WOOL, COTTON AND SILK DESIGNING AND FABRIC STRUCTURE FOR HARNESS WORK.

Lesson 2.

Our foundation weaves: The interlacing of warp and filling, *i. e.*, the different weaves at the disposal of the textile designer can be divided into the following three (3) distinct main divisions: (a) the plain weave, (b) the twills, and (c) the satins; these three divisions of weaves being the foundation for all the other subdivisions of weaves, technically known as "derivative or combination weaves."

The repeat or unit of a weave. This is a most important item to be mastered by the student; by it being meant that a perfect connection or joining in the fabric must consist between the first and the last thread in the repeat of the weave, both warp and filling ways, in order that no matter where in the fabric the interlacing of warp and filling is taken into consideration, it always will represent a proper duplicate of the unit or repeat of the weave, although a different place for starting the weave, as given in its plan, might have to be taken into consideration. In order to master the subject, it will be advisable for the student to always paint, for the first, at least, two or more repeats, each way, of every weave he will come in contact with, and when any imperfect joining, *i. e.*, imperfect connecting of the starting and ending point of said weave will be readily noticed by the student.

The plain or cotton weave. The same, as indicated by its name, is the most simple weave, requiring for its repeat 2 warp threads and 2 picks, or in other words, the lowest number of warp threads and picks possible to call for; and of which one or the other thread of either system is alternately up or down, with each change of threads in the other system. In order to simplify this weave to the student, diagrams Figs. 10, 11 and 12 are given, of which Fig. 10 shows us the plain weave executed on 16 warp threads and 12 picks, *i. e.*, 8 repeats of it warp ways and 6 repeats filling ways. Fig. 11 shows a corresponding portion of a woven fabric executed with this weave; the lines between weave and fabric structure, being given to connect the corresponding warp threads between both.

Examining fabric sketch Fig. 11, will show more in detail that the plain weave produces a very firm interlacing of warp and filling in the fabric, in fact the most thorough interlacing of warp and filling threads possible; in turn resulting in what we might term the strongest possible fabric to be produced with a certain number of warp threads and picks per inch, as each thread, by reason of its interlacing, supports the others to the utmost. This frequent interlacing of warp and filling will at the same time impart to the fabric a more or less perforated character, said perforations being regulated by the counts of the yarn used, as well as the twist imparted to the yarn; for the reason that the heavier in counts the threads are, the larger the perforations will be, and that the softer the twist, the less prominent the perforations; again, the perforations will be reduced by employing a twist for warp and filling which, when the threads are interlaced in the fabric, runs in the same direction.

Fig. 12 shows a section of a fabric interlaced with this plain weave. The warp threads are shown in full black, and in connection with the filling all the uneven number of picks are shown shaded and all the even number of picks in outline.

The first move towards figuring a fabric constucted with the plain weave is made by varying the thickness of the threads in the warp or filling, or in both systems at the same time; for example, in "repp" cloths as used

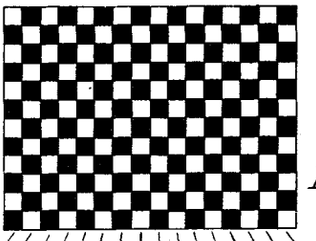


Fig. 10

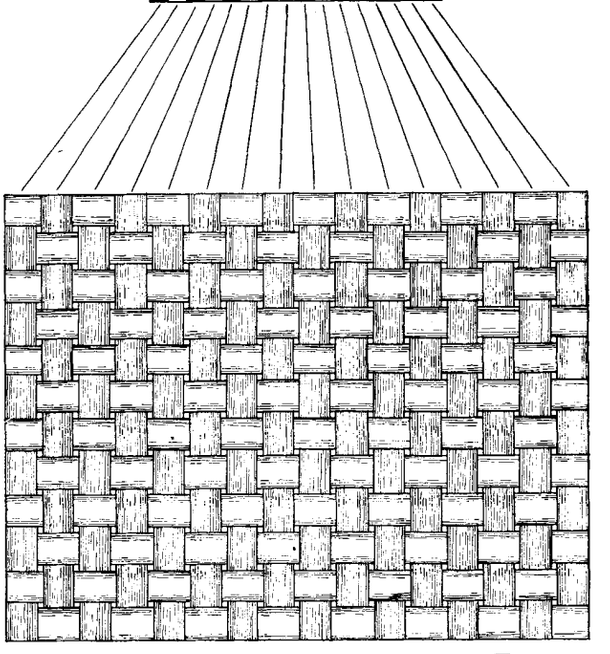


Fig. 11

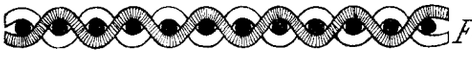


Fig. 12

Fig. 13

for ladies' dress goods, and also for decorative purposes. In these fabrics either one kind of warp and two kinds of filling (one pick heavy, one pick light); or two kinds of warp (one thread heavy to alternate with one thread light) and the before mentioned two kinds of filling are used. Fig. 13 shows the section of such a repp fabric, one system of the threads, either the warp or the filling (in this case the warp) being shown in full black, the other system of threads, either warp or filling (the filling in this case) being shown one thread shaded, the other in outline. These changes

