

Cyclopedia  
*of*  
Textile Work

*A General Reference Library*

ON COTTON, WOOLEN AND WORSTED YARN MANUFACTURE, WEAVING, DESIGN  
ING, CHEMISTRY AND DYEING, FINISHING, KNITTING,  
AND ALLIED SUBJECTS.

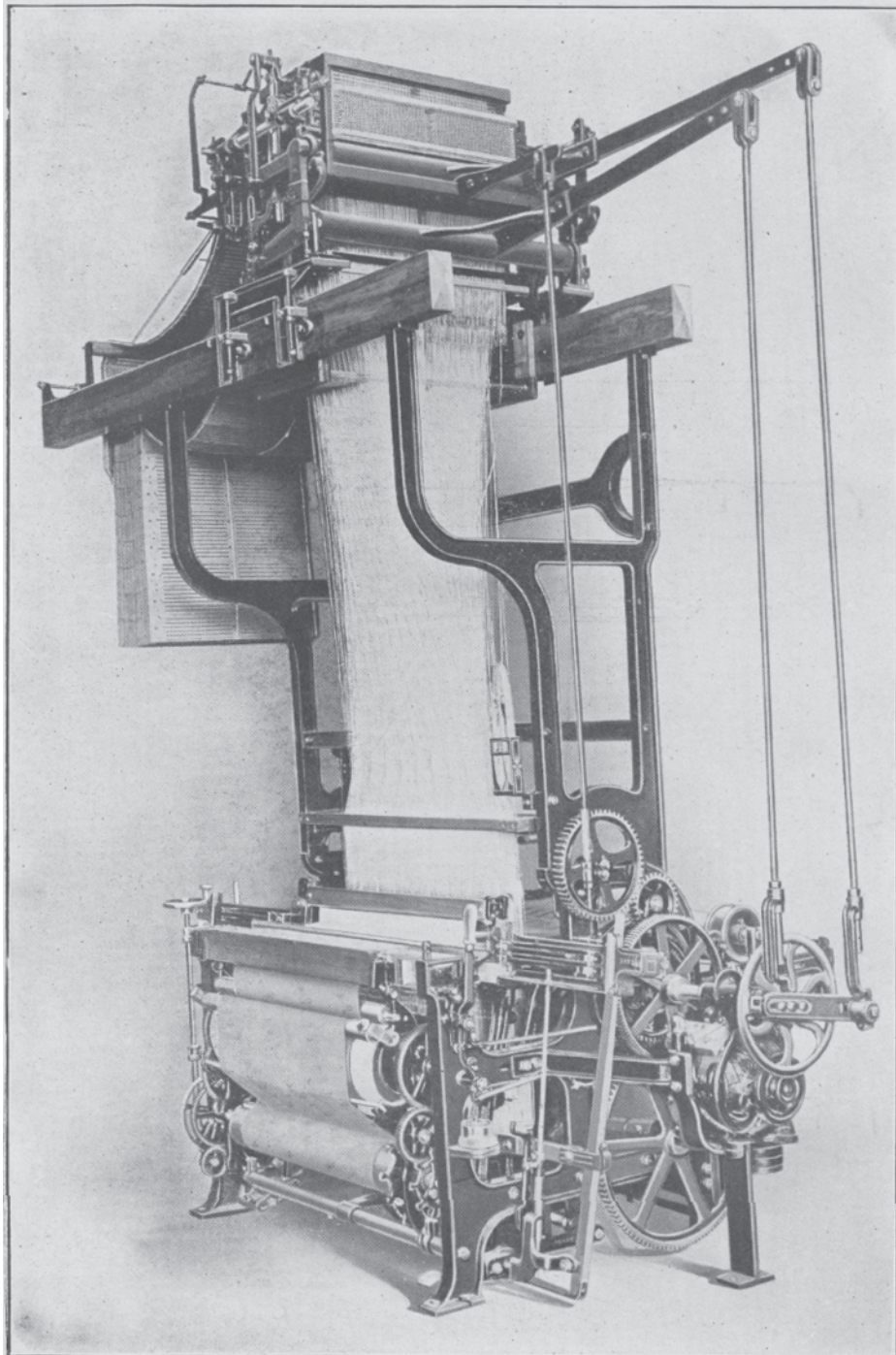
*Prepared by a Corps of*

TEXTILE EXPERTS AND LEADING MANUFACTURERS

*Illustrated with over Two Thousand Engravings*

SEVEN VOLUMES

CHICAGO  
AMERICAN TECHNICAL SOCIETY  
1913



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Crompton & Knowles Loom Works

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**T**HE editors have freely consulted the standard technical literature of Europe and America in the preparation of these volumes and desire to express their indebtedness, particularly to the following eminent authorities, whose well known treatises should be in the library of every one connected with textile manufacturing.

Grateful acknowledgment is here made also for the invaluable co-operation of the foremost manufacturers of textile machinery, in making these volumes thoroughly representative of the best and latest practice in the design and construction of textile appliances; also for the valuable drawings and data, suggestions, criticisms, and other courtesies.

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## Introductory Note

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THE Cyclopedia of Textile Work is compiled from the most practical and comprehensive instruction papers of the American School of Correspondence. It is intended to furnish instruction to those who cannot take a correspondence course, in the same manner as the American School of Correspondence affords instruction to those who cannot attend a resident textile school.

- The instruction papers forming the Cyclopedia have been prepared especially for home study by acknowledged authorities, and represent the most careful study of practical needs and conditions. Although primarily intended for correspondence study they are used as text-books by the Lowell Textile School, the Textile Department of the Clemson Agricultural College, the Textile Department of the North Carolina College of Agriculture and Mechanic Arts, the Mississippi Textile School, and for reference in the leading libraries and mills.
- Years of experience in the mill, laboratory and class room have been required in the preparation of the various sections of the Cyclopedia. Each section has been tested by actual use for its practical value to the man who desires to know the latest and best practice from the card room to the finishing department.

¶ Numerous examples for practice are inserted at intervals. These, with the test questions, help the reader to fix in mind the essential points, thus combining the advantages of a textbook with a reference work.

¶ Grateful acknowledgment is due to the corps of authors and collaborators, who have prepared the many sections of this work. The hearty co-operation of these men — manufacturers and educators of wide practical experience and acknowledged ability — has alone made these volumes possible.

¶ The Cyclopedia has been compiled with the idea of making it a work thoroughly technical, yet easily comprehended by the man who has but little time in which to acquaint himself with the fundamental branches of textile manufacturing. If, therefore, it should benefit any of the large number of workers who need, yet lack, technical training, the editors will feel that its mission has been accomplished.



## Contents

### VOLUME III.

DESIGN PAPER . . . . .	Page* 11
COLOR EFFECTS . . . . .	“ 39
DRAFTING AND REDUCTION . . . . .	“ 55
PLY-CLOTHS . . . . .	“ 121
DOUBLE PLAIN . . . . .	“ 175
SPOT WEAVES . . . . .	“ 179
PILE OR PLUSH FABRICS . . . . .	“ 185
JACQUARD DESIGNING . . . . .	“ 202
LENO DESIGNING . . . . .	“ 237
TEXTILE COLORING . . . . .	“ 281
COST FINDING . . . . .	“ 291
REVIEW QUESTIONS . . . . .	“ 337

\*For Page numbers see foot of pages.

# TEXTILE DESIGN.

## PART I.

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There are three primary elements in textile design.

*First*, the weave.

*Second*, amalgamation and combination of weaves.

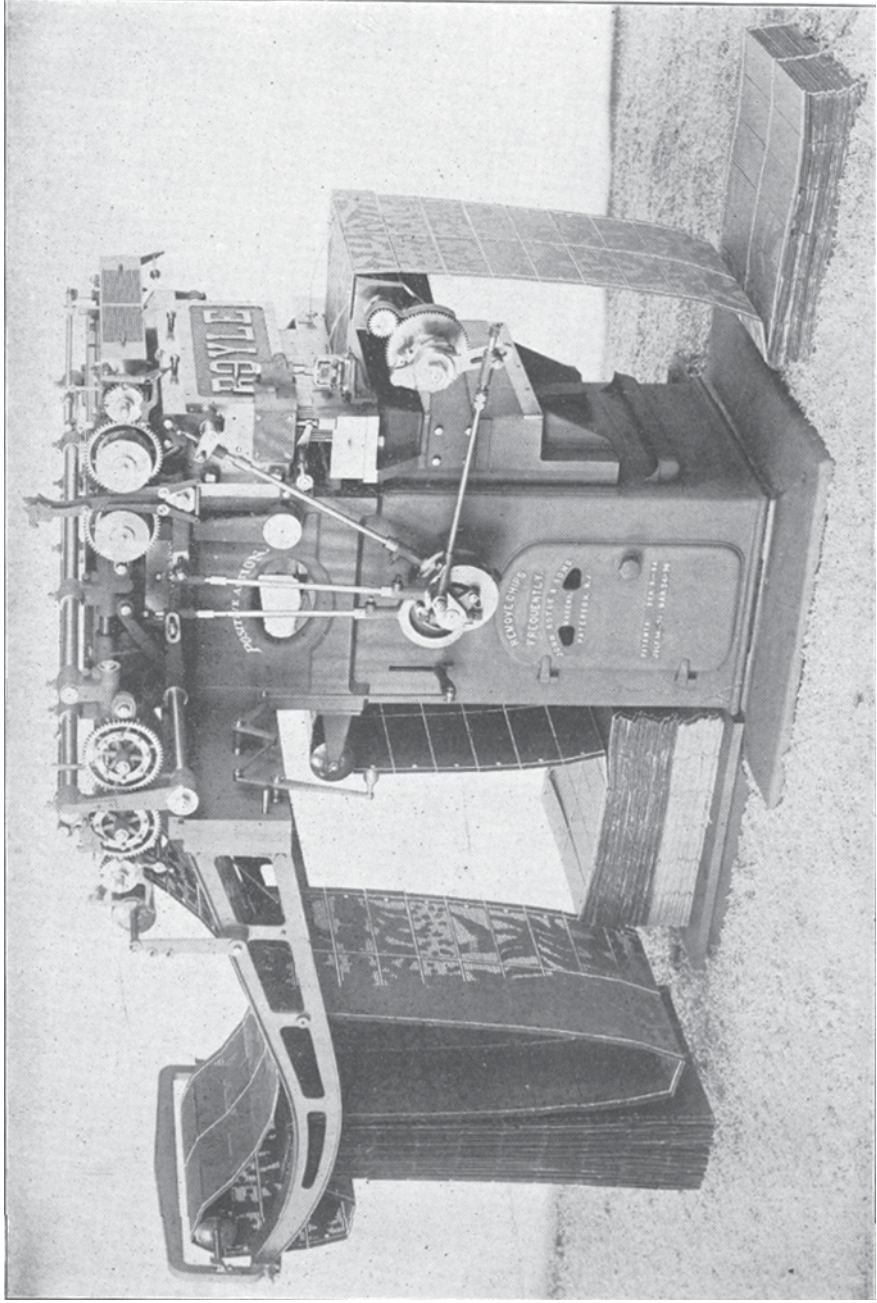
*Third*, the mixing and blending of colors as applied to textile fabrics.

The object to which a design is to be applied is of the utmost importance; the designer must first know the intended uses of the fabric. When a draftsman makes the drawings of a machine, or an engineer of a bridge, he first studies the convenience of arrangement, the conditions as to strength, durability and utility. It is necessary to consider all these particulars in the construction of a piece of cloth. Therefore a textile design, or the design of a woven fabric and its specifications, is, when complete, a perfect working plan, — descriptive and illustrative of the arrangement and character of all the component parts and processes. It describes the different materials, as to quality, kind, character, size, or counts and color of the yarn; it gives the arrangement of the threads, also quantities and proportions. The design illustrates the construction of the fabric, and the lay-out describes special processes and operations. To be complete and perfect, it should be so comprehensive that any qualified manager could produce the desired fabric without further instructions.

### USE OF DESIGN PAPER.

These papers are ruled with a heavy line to represent squares, and the sides are again divided by fainter lines into eight, ten, twelve or more divisions as required.

Fig. 1 represents a portion of design paper ruled  $12 \times 12$ . The use of ruled paper is exceedingly simple if the first principles and rudiments are comprehended. To have a clear and proper



ROYLE'S AUTOMATIC POSITIVE ACTION REPEATER WITH DOUBLE EXTENDED AND REVERSE CYLINDERS

In the plain or cotton weave, there are only two movements, one thread up and one thread down; this operation is repeated until the warp is woven out. Fig. 5 is a sketch or diagram of an enlarged section of a fabric woven on this principle; it is a simple



Fig. 3.

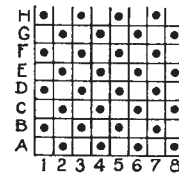


Fig. 4.

interweaving of one thread of filling over and under the warp threads alternately, first thread down and second thread up, etc. The 1st, 3rd, 5th and 7th threads are down, the 2nd, 4th, 6th and 8th threads are up, a thread or pick of filling A, is now lying between 1 and 2 warp threads; the next movement is to lift 1, 3, 5, 7, and sink 2, 4, 6, 8 and put in another thread or pick of filling B; the third pick is like the first and the fourth pick is like the second. These two movements are repeated over and over again until the web or warp is woven out. This constitutes a plain or cotton weave, and the appearance of the enlarged diagram (Fig. 5) is somewhat like the interlacing of the strips of willow in the making of baskets and mats.

