls partly within the area 125—126 which, together with the following stitches up to and including 133, forms an incomplete pattern unit like 127. The fabric continues in this way, with shell stitches and DC's as indicated in the drawings, except that the first stitch of each row consists of three chain stitches.

Because the two areas 123—124, and 125—126 are made up of repetitions of the pattern unit or when the pattern units run to the edges of these areas, of incomplete pattern units, it has been possible to make a regular diagonal pattern within these areas. R equals 12 chain stitches in width, 2D equals 6, 2S equals 3 for the center of either the white or the blue spot. If desired, the pattern unit can be chosen as ½ blue shell stitch, 1 white DC, 1 white shell stitch, another white DC, and another ½ blue shell stitch, and 2S equals 3 for the center of symmetry.

Fig. 11 shows a portion of a tubular knitted fabric having a pattern unit. The stitches shown as squares are knitting stitches. The stitches shown as squares with circles in them are special (as will be described below) stitches. All these stitches are of the same width, but the special stitches use a different length of yarn than the others. The fabric is knitted spirally from the bottom up and, therefore, the rows go in the same direction, from right to left, a blue knitting stitch 134 being the first stitch shown.

To make the special stitch, knit two stitches in next stitch of preceding row, knitting one stitch on front thread and one stitch on back thread of stitch without slipping the said stitch of the preceding row off the needle, thus making two loops on the right hand needle. Now slip the said loop of the preceding row off the needle on which it was which we will call the left-hand needle. Now pass the first-made of the two loops on the right-hand needle over the last-made of the two loops on the right-hand needle and slip this first loop off the needle, it now being held by the last-made loop. The whole structure of yarn now holding the loop of the preceding row, and held by the last loop now on the right-hand needle, comprises the special stitch the last loop now on the right-hand needle being included as part of the special stitch. This special stitch occupies the same space in the fabric as a regular knitting stitch, but uses a greater length of yarn.

The pattern unit is indicated by the bracket 135 and consists of two white knitting stitches, a blue knitting stitch, a blue special stitch, and another blue knitting stitch. All the pattern unit throughout, and having a circumference equal to an exact multiple of pattern units, less the width of just one knitting stitch in the whole circumference, will give the pattern shown.

In the claims, the fabrics formed will be described as "looped" and the method of forming the fabric as "looping" to define knitted and crocheted fabrics and the method of knitting and crocheting as distinguished from woven fabrics and the method of weaving.

What is claimed is:

1. A fabric looped from a single polychrome yarn made up of mixed stitches using up varying lengths of yarn, and which has a predetermined recognizable color pattern.

2. A fabric looped from a single polychrome yarn made up of mixed stitches of varying widths, and which has a predetermined recognizable color pattern.

3. A fabric looped from a single polychrome yarn made up of mixed stitches of varying widths and using up varying lengths of yarn, and which has a predetermined recognizable color pattern.

4. A fabric according to claim 1, and in which each color cycle of the yarn is formed into the same sequence of stitches.

5. A fabric looped from a single polychrome yarn and having a predetermined recognizable color pattern and in which some but less than all the stitches in a row are interlinked with stitches of the succeeding row.

6. A fabric looped from a single polychrome yarn and having a predetermined recognizable color pattern, and in which a plurality of stitches in one row are attached to a single stitch of the preceding row.

7. A fabric looped from polychrome yarn and made up of a plurality of substantially like pattern units containing mixed stitches.

8. A fabric looped from polychrome yarn, and made up of a plurality of substantially like pattern units containing stitches attached other than one in each consecutive stitch of the preceding rows.

9. A fabric looped from polychrome yarn, and made up of a plurality of substantially like pattern units containing a plurality of stitches attached in a single stitch of the preceding rows.

10. The method of looping a fabric from polychrome yarn with mixed stitches but having a predetermined recognizable color pattern, which comprises the following steps: predetermining the color of the yarn of which each stitch will be formed, and relating the sequence of stitches to the yarn color cycle.

11. The method of looping a fabric from polychrome yarn with mixed stitches but having a predetermined recognizable color pattern, which comprises the following steps: predetermining the color of the yarn of which each stitch will

be formed, relating the sequence of stitches to the yarn color cycle, and predetermining in each row of stitches the position relative to the edge of the fabric of the center of symmetry of the sequence of colored stitches repeated throughout the width of the fabric.

12. The method of looping a fabric from polychrome yarn with mixed stitches but having a predetermined recognizable color pattern, which comprises the following steps: predetermining the color of the yarn of which each stitch will be formed, relating the sequence of stitches to the yarn color cycle, and predetermining in each row of stitches the position relative to the edge of the fabric of an arbitrary point in the sequence of colored stitches repeated throughout the width of the fabric.

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