of heavy and light threads are also used for forming borders, as observed in some cambric handkerchiefs or similar fabrics.

Twills. This is the second division of the foundation weaves, and differs from the plain weave in that warp and filling do not interlace alternately, but that either thread rests, according to the twill weave used, for one, two, three or more threads in succession, either on face or back of the structure, before changing onto the other side.

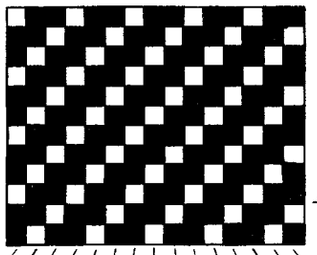


Fig. 14

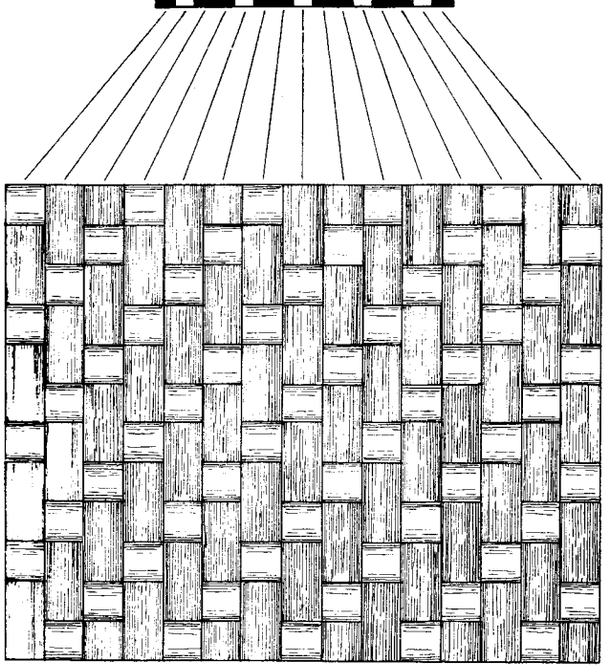


Fig. 15

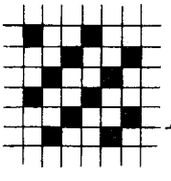


Fig. 17

Fig. 16

The rule for constructing twills is thus: After indicating on your point paper the interlacing of the first warp thread or the first pick, remember that every successive warp thread interlaces with its successive pick; for example, if the first warp thread interlaces with the first pick, the second warp thread interlaces with the second pick, the third warp thread with the third pick, and so on; again, for example, if the fifth warp thread should interlace with the second pick, the sixth warp thread in turn will interlace with the third pick, the seventh warp thread with the fourth pick, the eighth warp thread with the fifth pick and so on until the repeat of the complete weave is obtained. This manner of interlacing warp and filling will produce a distinct pattern upon the cloth, *i. e.*, lines running in a diagonal direction across it.

Comparing fabrics constructed with twills to those interlaced with the plain weave, we will notice readily that twill weaves permit of the introduction of more material, both with reference to warp as well as filling in the fabric structure, resulting in turn in a closer or heavier fabric than is possible to be made with the plain weave, for the fact that twills only interlace at intervals of threads and consequently permit warp and filling to lay closer towards each other in the structure. The direction of the twill itself can be either arranged to run from left to right, or *vice versa*, according to the nature and purpose of the fabric, although as a rule, the twill running from left to right in the fabric is the one mostly met with. This twill effect is more prominent to the eye provided the same runs in the same direction as the direction of twist in the warp, since in this way the weave will more closely lay the twist in the yarn, and hold it in the finishing process, for which reason this is the plan observed when dealing with fabrics requiring a smooth face; whereas when a rough face is desired, running the twill against the direction of twist in the warp yarn will assist the finishing process.

The least number of threads, of each system (warp and filling) required for constructing twills is 3, after which they can be designed for any number of threads for their repeat.