To thoroughly comprehend the use of design paper, the main fact to be borne in mind is the continuity of every individual thread, either in the warp or filling. In making a twill design, the leading consideration is that it shall be so arranged that

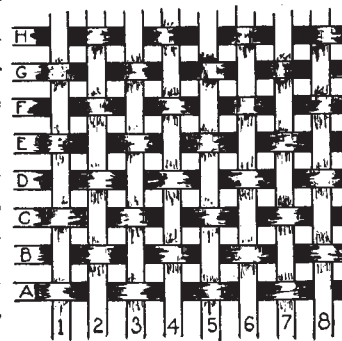


Fig. 5.

whatever the pattern it shall be continuous and unbroken, on the same principles that when we cover walls with paper or floors with carpet, the design must join perfectly and be continuous, or the broken, irregular design will offend the eye. How this affects the design will be best understood by a careful study of Fig. 6;

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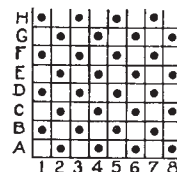


Fig. 4.

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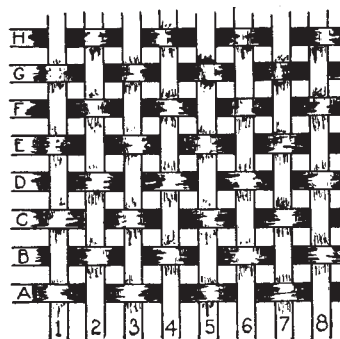


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3 and 4 are a repetition and continuation of 1 and 2, 5 and 6 a continuation of 3 and 4, and 7 and 8 of 5 and 6, and so on.

Fig. 7 illustrates the principles and construction of the vertical and transverse lines of the design paper. The vertical stripes in Figs. 4, 5 and 7 correspond with the warp threads 1 to 8 in each design; also the transverse or filling threads A to H correspond in Figs. 4, 5 and 7.

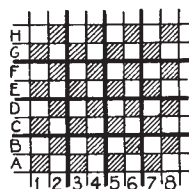


Fig. 6.

If point paper were ruled after the manner of Fig. 7, it would be difficult to see a pattern at a glance, as the many lines would be confusing. To overcome this, the paper is ruled without the spaces between the threads as shown in Fig. 7, but the spaces are represented with the faint lines as in Fig. 1. Fig. 8 shows the section of the first pick A of Fig. 6. We must understand that the lines do not represent threads but indicate the *divisions* between the threads, and it is this that enables an accurate plan of cloth to be made. When this stripe arrangement is fully understood, the first difficulty of textile design has been overcome.

Points to be remembered.

*First*, That light lines represent places of intersection.

*Second*, A mark, cross or dot on one of the small squares indicates that the thread is raised — the filling is under and the warp on the surface.

*Third*, An empty space or unmarked square shows that the filling is on the surface, thereby covering the warp.

*Fourth*, That the heavy dark line surrounding a series of small squares is for convenience in counting.

*Fifth*, That the design must be continuous and unbroken.

#### PLAIN CLOTH.

A plain cloth makes a very strong and firm fabric, but neither very close nor heavy, because the threads are not as close or compact as they are in other weaves. In a plain fabric, if the cloth is not shrunk or fullled in the finishing processes, the fabric is perforated more or less, according to the size and twist of yarns used. These perforations vary greatly under different conditions; if very heavy, coarse threads are used, the perfora-



tions will be large; if finer threads, the perforations will be smaller. There are also other conditions which may change the texture of the plain weave; if the threads are twisted hard, the cloth will be wirey and open. In making any fabric the twist of the yarn must be considered. For example, when two pieces of heavy rope or cord of the same twist are woven, they will interlay or become embedded with each other, but if ropes of contrary

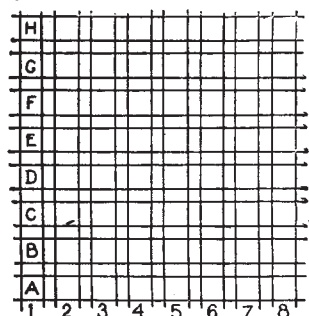


Fig. 7.



Fig. 8.

twist are used, they do not lay close or compact and the perforations are large, because the ridges of the twist cannot become compact.

**TWILLS AND DIAGONALS.**

After the plain weave is thoroughly understood, the next step is the study of twill weaves. These are weaves in which the intersections of the warp and filling threads are such that they produce lines diagonally across the fabric, either from right to left or from left to right, at an angle of 45 degrees. The simplest twill weave that can be constructed is one for three harnesses, variously known as the 3-harness twill, prunella twill, and 3-harness doeskin. These names vary according to the nature of the material or the relation of warp and filling employed in the construction of the particular kind of fabric.

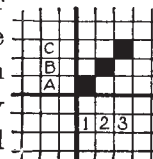


Fig. 9.

Fig. 9 is an illustration of this simple twill weave. It shows the three different positions of the threads to form the twill and, as in plain cloth, whenever the warp is raised, an indication is made in the corresponding small square on the design

paper, thus denoting which thread has to be lifted when the filling pick or thread is inserted.

Fig. 10 shows an enlarged diagram of a fabric woven upon this principle. It will be noticed that the warp thread 1 is raised as indicated by the mark in the small square at the left-hand lower corner in Fig. 9.

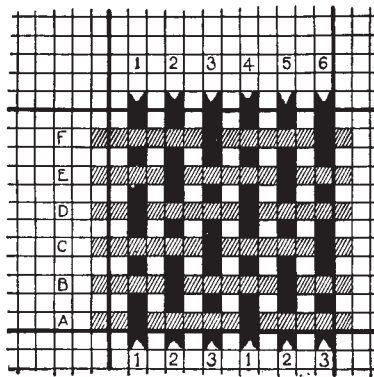


Fig. 10.

The first pick A passing under it and over 2 and 3. For the second pick, the mark is on the second thread, consequently the filling thread B passes over 1, under 2 and over 3. For the third pick, the mark is on the third thread, therefore the third filling thread passes over 1 and 2, and under No. 3.

In this design (Fig. 11) the twill is complete within a given space, and if we extend the design, it will be a continuous and unbroken repetition of the first three threads, 1, 2, 3, also the first three picks as shown in design Fig. 11. Let us go one step farther and examine Figs. 12 and 13; the conditions are quite opposite; this is a simple reversal of the twill, that is, the warp

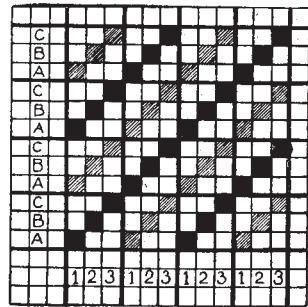


Fig. 11.

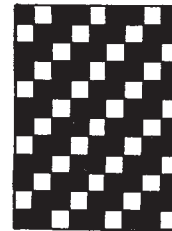


Fig. 12.

is lifted two threads, on each pick of the complete design, viz.: the first two threads are raised as indicated by black squares, while the third thread is left down or depressed,—exactly the reverse of Figs. 9, 10 and 11.

In these examples, every three threads and picks are an exact repetition of the first three, and any number of threads may be taken from one side and placed on the other side, or they may be taken from the bottom and vice-versa. The twill will be continuous and unbroken. In the absence of design paper there are other methods of indicating a weave. Take the plain weave as the

First Example. It can be stated thus  $\frac{1}{1}$ , or written 1 up and 1 down.

Second Example. The three-harness twill, filling flush, or  $\frac{1}{2}$ , or 1 up and 2 down.

Third Example. The three-harness twill, warp flush, or  $\frac{2}{1}$ , or 2 up and 1 down.

The word up, or figure above the line, indicates the number of threads to be raised on each pick, while the word down, or figure below the line, signifies that such threads must be depressed for the filling to pass over.

The 45-degree twills are divided into two classes, those which are even-sided and those which are uneven-sided. The even-sided twills are those in which the warps and fillings are evenly balanced.

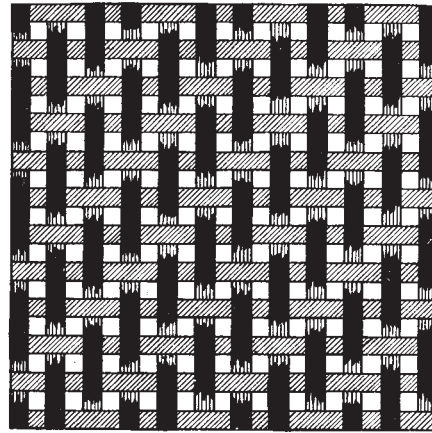


Fig. 13.

By an examination of Figs. 14 and 15, it will be noticed that the number of threads raised is equal to the number of threads depressed. Also notice that it is a four-harness twill, and that each succeeding four threads and picks are a repetition of the first four. The line of twill is continuous and unbroken.

The written formula is 2 up and 2 down, or  $\frac{2}{2}$ . This weave is

called the four-harness common twill, cassimere twill and shalloon twill.

The uneven-sided twills are of two kinds,—those that are on an even number of harnesses and those that are on an uneven number of harnesses.

Fig. 16 represents an uneven-sided twill on an even number of harnesses. This weave is called the 4-harness swansdown; it has three-fourths of the filling on the surface. Formula  $\frac{1}{3}$ .

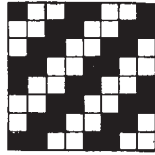


Fig. 14.

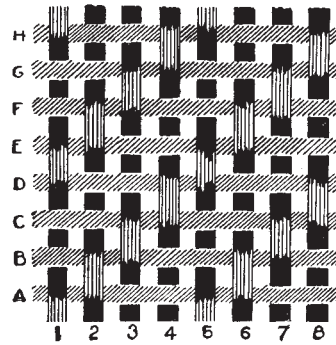


Fig. 15.

The reverse of this weave would be the  $\frac{3}{1}$ , and would indicate the warp surface weave, commonly called the crow weave.

Fig. 17 represents an uneven-sided twill on an uneven number of harnesses. On this weave, it will be noticed that there are only two threads raised, while there are three threads depressed; formula  $\frac{2}{3}$ . This weave can be reversed so that

the conditions would be opposite; formula  $\frac{3}{2}$ .

Attention is again called to the angle of the twill. It is continuous and unbroken and at an angle of 45 degrees. In designing twills always begin at the lower left-hand corner of the design and make out angle of twill for full number of threads, both warp and filling. Thus, a full weave for an eight-harness twill would require eight threads and eight picks, requiring eight small squares each way of the design paper. The student

should run out each design to fully twice the original number of threads and picks. Study each side, top and bottom, also study the termination when a design is complete. The number of

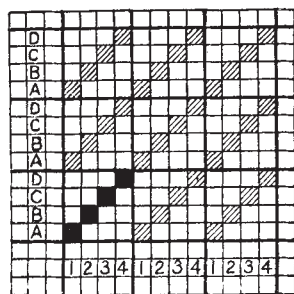


Fig. 16.

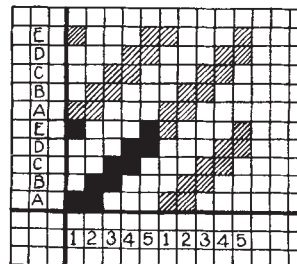


Fig. 17.

threads and picks to complete the design should be seen at a glance and to be sure that in repetition it will be continuous and unbroken.

**EXERCISES FOR PRACTICE.**

Copy Figs. 11, 12, 14, 16 and 17 and extend them over at least double the number of threads in each direction, taking care to work upon squares which represent the number of threads occupied by the original design, filling each in succession, and paying no attention to the thick lines upon the paper. At first, do not be in a hurry to carry the design in a straight line over the whole space, but work strictly in the squares as shown in the above examples.

1. Make all the 45° twills possible upon four threads, and repeat them after the manner shown in Figs. 11 and 12, to be certain that the pattern will be complete and continuous for an indefinite length.

2. Make all the 45° twills possible upon 5, 6 and 7 threads respectively, after the manner suggested in No. 1.

NOTE. In working out these Exercises the chief objects are *first*, to determine when a pattern is complete, and, to be certain that this is the case, the student might cut a portion from one side and place it on the opposite side, to see if the design

really fits together. A little practice in comparing one side with the other will soon enable him to discern this without cutting. The *second* object is to ascertain the number of threads in the design when complete, to prepare for the lessons in drafting, and drawing the warp threads through the heddles, in order to weave

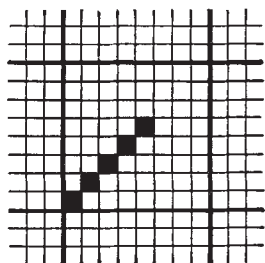


Fig. 18.

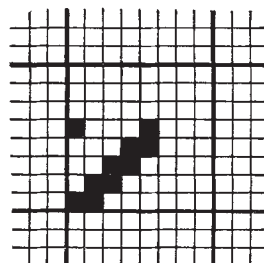


Fig. 19.

with the fewest number possible. The comparison of designs is of great importance, as a knowledge of their relations will be required in subsequent work.

#### FANCY 45 DEGREE TWILLS.

The student must not confine himself to what are commonly known as simple twills, but should find out how many designs

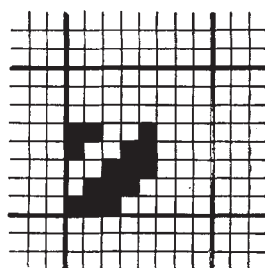


Fig. 20.

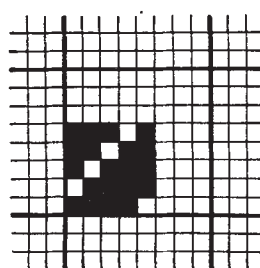


Fig. 21.

and what variety he can produce upon a given number of threads. The best plan in going about this work — and this holds good in every branch of the work — is to proceed in the most systematic manner.

For instance, take five threads as a base and work out as

many regular twills as possible. These are given in Figs. 18, 19, 20, 21, 22 and 23, which show the full limit in producing what are commonly known as "regular twills" on five harnesses.

This expression "regular twills" must be understood, as it is in the trade, to apply to twills running at an angle of 45 degree, and with no fancy figure accompanying it.

It should be noticed that all 45-degree twills move or advance 1 thread to the right until the full repeat of the weave has

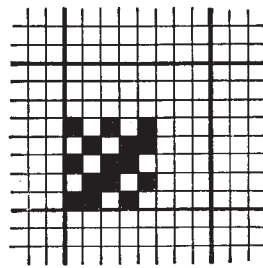


Fig. 22.

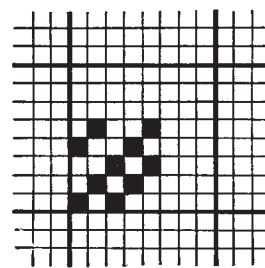


Fig. 23.

been obtained and can be worked out from a written formula, thus,

Fig. 18,  $\frac{1}{4}$ ; Fig. 19,  $\frac{2}{3}$ ; Fig. 20,  $\frac{3}{2}$ ; Fig. 21,  $\frac{4}{1}$ ; Fig.

22,  $\frac{2}{1} \frac{1}{1}$ ; Fig. 23,  $\frac{1}{1} \frac{1}{2}$ . These examples refer to the first

pick of each design which is a 45-degree twill, but when the twill is irregular there must be another method of indicating the weave.

For instance, Fig. 18 is on 5 harnesses and could be indicated  $\frac{1}{4}$  or  $1 + 1 + 1 + 1 + 1$  or  $1$ , the move number, or  $\frac{1}{4}/1$ .

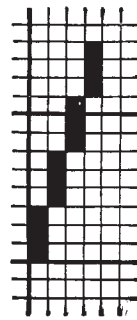


Fig. 24.

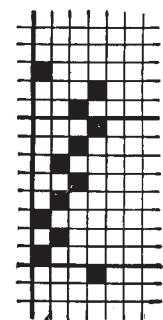


Fig. 25.

The weave on 4 harnesses as shown at Fig. 24 is known as the 70-degree steep twill, the written formula is  $1 + 0 + 0$ .

The terms  $1 + 0 + 0$ , etc., refer to the position of the points in a base with reference to one another, counted horizontally in

the example given. Thus, in Fig. 24 the mark on the first pick is placed in the first point or small square, that on the second pick moved in position 0, *i. e.*, in the same position; that on the third pick moved 0, that on the fourth moved 1 and so on throughout.

Fig. 25. weave commencing on 1st pick.  
 $1 + 1$  2nd pick moves 1 forward.  
 $1 + 1 - 1$  3rd pick moves 1 in opp. direction.  


---

 $1$  4th pick moves 1 forward.  
 $1 + 1$  5th pick moves 1 forward.  
 $1 + 1 - 1$  6th pick moves 1 in opposite direction, and so on until the weave begins to repeat. Similarly  $3 + 3 - 5$  may be commenced at any point as shown at Fig. 26; weave on 9 harnesses  
 $+ 3$  1st thread and 1st pick.  
 $- 5$  moves 5 in opposite direction.  
 $+ 3$  moves 3 forward.

Take Fig. 26 as an example. The weave is on 9 threads, therefore the counting or moving must be worked from 1 to 9.

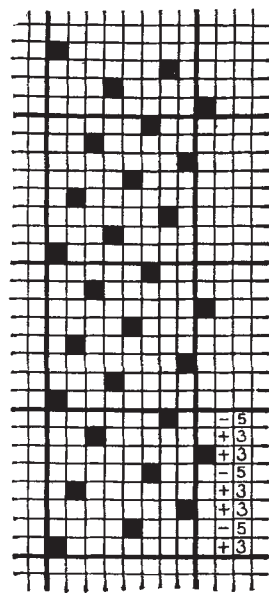


Fig. 26.

Commencing at the first thread a point is placed on the 1st square, the 2nd pick is marked  $- 5$  or 5 in the opposite direction, or, 9, 8, 7, 6, 5, hence the next point is on thread 5. The 3rd pick is marked  $+ 3$  or 3 forward, or 6, 7, 8, the third point on the 8th thread; the fourth pick is marked  $+ 3$  or 3 forward, then 9, 1, 2, fourth point on 2nd thread, 5th pick is marked  $- 5$  or 5 in opposite direction, then, 1, 9, 8, 7, 6, fifth point on 6 thread and so on throughout until the weave repeats.

The next step in the work is to produce as many designs as possible upon any given number of threads, and in doing so proceed systematically, as in the five-harness examples, first with 1 point, then with 2, and so on, until a

complete series of simple lines as in Figs. 18 to 23 has been run



through, and, according to the number of threads, open out the space between the lines of twill. Make light and heavy lines and vary them until there is no further room for variation, observing the repetitions of the pattern in the reverse order, both in the

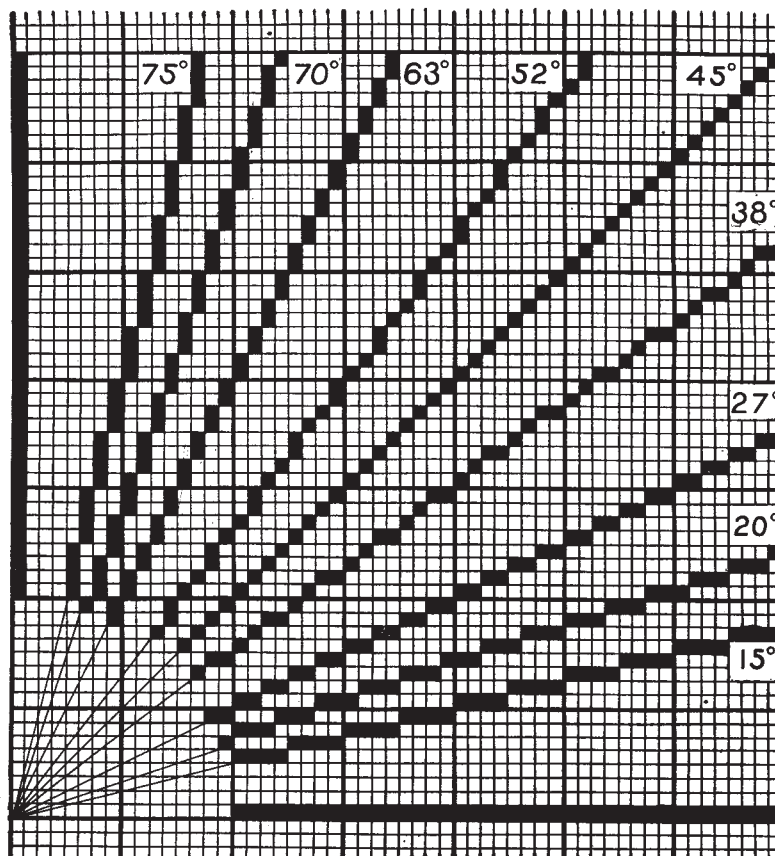


Fig. 27.

quantity of material which comes to the surface, and in the position of the twill.

Diagrams for illustrating the construction of reclining and steep twills are shown in Fig. 27.

## Steep and Reclining Twills.

The 15° reclining twill is formed by moving  $\frac{1}{2}$  points, Fig. 28

" 20°	"	"	"	"	"	"	3	"	"	29
" 27°	"	"	"	"	"	"	2	"	"	30
" 38°	"	"	"	"	"	"	1+2	"	"	31
" 45° Regular	"	"	"	"	"	"	1	"	"	32
" 52° Steep	"	"	"	"	"	"	1+1+0	"	"	33
" 63°	"	"	"	"	"	"	1+0	"	"	34
" 70°	"	"	"	"	"	"	1+0+0	"	"	35
" 75°	"	"	"	"	"	"	1+0+0+0	"	"	36

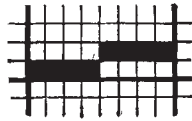


Fig. 28.

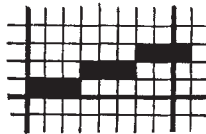


Fig. 29.



Fig. 30.

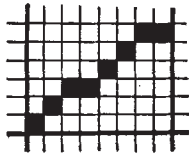


Fig. 31.

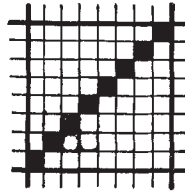


Fig. 32.

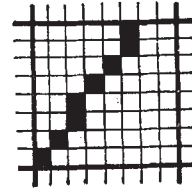


Fig. 33.

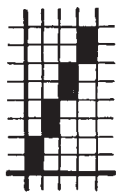


Fig. 34.



Fig. 35.



Fig. 36.

Any of the intermediate degree twills can be formed according to the requirements of design.

**INTERSECTIONS, INTERLACING, AND CUT SECTIONS.**

What is the meaning of intersecting, interlacing, and interweaving? Take the plain weave for an example,  $\frac{1}{1}$ . If we have a number of threads and lift the 1st, 3rd, 5th, 7th, etc., and depress or sink the 2nd, 4th, 6th, 8th, etc., and between these sets of threads we introduce a pick of filling, we should be interlacing or interweaving the warp threads. What would be the result? Fig. 37 illustrates the section of 8 warp threads in a



Fig. 37. Cut Section.

plain cloth, interwoven with one pick of filling, A. We have 1st thread up, then an intersection of filling, 2nd thread down, then an intersection of filling. In Fig. 37 there are 8 warp threads and 8 intersections of filling. = 16 units.

The answer to the above question is: Interlacing and interweaving is inserting the filling between two or more systems of warp threads, while the intersection is the space occupied by the warp or filling between any number of threads, warp or filling.



Fig. 38. Cut Section.

On the design paper the spaces represent the warp and filling, while the lines represent the intersections.

Take the next example, the three-harness  $\frac{1}{2}$  twill: one thread up and one intersection, two threads down and one intersection, threads 2 and 3 lying close together and no intersection. Fig. 38 shows 3 threads and 2 intersections = 5 units.

We will now examine the cassimere or shalloon twill  $\frac{2}{2}$ . (See Fig. 15.) We notice that the filling thread interweaves

alternately over and under two warp threads as shown in Fig. 39, and in the same order the warp threads interlace over and under two filling threads, (Fig. 40); but by studying Fig. 15, we find that each succeeding filling thread does not pass over the same two warp threads, nor does each consecutive warp thread interlace over or under the same two filling threads, nor are they alternate as in plain cloth, but they change in regular consecutive



Fig. 39. Cut Section.

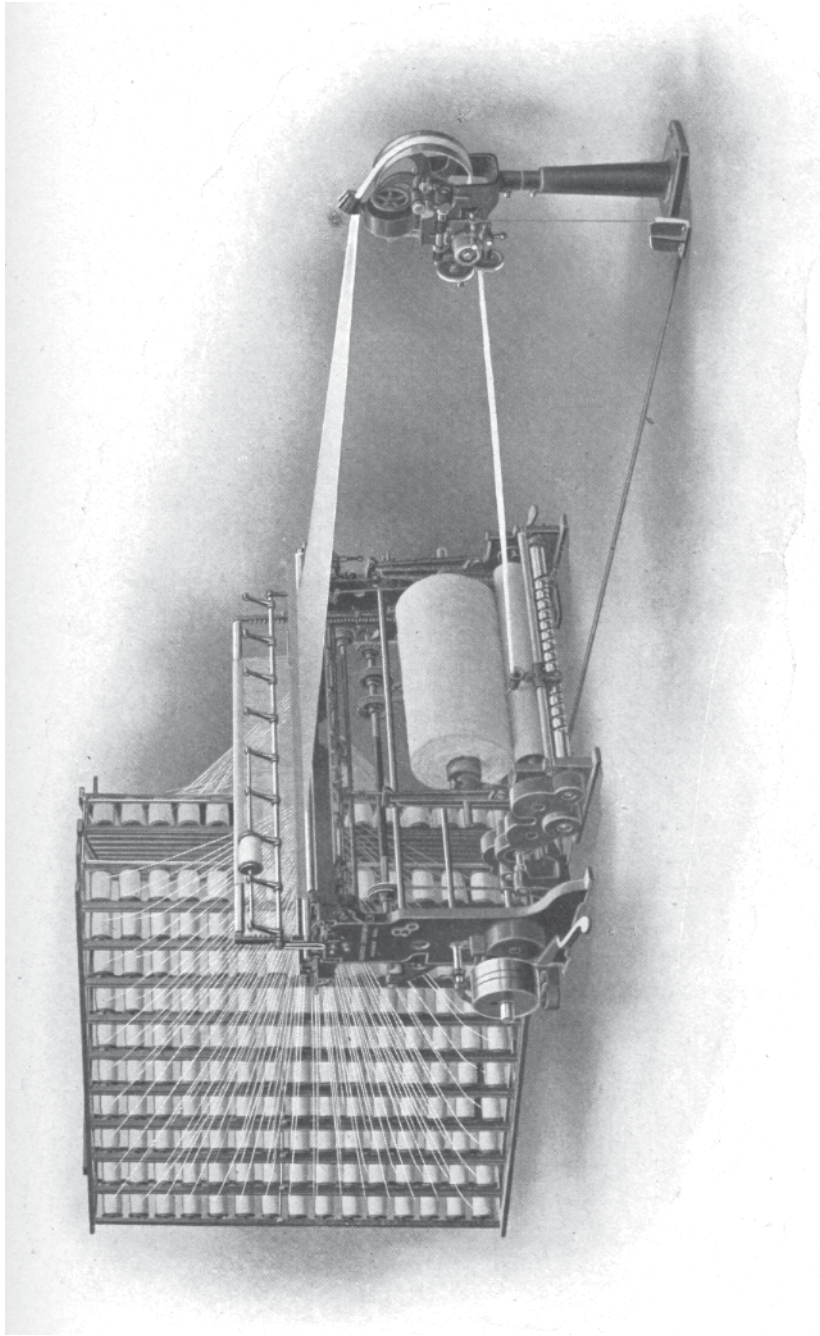
order. That is, if the 1st pick, A, interweaves over the threads Nos. 1 and 2, and under Nos. 3 and 4; the 2nd pick, B, will pass under Nos. 1 over 2 and 3 and under 4; the 3rd pick, C, will pass under 1 and 2, and over 3 and 4; the 4th pick, D, will pass over 1 under 2 and 3, and over 4. The 5th pick, E, is a repetition of No. 1, and so on. The design is continuous and unbroken, each thread and pick advancing one before it rises to the surface or passes to the back of the fabric. It is this order of interlacing that gives the effect of producing in the cloth distinct twills or diagonal lines at an angle of 45 degrees. This mode of interweaving is called the even, or balanced system. There are, as in the plain weave, as many of each system of threads on the face of the cloth as there are on the back. The longer the floats or intervals that we interweave and interlace the warp and filling, the greater the amount of material that can be introduced the greater the gain in weight and substance.