Twills can be divided into two sub-divisions, *viz*:

(a) *"uneven sided twills,"* are twill weaves in which more or less warp-up indications appear on the design, compared with filling-up indications, or the amount of indications for warp and filling balance but the general arrangement is different in one compared with the other. For example, the $^{3}_{\ 2}$ 5-harness twill is an uneven sided twill, for reason first stated, whereas the $^{2}_{3}\ ^{2}_{1}$ 8-harness twill is an uneven sided twill, for the reason last stated, since although there are found ($2 + 2 = 4$, and $3 + 1 = 4$) four raisers and four sinkers in the repeat of the weave, still the arrangement (2, 2 and 3, 1) differs.

(b) *"even sided twills,"* are twill weaves in which the amount and arrangement of warp up and filling up, is completely balanced.

3-harness twills. Two twills can be constructed for a 3-thread repeat, in warp and filling, and which are the 2 up 1 down (technically written $^{2}_{1}$) and the 2 down 1 up ($^{\ 1}_{2}$) 3-harness twill. The first mentioned weave is what we call the warp effect, *i. e.*, warp predominates on the face of the fabric, whereas the second referred to weave is its mate filling effect, *i. e.*, the filling predominates on the face of the fabric in this instance. Both weaves are uneven sided twills, consequently, if one of them forms the face of the fabric, the other forms its back, however with the twill running in the reverse direction from the direction of the twill on the face of the fabric.

In order to simplify matters to the student, diagrams Figs. 14, 15 and 16 are given, and of which Fig.

14 shows us the $\frac{2}{1}$ 3-harness twill, warp effect, executed for 15 warp threads and 12 picks. Fig. 15 shows its corresponding fabric structure, with connecting guide lines between it and the weave, so the student can readily follow the interlacing of each thread between both diagrams. Fig. 16 shows the section of the fabric, showing 6 warp threads in their section (shown in full black) taken in connection with pick number 1 of the weave or fabric structure, the latter being shown in outlines shaded.

Diagram Fig. 17 shows us two repeats each way of the $\frac{1}{2}$ 3-harness twill, *i. e.*, the mate twill to weave Fig. 14.

We call our twills by the name "harness," in place of "warp threads, as required for one repeat of the weave," since this is the custom to do; the word harness indicating the lowest number of harnesses required in the loom for said weave, although small twills of a 4, 5 or 6 harness repeat, will be frequently doubled up on the loom, *i. e.*, woven with 8, 10 or 12 harnesses respectively.

Four harness twills. Three twills can be constructed on this number of harnesses, or for a 4 thread repeat warp and filling ways, *viz:* the 3 up 1 down ($\frac{3}{1}$), the 3 down 1 up ($\frac{1}{3}$), and the 2 up 2 down ($\frac{2}{2}$) twill. Of these three weaves, the first two are uneven sided twills—one weave the mate of the other—the last quoted weave being the first even sided twill come into contact with, it being the most frequently employed weave met with in the textile industry, and is also known as the cassimere twill, on account of being the most useful weave in that line of the industry. Of our plate of twill weaves accompanying this lesson, Fig. 18 shows us the 3 up 1 down, Fig. 19 the 3 down 1 up, and Fig. 20 the 2 up 2 down twill.

Five harness twills. Six different twills can be constructed on this number of harnesses, *i. e.*, twills repeating on 5 warp threads and 5 picks, *viz:*

The 4 up 1 down—see Fig. 21,
The 4 down 1 up—mate of it.
The 3 up 2 down—See Fig. 22,
The 3 down 2 up—mate of it.
The 2 up 1 down 1 up 1 down—see Fig. 23 and
The 2 down 1 up 1 down 1 up—mate of it.