Fig. 46.

We will now examine the three weaves under consideration. Plain weave one up and one intersection, one down and one intersection or two threads and two intersections.

We have already learned in studying the plain weave that when constructed on the truest principles, warp and filling of the same size or counts, number of threads and picks being equal, it will make a cloth more or less perforated according to the material used. The fabric would be built to withstand wear and tear and friction, but we could not obtain bulk and compactness.



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Now let us examine the three-harness twill,  $\frac{1}{2}$ , Fig. 41. We have two intersections in every three threads, as one up and one intersection, two down and one intersection, therefore, allow-



Fig. 41. Cut Section.

ing threads 2 and 3 to lie close together without any perforations.

In the four-harness cassimere or shalloon twill,  $\frac{2}{2}$ , Fig. 42, we find that there are only two intersections on every four threads; two threads up and one intersection, and two threads



Fig. 42. Cut Section.

down and one intersection, thus giving still more opportunity to gain weight and compactness of texture, as an examination of Fig. 42 will show. On the first pick the first and second threads are lying close together, then an intersection; third and fourth threads lying together, then an intersection, and so on, consecutively and continuously.



Fig. 43. Cut Section.

The three weaves on twelve threads, their intersections and units stand as follows:

Plain weave Fig. 43, 12 threads and 12 intersections = 24 units. Three-harness twill Fig. 41, 12 threads and 8 intersec-



Fig. 44. Cut Section.

tions = 20 units. Four-harness twill Fig. 42, 12 threads and 6 intersections = 18 units.

Take another example, Fig. 44: The four-harness filling-flush twill, commonly called the swansdown weave; one up and three down, or the warp-flush twill Fig. 45; one down and three up, commonly known as the crow weave.

In these two weaves there are only two intersections on four



Fig. 45. Cut Section.

threads, and there are three warp threads lying close together, either on the face or back of the cloth. These weaves give us more liberty to use heavier material or a greater number of threads in the warp or filling, according to the weave used.

These intersections, units and warp or filling flushes are items that must be considered when designing textile fabrics.

The following will show how an examination question or exercise should be answered.

**Question.** Write in your own words an explanation of the use of design paper. What do you mean by the dots placed upon it and how does it convey your ideas to others?

**Answer.** Design paper is used to represent woven cloth as follows: The series of squares running vertically represent the warp threads in the loom and the series of squares running horizontally represent the filling, weft, wool or pick threads inserted by the shuttle. If the warp threads are to show on the face of the cloth, the filling or weft threads must go under them. A dot or cross placed in a square indicates that the warp thread is on the surface and vice versa a blank square means that the filling or weft is on the surface and the warp under the filling.

Suppose the warp threads are black and those to be put in by the shuttle are white. A black and white design, or fabric to be woven, is shown on the design paper by indicating by a cross or dot placed in the square what warp threads are to show on the surface. Imagine that each small square on the design paper is reduced so small that it can contain only a needle point. It is then readily seen that a design is traced by a succession of minute dots. The design paper thus used will give a very good imitation of a woven fabric.

MOVE NUMBERS FOR ALL REGULAR WEAVES UP TO 10 THREADS.

Threads	SINGLE MOVE NOS.		DOUBLE MOVE NOS.		TREBLE MOVE NOS.		IRREGULAR
	1	2	1+0	2+0	1+1+0	2+1+0	
2	1	2	1+0		1+1+0		
3	1	2	1+1		1+1+0		
3	3	4	2+0		2+0+0		
4	1	2	2+1		2+1+0		2+1+2-1
4	3	4	3+0		3+0+0		4
5	1	2	2+1		2+2+2		
5	3	4	3+0		3+1+0		
5	5	6	4+0		4+0+0		
6	1	2	3+1		3+1+1		3+1+3-1-1
6	3	4	3+2		3+2+1		3+1+2+1-1
6	5	6	4+1		4+1+1		3+2+2+3-2-2
6	7	8	5+0		5+0+0		6
7	1	2	3+1		3+1+1		
7	3	4	3+2		3+2+1		
7	5	6	4+1		4+1+1		
7	7	8	5+1		5+1+1		
8	1	2	4+1		4+1+1		
8	3	4	4+2		4+2+1		
8	5	6	5+1		5+1+1		
8	7	8	6+0		6+0+0		
8	9	10	7+0		7+0+0		
9	1	2	4+1		4+1+1		
9	3	4	4+2		4+2+1		
9	5	6	5+1		5+1+1		
9	7	8	6+1		6+1+1		
9	9	10	7+1		7+1+1		
10	1	2	5+1		5+1+1		
10	3	4	5+2		5+2+1		
10	5	6	6+1		6+1+1		
10	7	8	7+1		7+1+1		
10	9	10	8+0		8+0+0		



SELECTED ORDERS FOR WEAVING ON 2 TO 10 THREADS.

Number of threads	For all move nos.		For double move nos. only		For treble move nos. only	
2	$\frac{1}{1}$					
3	$\frac{1}{2}$					
4	$\frac{2}{2}$		$\frac{2}{2}$ & $\frac{1}{1}$		$\frac{2}{2}$ & $\frac{1}{1}$ & $\frac{2}{2}$	$\frac{1}{1}$ & $\frac{2}{2}$ & $\frac{1}{1}$
5	$\frac{2}{3}$	$\frac{1}{1}$ & $\frac{1}{2}$	$\frac{2}{3}$ & $\frac{1}{1}$ & $\frac{1}{2}$		$\frac{2}{3}$ & $\frac{1}{1}$ & $\frac{2}{3}$	$\frac{1}{1}$ & $\frac{2}{3}$ & $\frac{1}{1}$ & $\frac{1}{2}$
6	$\frac{3}{3}$	$\frac{2}{1}$ & $\frac{1}{2}$	$\frac{3}{3}$ & $\frac{2}{1}$ & $\frac{1}{2}$	$\frac{2}{1}$ & $\frac{2}{1}$ & $\frac{2}{1}$	$\frac{3}{3}$ & $\frac{2}{1}$ & $\frac{3}{3}$	$\frac{2}{1}$ & $\frac{3}{3}$ & $\frac{2}{1}$
7	$\frac{3}{4}$	$\frac{2}{1}$ & $\frac{1}{3}$ & $\frac{1}{1}$ & $\frac{1}{2}$	$\frac{2}{1}$ & $\frac{2}{1}$ & $\frac{1}{3}$ & $\frac{1}{1}$ & $\frac{1}{2}$	$\frac{2}{1}$ & $\frac{2}{1}$ & $\frac{1}{3}$ & $\frac{2}{2}$ & $\frac{2}{1}$ & $\frac{2}{1}$		
8	$\frac{4}{4}$	$\frac{2}{2}$ & $\frac{1}{3}$ & $\frac{2}{1}$ & $\frac{1}{1}$ & $\frac{1}{2}$	$\frac{3}{1}$ & $\frac{3}{1}$ & $\frac{2}{1}$ & $\frac{1}{3}$ & $\frac{3}{1}$ & $\frac{1}{1}$ & $\frac{1}{2}$	$\frac{3}{1}$ & $\frac{2}{2}$ & $\frac{3}{1}$ & $\frac{1}{3}$ & $\frac{1}{3}$ & $\frac{2}{1}$ & $\frac{2}{1}$		
9	$\frac{4}{5}$	$\frac{2}{2}$ & $\frac{2}{3}$ & $\frac{1}{1}$ & $\frac{1}{1}$ & $\frac{1}{1}$	$\frac{3}{1}$ & $\frac{3}{1}$ & $\frac{3}{2}$ & $\frac{2}{3}$		$\frac{3}{1}$ & $\frac{2}{2}$ & $\frac{3}{1}$ & $\frac{1}{4}$ & $\frac{2}{3}$ & $\frac{4}{1}$	
10	$\frac{5}{5}$	$\frac{4}{1}$ & $\frac{1}{4}$ & $\frac{2}{2}$ & $\frac{1}{2}$ & $\frac{1}{1}$ & $\frac{1}{2}$	$\frac{4}{1}$ & $\frac{4}{1}$ & $\frac{1}{4}$ & $\frac{4}{1}$	$\frac{2}{2}$ & $\frac{3}{1}$ & $\frac{2}{1}$ & $\frac{1}{1}$ & $\frac{2}{1}$ & $\frac{2}{1}$	$\frac{1}{1}$ & $\frac{3}{1}$ & $\frac{3}{1}$ & $\frac{1}{1}$	

EXERCISES IN PLAN MAKING.

Work out weaves from the following:

(1)  $\frac{2}{3} \frac{2}{1} \frac{2}{2} / 1$

(2)  $\frac{3}{2} \frac{2}{1} \frac{2}{2} / 5$

(3)  $\frac{1}{1} \frac{2}{2} \frac{3}{3} / 1$

(4)  $\frac{1}{1} \frac{2}{2} \frac{3}{3} / 5$

(5)  $\frac{2}{1} \frac{2}{1} \frac{2}{4} / 1$

(6)  $\frac{2}{1} \frac{2}{1} \frac{2}{4} / 5$

(7—12)  $\frac{3}{1} \frac{1}{1} \frac{3}{3} / 1, 2, 3, 4, 5, 6.$

(13—17)  $\frac{2}{1} \frac{2}{1} \frac{2}{3} / 1, 2, 3, 4, 5.$

(18)  $\frac{3}{1} \frac{3}{2} \frac{1}{2} / 5$

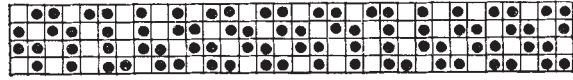
(19—21)  $\frac{4}{2} \frac{1}{2} \frac{1}{2} / 1, 2, 3.$

(22—25)  $\frac{2}{1} \frac{2}{1} \frac{2}{4} / 1, 2, 3, 4.$

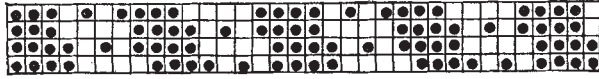
(26—29)  $\frac{3}{2} \frac{2}{1} \frac{2}{2} / 1, 2, 3, 4. \quad 3-2+2, 4-3+2, 4-2+1.$

(30—33)  $\frac{2}{3} \frac{2}{2} \frac{2}{1} /$  and  $\frac{2}{3} \frac{2}{1} \frac{2}{2} / 2+0, 3-1, 4-2, 5-3.$

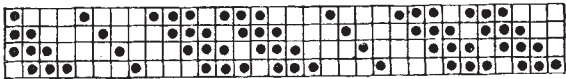
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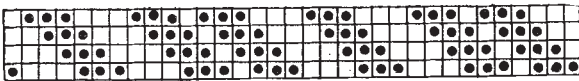
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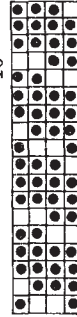
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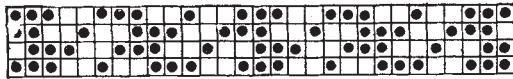
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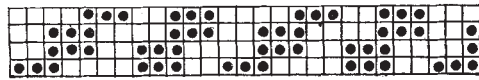
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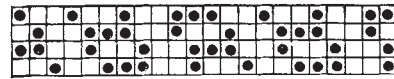
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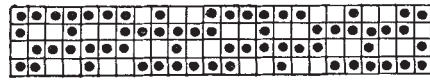
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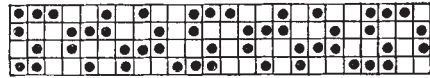
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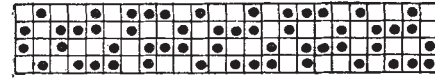
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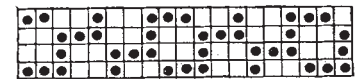
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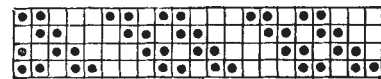
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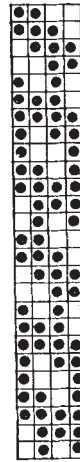
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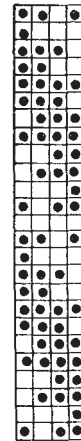
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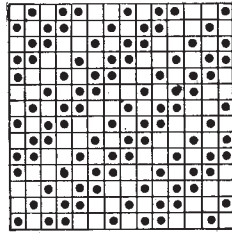


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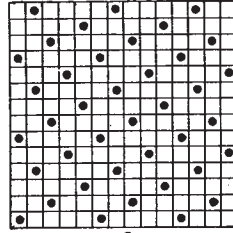


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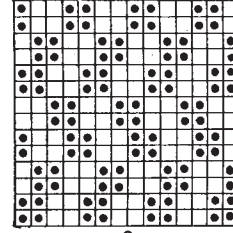
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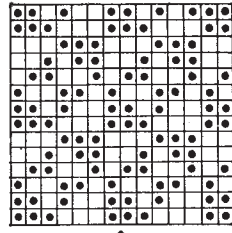
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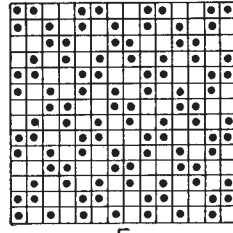
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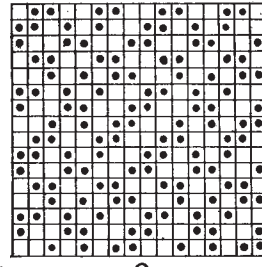
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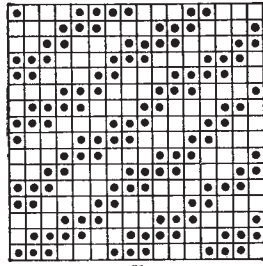
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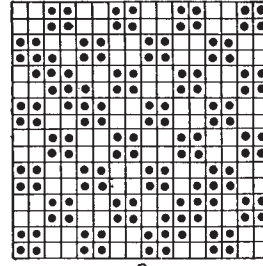
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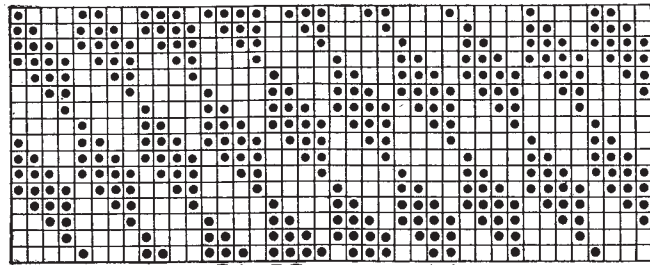


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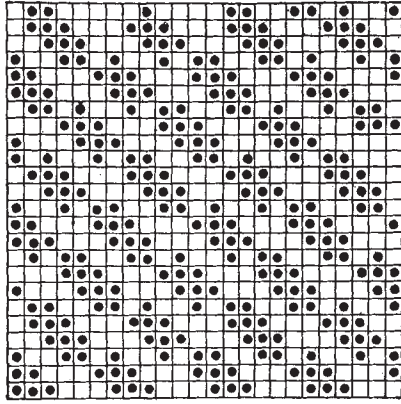


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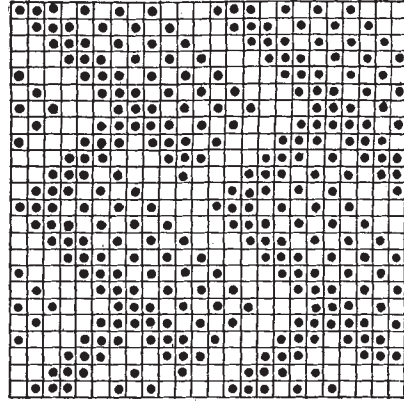
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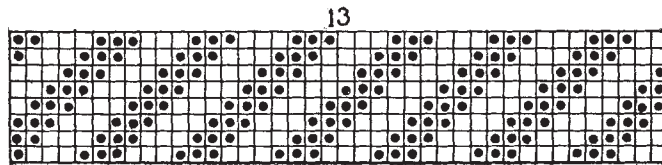
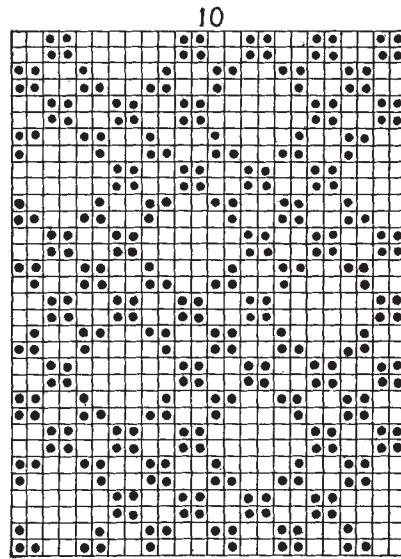
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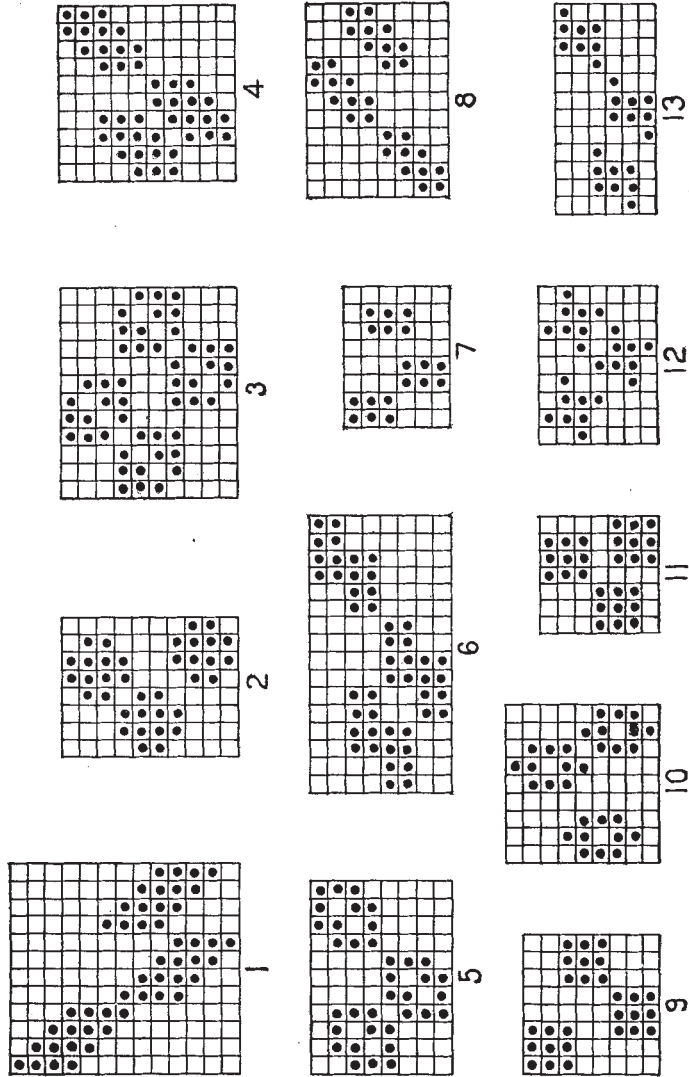


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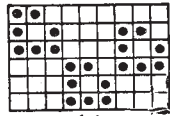


30 EXERCISES IN SPOT WEAVES.

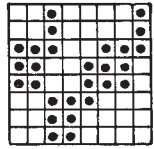
COMPLETE THE WEAVES FROM THE ACCOMPANYING PORTIONS.



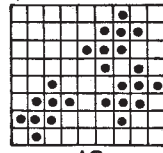
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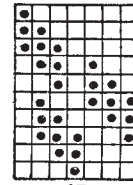
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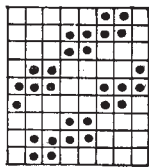
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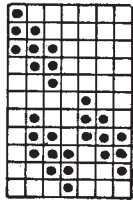
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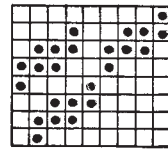
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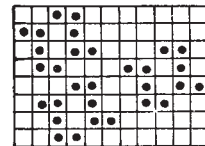
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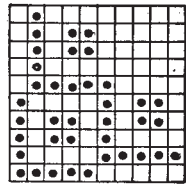
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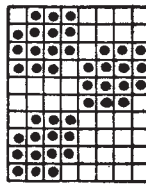
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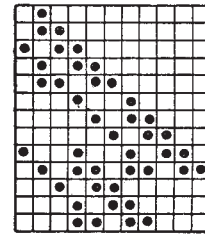
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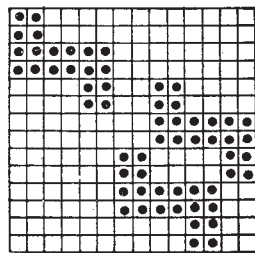
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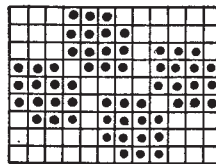
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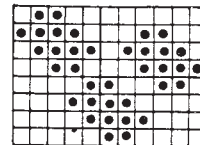
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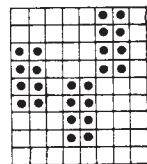
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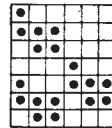
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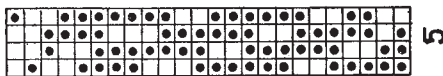
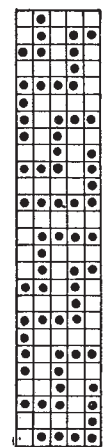
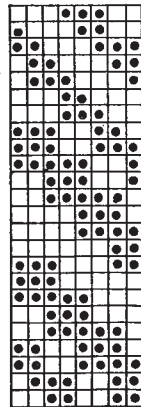
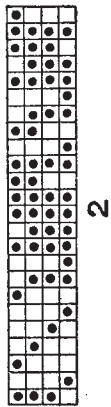
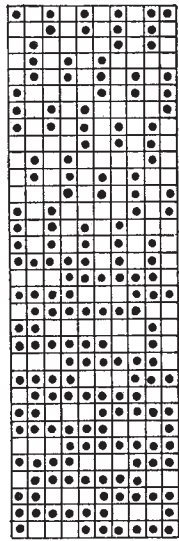
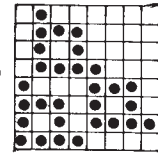
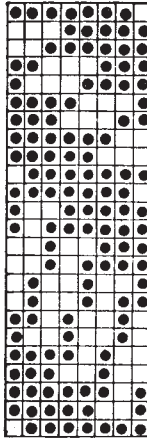
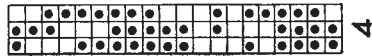
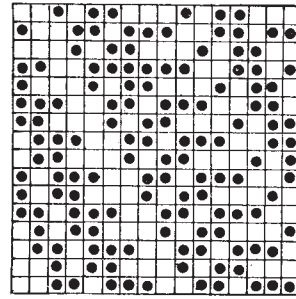
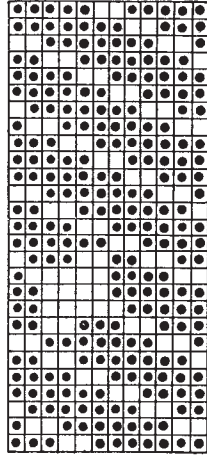
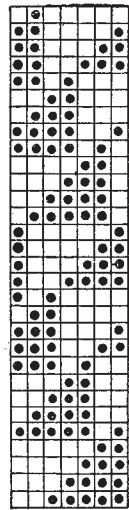


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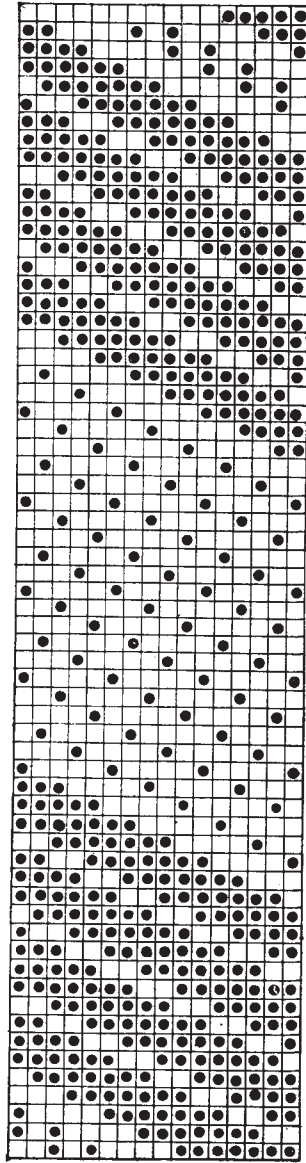
30

MAKE ONE COMPLETE REPEAT OF EACH OF THESE DESIGNS.

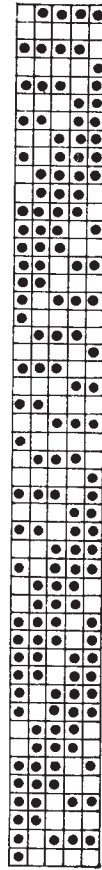


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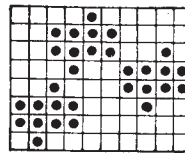




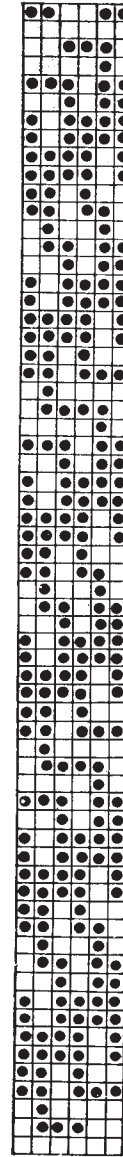
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12



15

COLOR EFFECTS.