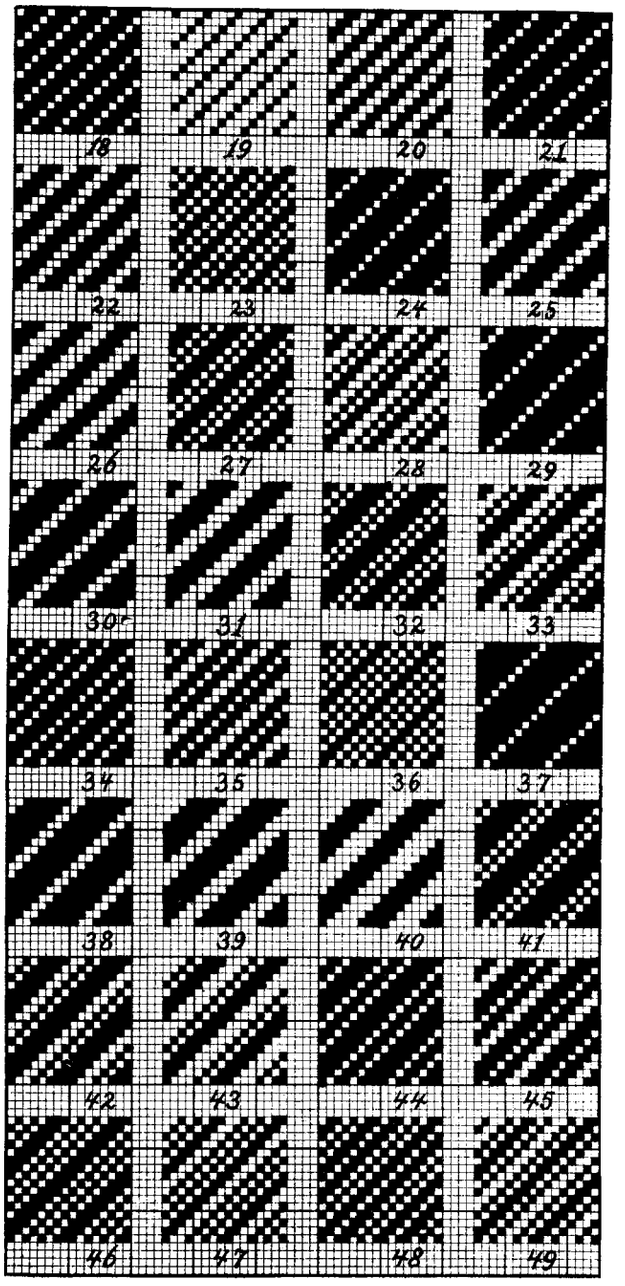
Six harness twills. Eight different twills can be designed for this repeat, which are:

The 5 up 1 down—see Fig. 24,
The 5 down 1 up—mate of it.
The 4 up 2 down—see Fig. 25,
The 4 down 2 up—mate of it.
The 3 up 3 down—see Fig. 26,
The 3 up 1 down 1 up 1 down—see Fig. 27
The 3 down 1 up 1 down 1 up—mate of it, and
The 2 up 1 down 1 up 2 down—see Fig. 28.

Seven harness twills. Sixteen different twills can be made on this repeat, and of which eight are shown in diagrams Figs. 29, 30, 31, 32, 33, 34, 35 and 36, the other eight being the mate weaves to those given, *i. e.*, consider in this case □ for risers and ■ for sinkers in said eight diagrams Figs. 29 to 36.

Eight harness twills. Twenty-two different twills can be made on this repeat, and of which thirteen (13) are shown in diagrams Figs. 37 to and inclusive 49, the remaining nine being mate weaves to those shown in Figs. 37, 38, 39, 41, 42, 44, 45, 46 and 48, considering again in connection with these nine weaves □ for risers and ■ for sinkers.

We have given every one of the twills possible to be made on 3, 4, 5, 6, 7 and 8 harness for the purpose



to show the student not only the immense variety of twills at the disposal of the textile designer, but at the same time to supply him with the best plan of constructing twills for any number of harnesses called for; which of these twills to use depending on the character of the fabric to be made. The larger the number of harnesses at our disposal, the greater is the number of twills that can be constructed for each repeat. In connection with diagrams Figs. 18 to 49 we have

shown each weave executed for 16 warp threads and 16 picks, in order to present this collection of twill weaves in the most convenient manner, it being understood that in connection with the 3-harness twills we showed ($16 \div 3 = 5\frac{1}{3}$) 5 repeats + 1 end, warp and filling ways; with the 4-harness twills ($16 \div 4 = 4$) 4 repeats, warp and filling ways; with the 5-harness twills ($16 \div 5 = 3\frac{1}{5}$) 3 repeats + 1 end, warp and filling ways, etc.

Questions:

(1) Quote sub-divisions of our foundation weaves.

(2) Why does the plain weave, texture of fabric, counts and twists of yarn alike, produce a stronger fabric than any other weave?

(3) Quote rule for constructing twills.

(4) What is the difference between an even sided and an uneven sided twill? Illustrate affair with an example of two 10-harness twills, painting two repeats warp and filling ways of each weave.

(5) Quote least number of harness, twills can be designed for.

(6) Construct 42 different twills for 9-harness. Produce no duplicates. Construct each twill with two repeats warp and filling ways. Be sure you have no duplicates. Mate twills are included in the 42 weaves asked for.

(7) Produce all four twill line twills possible to be made on 13 harnesses.

(8) Produce all the even sided twills you can find for 11 harnesses.

(9) What is the reason that you can use a higher texture, both warp and filling ways, with any twill weave, as compared to the plain weave?