**Influence of Color on Weaves, or the Application of Color to Fabrics.**

The great variety of patterns produced in all lines of fabrics, are many of them made on the same weave, the change in the pattern being obtained in the arrangement of the colors in the warp and filling. To understand how this change is made, it is only necessary to bear in mind that where warp is raised that color will appear, and where filling is on the surface that color will appear. These changes are called color effects, and the simplest form which can be designed is the common hair-line, which shows in the pattern one thread of a light color and one thread of a dark color, running lengthwise of the fabric. It is made on the plain weave. By careful study the method will be learned quickly, so that any number of effects can be produced.

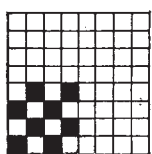


Fig. 46.

will appear. These changes are called color effects, and the simplest form which can be designed is the common hair-line, which shows in the pattern one thread of a light color and one thread of a dark color, running lengthwise of the fabric. It is made on the plain weave. By careful study the method will be learned quickly, so that any number of effects can be produced.

These color effects are made to get an idea of the appearance after weaving of any arrangement of colors on a certain weave. In making these color patterns, decide what weave is to be used. To commence, we will use the plain weave, Fig. 46. Next indicate the weave on the design paper by a small dot or faint mark, Fig. 47, which will serve as a guide which thread must

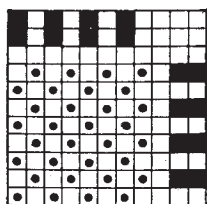


Fig. 47.

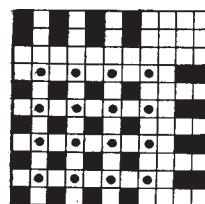


Fig. 48.

be raised. Then indicate at the top, and right-hand side of the design, the arrangement of colors (see Fig. 47) which we will assume to be one thread red and one thread green in the warp, and one thread green and one thread red in the filling. After having indicated the weave and the arrangement of colors, the next operation is to mark where the warp is raised as indicated

by a small dot, the mark or square to be filled with such color as indicated by the color on the top of design as shown in Fig. 48. When this has been done, mark every filling pick as indicated by the squares being left blank, which indicates the warp down, with such color as represented on right-hand side of design, Fig. 49.

This pattern in color is called "The Hair-line." The simplest change from this hair-line pattern is to produce the line effect across or in the width of the fabric; this effect is made on

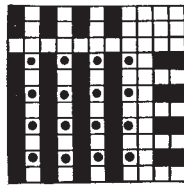


Fig. 49.

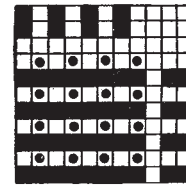


Fig. 50.

the same weave and arrangement of color in the warp, the only change being in the filling, which is one of red and one of green (see Fig. 50). The chief characteristic of such hair-lines and stripes, is that each color must cover its own or like color, that is, if red warp is down a red filling must cover it.

These color effects are the most important in designs for dress goods and in cotton, woolen and silk fabrics. Constant practice in making them will be of great assistance to the student, as an excellent experience will be obtained in regard to the various effects, and by the use of several colors the effect as in the cloth will be obtained.

*Explanation of Fig. 47.* The design is 8 threads by 8 picks, all plain or cotton weave. The small dots indicate which warp threads must be on the surface, the marks on the top indicate the color of such threads in the warp which must appear on the surface of the fabric. In this instance we will suppose the warp is dressed 1 thread black and 1 thread white all the way across. The marks on the right-hand side of Fig. 47 indicate the color of the weft or filling which must appear on the surface of the fabric.

*Explanation of Fig. 48.* Fig. 48 is like Fig. 47, with the warp threads lifted, squares filled out, showing the colors which are on

the surface. In Fig. 47, the first thread and first pick is represented by  $\square$  which indicates such thread to be lifted, and in Fig. 48 the corresponding square is filled up black, which is the color on the surface of the fabric, the 2nd thread and 1st pick is represented by  $\square$ , which indicates such thread to be down, and would be covered by the filling and the surface of the cloth would

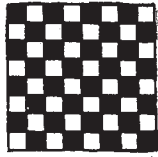


Fig. 51.

be the color of the filling. The second pick: the 1st thread is represented as down  $\square$ , this would be covered by the filling; the second thread on second pick is represented by  $\square$ , which indicates the thread to be on the surface.

The color mark over the second thread in Figs. 47 and 48 is white, therefore, white will be on the surface of the cloth.

*Explanation of Fig. 49.* This is like Figs. 47 and 48, but interwoven with the filling as shown at the right-hand side.

Detail: 1st pick white: under black and over white alternately.

2nd pick black: over black and under white alternately.

3rd pick like the 1st, 4th pick like the 2nd, and so on, thus forming the "Hair-line" pattern, one dark line and one light line down the cloth. In the hair-line design black covers black and white covers white.

*Explanation of Fig. 50.* The particulars for the warp colors and weave are identical with Figs. 47, 48 and 49, but the interweaving of the filling is important.

The first pick is black in place of white. The second pick is white in place of black, or black covers white and white covers black, thus making the dark line across the fabric as shown in Fig. 50.

*Explanation of Fig. 51.* This shows the effect of the plain weave, warp solid black, filling solid white.

Fig. 52 is an example of the plain weave on 8 threads and 8 picks, arranged in the following manner:

$$\begin{array}{l} \text{1st section} \\ \text{4 threads} \end{array} \left\{ \begin{array}{l} \text{4 threads and 4 picks, plain weave } \frac{1}{1} \\ \text{4 " " } \frac{4}{8} \text{ " " " } \frac{1}{1} \end{array} \right.$$

$$\begin{array}{l}
 \text{2nd section} \\
 \text{4 threads}
 \end{array}
 \left\{
 \begin{array}{l}
 \text{4 threads and 4 picks, plain weave } \frac{1}{1}. \\
 \text{4 " " } \frac{4}{4} \text{ " " " } \frac{1}{1}.
 \end{array}
 \right.$$

Explanation: 1st section consists of 4 threads, 8 picks high, divided into two parts, 4 threads and 4 picks regular  $\frac{1}{1}$  plain weave

- 1st pick — 4 threads, 1st up, 2nd down, 3rd up, 4th down.
- 2nd “ — 4 “ 1st down, 2nd up, 3rd down, 4th up.
- 3rd “ — 4 “ 1st up, 2nd down, 3rd up, 4th down.
- 4th “ — 4 “ 1st down, 2nd up, 3rd down, 4th up.

This is the first part of 1st section. See the first 4 threads and picks 1 to 4 and picks A to D, Fig. 52.

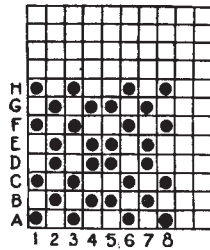


Fig. 52.

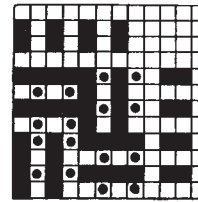


Fig. 53.

Second part of 1st section reads, 4 threads and 4 picks, plain weave, commencing with the second thread of the plain weave, which will read on the design paper:

$$\begin{array}{l}
 \text{1st section} \\
 \text{4 threads}
 \end{array}
 \left\{
 \begin{array}{l}
 \text{5th pick 4 threads 1st down, 2nd up, 3rd down, 4th up.} \\
 \text{6th " 4 " 1st up, 2nd down, 3rd up, 4th down.} \\
 \text{7th " 4 " 1st down, 2nd up, 3rd down, 4th up.} \\
 \text{8th " 4 " 1st up, 2nd down, 3rd up, 4th down.}
 \end{array}
 \right.$$

See Fig. 52. Threads 1 to 4 and picks E, F, G, H. This completes the first section, 4 threads and 8 picks.

Now take the second section of 4 threads, Nos. 5, 6, 7 and 8, in Fig. 52. First part reads 4 threads and 4 picks, plain weave, commencing with the second thread of the plain weave, which will read on the design paper :

1st pick — 5th thread down, 6th up, 7th down, 8th up.  
 2nd “ — 5th “ up, 6th down, 7th up, 8th down.  
 3rd “ — 5th “ down, 6th up, 7th down, 8th up.  
 4th “ — 5th “ up, 6th down, 7th up, 8th down.

Second part of section 2 reads 4 threads and 4 picks, plain weave, which reads on the design paper:

5th pick — 5th thread up, 6th down, 7th up, 8th down.  
 6th “ — 5th “ down, 6th up, 7th down, 8th up.  
 7th “ — 5th “ up, 6th down, 7th up, 8th down.  
 8th “ — 5th “ down, 6th up, 7th down, 8th up.

Fig. 53 is the same weaving plan as given in Fig. 52.

The warp is dressed 1 black and 1 white.

The filling is interwoven 1 white and 1 black.

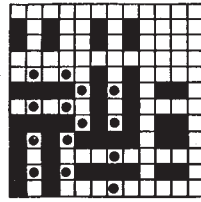


Fig. 54.

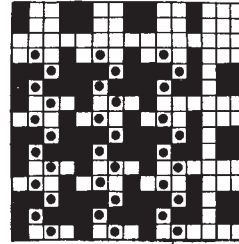


Fig. 55.

Fig. 54. The design is on 8 threads and 8 picks all plain weave,  $\frac{1}{1}$ .

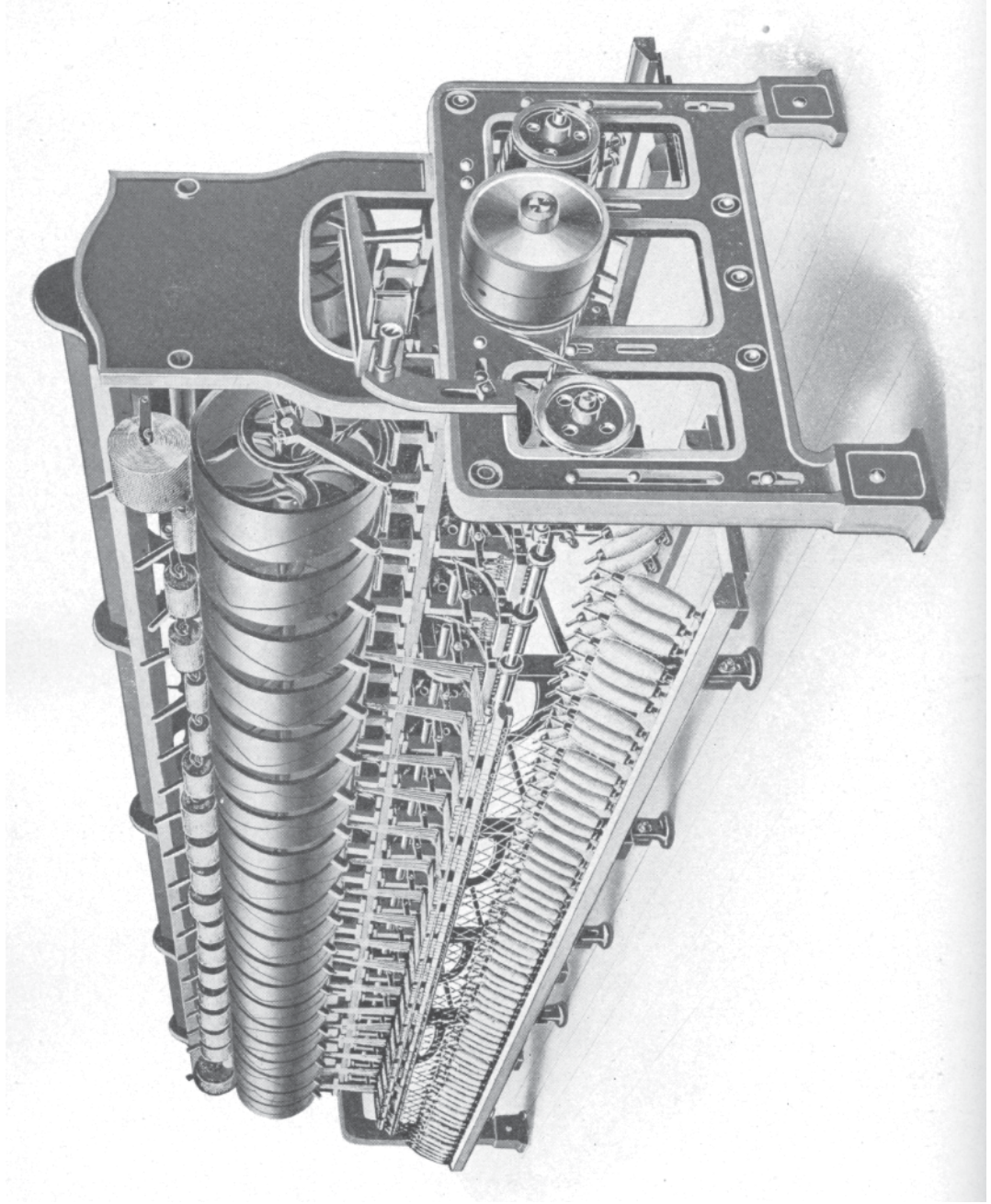
The warp is dressed 1 black, 1 white, 1 black, 2 white, 1 black, 1 white, 1 black; = 8 threads.

The filling is interwoven, 1 white, 1 black, 1 white, 2 black, 1 white, 1 black, 1 white; = 8 picks.

Fig. 55. This design is shown on 12 threads and 12 picks, all plain weave.

The warp is dressed 1 black, 2 white, 2 black, 2 white, 2 black, 2 white, 1 black; = 12 threads.

The filling is interwoven, 1 white, 2 black, 2 white, 2 black, 2 white, 2 black, 1 white; = 12 picks.



**THE MULLER PATENT TRAVERSE WINDING FRAME**  
Easton & Burnham Machine Co.


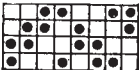
## EXERCISES FOR PRACTICE.

All on the Plain Weave.

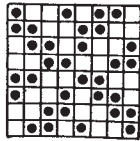
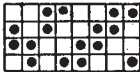
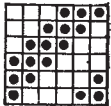

	WARP.		FILLING.
1.	1 Red 1 Black } 16 Threads.		1 Black 2 Red } 16 Picks.
2.	1 Red 1 Black } 16 Threads.		1 Red 1 Black } 16 Picks.
3.	1 White 1 Black 2 White 1 Black } 20 Threads.		1 Black 1 White 1 Black 2 White } 20 Picks.
4.	2 White 1 Black } 12 Threads.		2 White 1 Black } 12 Picks.
5.	2 Black 2 Green } 16 Threads.		2 Black 2 Green } 16 Picks.

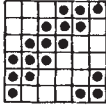
## EXERCISES FOR PRACTICE.

Sketch on point paper the effect produced by the following weaves and colorings.

	WEAVE.	WARP.	FILLING.
(1)		Color— 1 } =2 Ground—1 }	as warp
(2)	same as (1)	Color— 2 } =4 Ground—2 }	as warp
(3)	same as (1)	Color— 2 } =4 Ground—2 }	as warp
(4)	same as (1)	Color— 4 } =8 Ground—4 }	as warp
(5)	same as (1)	Color— 2 2 } =8 Ground—1 3 }	Color— 1 3 } =8 Ground—4. }
(6)		Color— 4 } =8 Ground—4 }	as warp

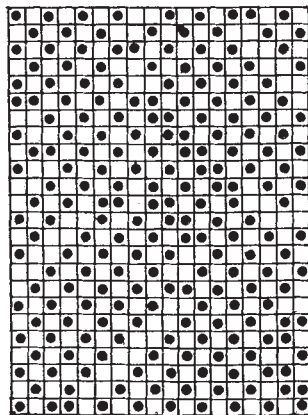


WEAVE.	WARP.	FILLING.
(7) 	Color— 1 1 } =4 Ground— 2 . } =4	as warp
(8) same as (6)	Color— 1 1 } =4 Ground— 2 . } =4	Color— . 1 } =2 Ground— 1 . } =2
(9) 	Ground— 2 2 } =8 Color— 4 . } =8	Ground— 3 1 } =8 Color— 4 . } =8
(10) 	Ground— 1 } =4 No. 1 Color— 1 } =4 No. 2 Color— 2 } =4	as warp
(11) same as (10)	Ground— 1 1 } =4 Color— 2 . } =4	as warp
(12) same as (10)	Ground— 3 } =6 Color— 3 } =6	Color— 3 } =6 Ground— 3 } =6
(13) same as (10)	Ground— 3 } =6 Color— 3 } =6	Ground— 1 } =2 Color— 1 } =2
(14) same as (10)	Ground— 1 } =3 Color— 2 . } =3	Ground— 1 } =2 Color— 1 } =2
(15) same as (10)	Ground— 1 } =3 Color— 2 . } =3	Ground— 3 } =6 Color— 2 1 } =6
(16) same as (10)	Ground— 1 1 3 2 } =12 Color— 1 1 3 . } =12	Ground— 1 3 3 } =12 Color— 1 3 1 } =12
(17) same as (10)	Ground— 1 3 } =6 Color— 1 1 . } =6	Ground— 1 } =3 Color— 2 . } =3
(18) same as (10)	Ground— 2 1 } =6 Color— 1 2 } =6	as warp
(19) 	No. 1 Color— 1 3 } =16 No. 2 Ground— 1 1 } =16 4 times twice	No. 2 Ground— All
(20) same as (19)	No. 1 Color— 1 1 1 2 2 } =24 No. 2 " 1 1 1 2 2 } =24 No. 3 Ground— 2 2 2 2 2 } =24	No. 3 Ground— All
(21) same as (19)	No. 1 Color— 1 1 1 2 2 } =24 No. 2 " 1 1 1 2 2 } =24 No. 3 Ground— 2 2 2 2 2 } =24	No. 2 Color— 1 1 } =4 No. 3 Ground— 2 . } =4
(22) same as (19)	No. 1 Color— 2 2 } =8 No. 2 Ground— 1 3 } =8	No. 1 Color— . 4 } =8 No. 2 Ground— 1 3 } =8

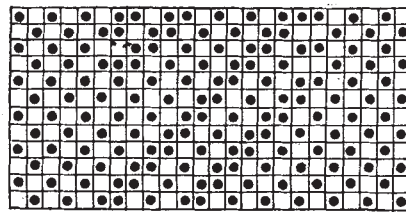
WEAVE.	WARP.	FILLING.
(23) 	$\left. \begin{array}{l} \text{No. 1 Color— } 1\ 2\ .\ .\ 2 \\ \text{No. 2 " } 1\ .\ 1\ 1\ . \\ \text{No. 3 Ground— } 1\ 1\ 2\ 2\ 1 \end{array} \right\} = 24$ <p style="text-align: center;">4 times</p>	$\left. \begin{array}{l} \text{No. 1 Color— } 1 \\ \text{No. 3 Ground— } 2 \end{array} \right\} = 3$
(24) same as (23)	$\left. \begin{array}{l} \text{No. 1 Color— } 1\ 3 \\ \text{No. 2 Ground— } 1\ 3 \end{array} \right\} = 36$ <p style="text-align: center;">6 times 4 times</p>	$\left. \begin{array}{l} \text{No. 1 Color— } 2 \\ \text{No. 2 Ground— } 1 \end{array} \right\} = 3$
(25) same as (23)	$\left. \begin{array}{l} \text{No. 1 Color— } .\ 1\ 1\ 3 \\ \text{No. 2 Ground— } 1\ 1\ 3\ 2 \end{array} \right\} = 12$	$\left. \begin{array}{l} \text{No. 1 Color— } .\ 1\ 3\ 1 \\ \text{No. 2 Ground— } 1\ 3\ 3 \end{array} \right\} = 12$
(26) plain	$\left. \begin{array}{l} \text{Ground— } 1\ 1\ 1\ 1\ 1 \\ \text{No. 1 Color } 3\ .\ 1\ 1\ . \end{array} \right\} = 40$ <p style="text-align: center;">4 times 4 times</p>	
(27) same as (26)	$\left. \begin{array}{l} \text{Ground— } 1\ 1\ 1 \\ \text{No. 1 Color— } 1\ 1\ . \end{array} \right\} = 20$ <p style="text-align: center;">4 times 4 times</p>	
(28) same as (26)	$\left. \begin{array}{l} \text{Ground— } 1\ 1\ 1 \\ \text{No. 1 Color— } 1\ 1\ . \end{array} \right\} = 5$	
(29) same as (26)	$\left. \begin{array}{l} \text{Ground— } 1\ 1\ 1\ 1\ 1 \\ \text{No. 1 Color— } 2\ .\ 1\ 2\ . \end{array} \right\} = 24$ <p style="text-align: center;">3 times twice</p>	

Sketch on point paper the effects produced by weaves 30 and 31 warped and picked 1 color

$$\frac{1}{2} \text{ ground}$$



30



31

**Design from a written formula.** Suppose a design is required similar to Fig. 56. The first question is; how many threads and picks are necessary to form the full design? Second; how many threads and picks are necessary for the large body square at the lower left-hand corner? Third; how many threads and picks are necessary for the small border squares? Fourth; what weave will be the most suitable for the required fabric?

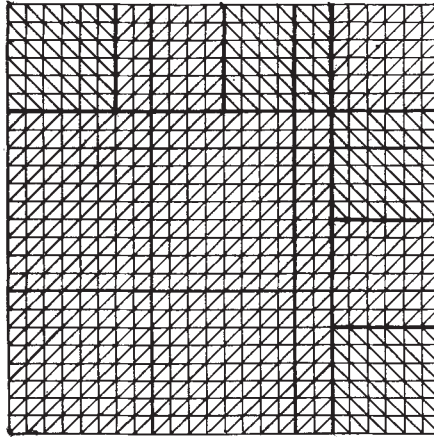


Fig. 56.

A design should never be made without taking into consideration the requirements of each operation and the effect to be produced. In the main body square of Fig. 56 the twill is running at an angle of 45°, and in the small squares the twill is running to the right and left in alternate squares. We will make our first design on 24 threads  $\times$  24 picks in one repeat of the design.

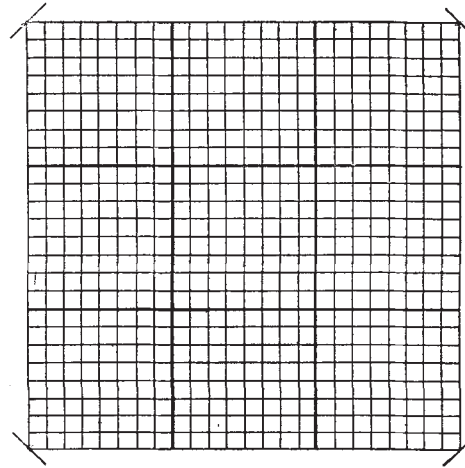


Fig. 57.

*First.* Mark off design paper to the required dimensions.

*Second.* How many threads and picks are necessary for the large body square A at the left-hand lower corner? In this instance  $18 \times 18$  are required. Mark off the design paper to the required number of threads and picks (See Fig. 58).

*Third.* How many threads and picks are necessary for the

small border squares B and C? In this case we will divide the border into four parts of 6 threads  $\times$  6 picks each way (See Fig. 59).

*Fourth.* On examination of the skeleton design of Fig. 59, we notice that it can be divided into four sections, 1, 2, 3, 4, as shown in Fig. 60.

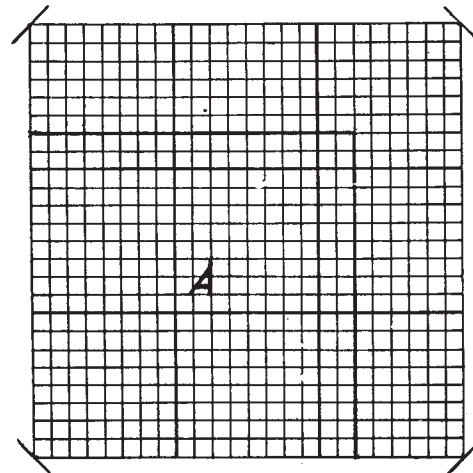


Fig. 58.

*Fifth.* Decide what weaves will be most suitable for the required fabric. This design Fig. 56 shows a fine twill or diagonal, therefore we will use the 3-harness twill, filling flush  $\frac{1}{2}$  to right and which we will call class weave "B1," also the 3-harness twill, warp flush  $\frac{2}{1}$  to left, and which we will call class weave "B2."

Now to construct the design from a written formula or problem.

**PROBLEM.**

**Dress Goods Design.**

24 threads and 24 picks.

Section 1.	6 threads $\times$ 18 picks	B1. See first section Fig. 60, 61
	6 " 6 "	B2.
	<hr/>	
Section 2.	6 " 24 "	B1. See second " " " "
	6 " 24 "	
	<hr/>	
Section 3.	6 " 18 "	B1. See third " " " "
	6 " 6 "	B2.
	<hr/>	
Section 4.	6 " 6 "	B2. See fourth " " " "
	6 " 6 "	B1.
	6 " 6 "	B2.
	6 " 6 "	B1.
	<hr/>	
	24	

**Harness, Heddles and Eyes or Mails.** At this point the student should begin to examine into the practical carrying out of his designs at the loom. The first step in this direction is to deal with the arrangement of the warp threads in the heddles on

the harnesses, or, as it is termed, "warping and dressing;" and the next will be the method of actuating the harnesses by means of a chain, or order to produce the required pattern.

In this, as in all other work, there must be some recognized means of conveying or indicating the order in which the threads must be drawn through the harness.

When the weaver is standing in front of the loom, whether hand or power, the harnesses are in front of him, as in Fig. 62, which represents a common hand loom, such as is adapted for plain weaving. It consists of four wooden posts framed together at the top by two long cross pieces. The two long pieces C C are called the capes of the loom. Between the two pairs of posts, forming the ends of the loom, are placed two cylindrical beams; the beam A being the warp beam, upon which the warp is wound, and B the cloth beam, upon which the cloth is wound as it is woven.

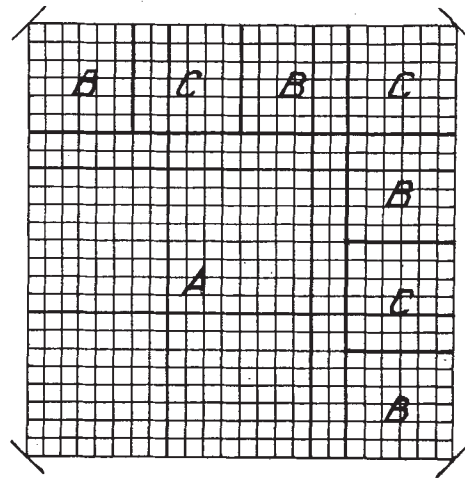


Fig. 59.

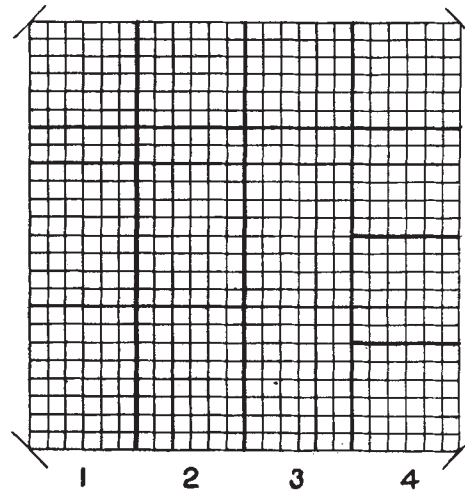


Fig. 60.

The warp threads are placed parallel to each other, as before described, and are carried from the warp beam A and attached to the cloth beam B. This is done by threading the

knotted ends of the threads upon a small rod, and wedging it into the slot or groove formed in the beam for that purpose, as shown at X in Fig. 63.

In order to keep the threads in their relative positions and parallel to each other, two rods D D are inserted between the warp threads in such a manner that each thread passes over one of the rods and under the other alternately, as shown. Thus a cross or leese is formed by the threads between the two rods, which not only keeps the threads in proper order, but enables the

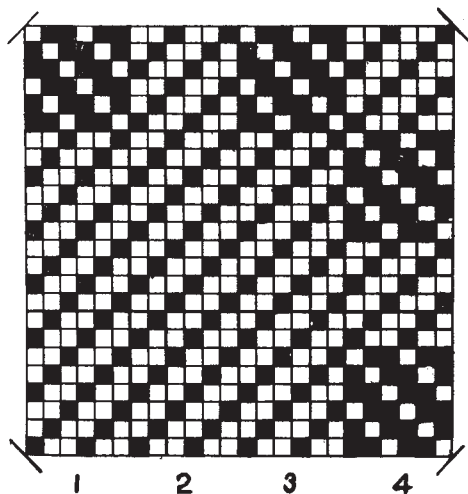


Fig. 61.

weaver to detect with ease the proper position of any broken thread that he may have to repair. This arrangement of the threads is formed during the process of warping or warp dressing and slashing.

After the warp has passed the leese it is then passed through the heddles, as shown at H in Figs. 62 and 63. The heddles are composed of a number of threads or wires threaded between laths or harness shafts. Each wire or thread has a loop in the middle, or, instead, an eye called a mail or heddle eye is threaded upon it, through which the warp thread passes. There are two heddles shown at H H, one of which receives every alternate thread of the warp, and the other receives the remainder. Consequently, if either of them be raised, it will also raise the warp threads which have been threaded through the heddle eye or mails.

The arrangement of the warp threads, and the various parts of the loom which operate them may be best understood by referring to Fig. 64, which is a diagram showing each warp thread separately.

In Fig. 64 the harness shafts are shown connected and balanced by cords passing over pulleys, P P, and the lower part

attached to the treadles T. The right treadle is shown depressed, consequently it raises the other treadle and the harness. Thus

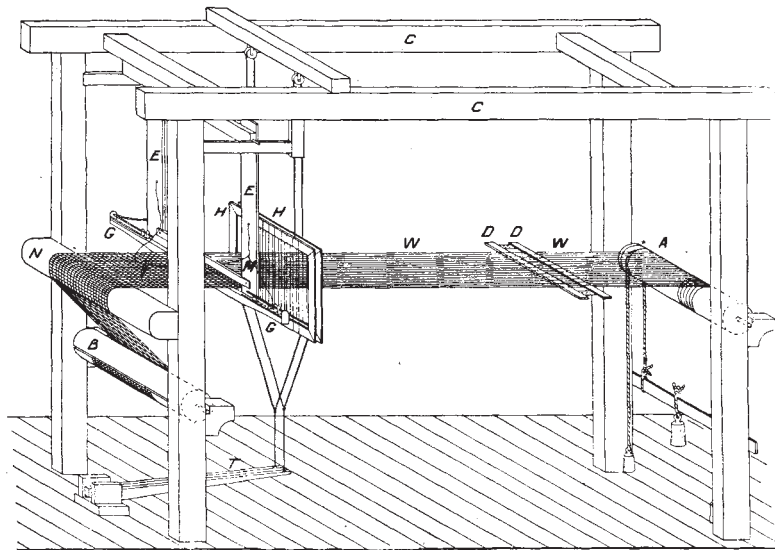


Fig. 62.

half of the warp can be alternately raised for the passage of the shuttle.

The warp is kept in tension by means of weights connected

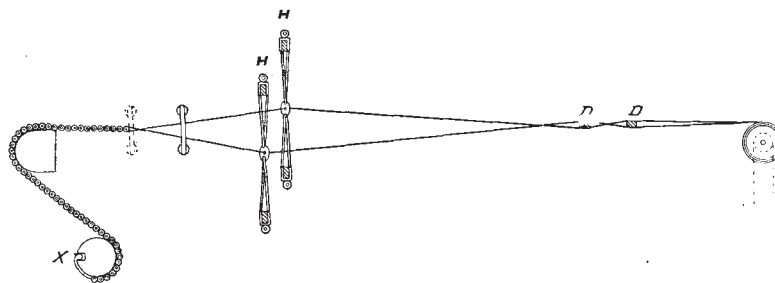


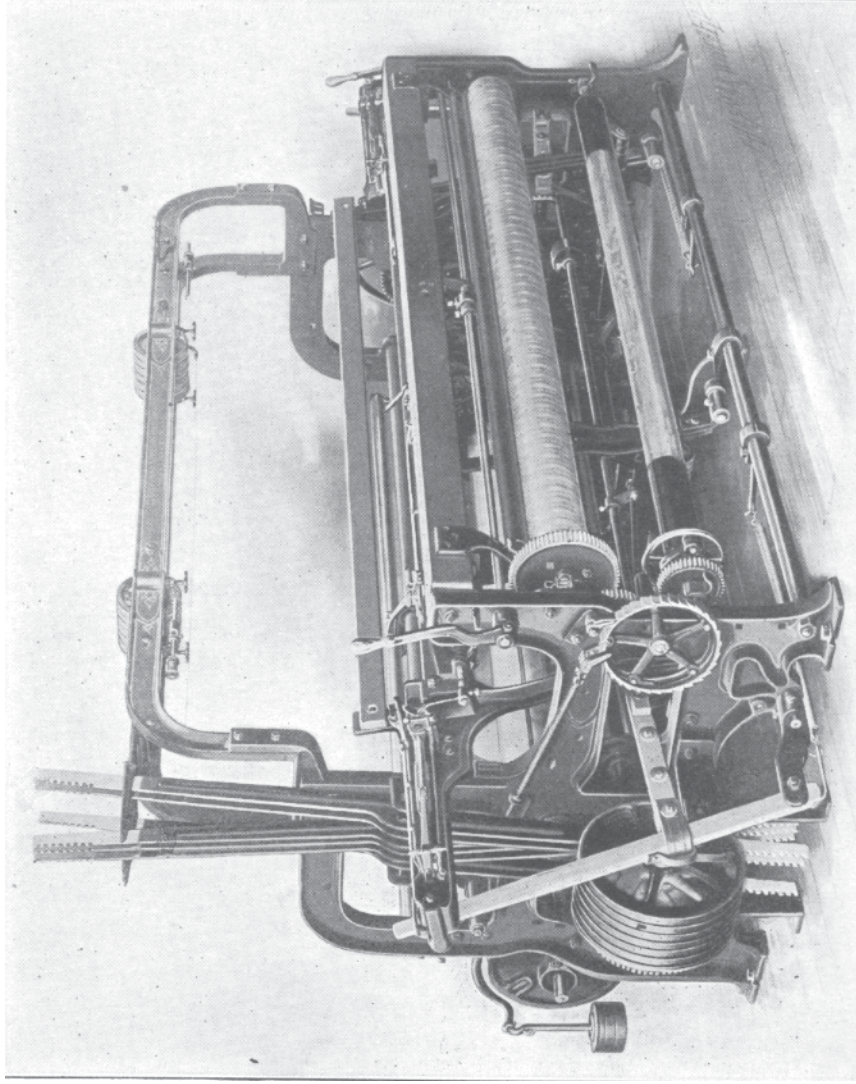
Fig. 63.

to a rope passing once or twice round the warp beam. The cloth beam is provided with a ratchet wheel and pawl M, also with a handle Z, for winding on the cloth as it is woven.

In Fig. 64 only one each of the leeses is shown, but as







**KNOWLES CLAY TWILL LOOM WITH 80-INCH REED SPACE**  
Crompton & Knowles Loom Works

# TEXTILE DESIGN.

## PART II.

### ACTUATING THE HARNESSSES.

**Drafting and Reduction.** This is an important part of designing, and necessary for the production of extended patterns on a limited number of harnesses.

Although presenting no great difficulty to those wishing to understand the operation, yet it is surprising that so much ignorance exists in reference to it, even by those conversant with other aspects of the art of weaving. In the design for the pattern, drafting deals with 2 or more threads which are found to be always working alike, that is, always up and always down together, throughout the weaving operation. This unites them in one motion or harness, instead of employing separate harnesses for each individual thread. By this means a great variety of effects may be obtained, and large patterns produced



Fig. 65.

in looms having the simplest appliances. Especially is this the case in the weaving of stripes, in looms capable of allowing only a limited number of harnesses, and with only one shuttle. But for the production of checks and stripes requiring a large number of picks and threads before the pattern repeats, the Dobby head or an equivalent motion is necessary. For this reason, although a design may be drafted so as to employ but few harnesses, yet the number of picks cannot be reduced, but must be fully carried out to the extent of the design.

For the purpose of representing the harnesses, draw horizontal lines after the manner of Fig. 65, and then adopt a system of indicating the warp threads. A good, neat method is shown in Fig. 66. Here the horizontal lines represent the harness shafts, and the vertical lines the warp threads. The point at which the

vertical line stops indicates the heddle through which the warp thread is drawn. This form indicates at a glance the order of the draft. Another method is shown in Fig. 67, but as will be presently shown, this is not as convenient, and it is better to employ this manner of marking for another purpose. A third form (see Fig. 68) employs numbers instead of the vertical lines ; this form

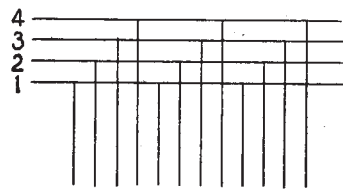


Fig. 66.

is commonly used, and is very convenient. A still more convenient method is to use design paper ; this will be resorted to later on, but, for the beginner, it is better to work on the plan shown in Fig. 66. When

he has thoroughly mastered the system of drafting, he can resort to whatever method he finds most convenient.

Let us turn to the actuating of the harnesses to produce the design. It will be most readily dealt with by following the method employed by hand-loom weavers, as this will enable the question of drafting and the actuating of the harnesses to be considered at the same time. Suppose a plain cloth is to be woven. Where every alternate thread is alike, as explained under the head of plain cloth, there would be only 2 harnesses required, one to actuate the first, third, fifth, etc., and the other to actuate the second, fourth, sixth, etc., threads.

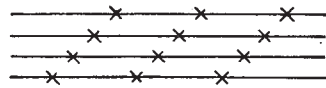


Fig. 67.

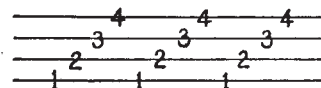


Fig. 68.

The draft and treading plan as made for the hand-loom weaver is shown in Fig. 69. The horizontal lines represent the harnesses ; the vertical lines at the left the warp threads ; the vertical lines at the right the hand-loom treadles ; the cross at each intersection indicates the harness to be raised by the treadle ; and the numbers upon the vertical lines at the right indicate the order in which the treadles are to be depressed. In this case the weaver depresses his right foot for the first pick, his left for the

second, and so on. For a plain cloth this is exceedingly simple, more especially when only 2 harnesses are employed, but sometimes 4 or more are used.

It will be well to examine the drafts for the use of 4 or more harnesses, as it will be the simplest means of making the subject clear and preparing the way for more advanced work.

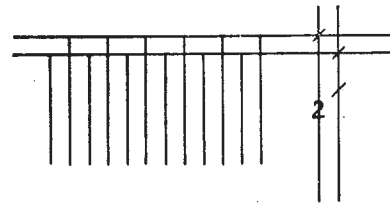


Fig. 69.

Let us turn to Figs. 70 and 71. They are both plans for weaving plain cloth upon 4 harnesses, the first by what is known as the straight draft, and the second by a cross draft. This means that in the first case the warp threads are drawn through each of the heddles consecutively, and in the other that they are crossed from the first to the third and second to fourth. Now, if the threads are to be raised alternately, the harnesses carrying the alternate threads must be raised at the same time, no matter what position they occupy in the series. This first portion must be thoroughly understood. The student must accustom himself to following the threads, and actuating the harnesses which carry them in exactly the order required.

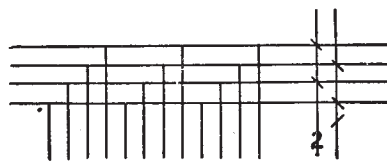


Fig. 70.

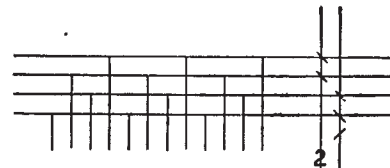


Fig. 71.

In Fig. 70, treadle No. 1 is attached to the first and third harnesses, always counting from front to back or from that nearest you. These 2 harnesses carry between them alternate threads. Treadle No. 2 is attached to the second and fourth harnesses and actuates the threads not touched by No. 1; consequently by depressing the treadles alternately, plain cloth will result. In Fig. 71, the first and second harnesses are attached to No. 1 treadle, and the third and fourth to No. 2; the reason for this

will be apparent on examining the draft, for the first and second harnesses in this case carry the threads corresponding to those carried by the first and third in Fig. 70, so that the result will be the same.

An explanation must be made here to those who have some knowledge of power looms. The system of attaching jacks and vibrators of the harnesses in power looms is different from attaching the treadles in the hand loom. Thus, in making the plans, it would appear at first sight that the process in one case is exactly the reverse of that of the other. In the power loom there is a separate jack and vibrator attached to each harness, while in the hand loom each treadle is attached to as many har-

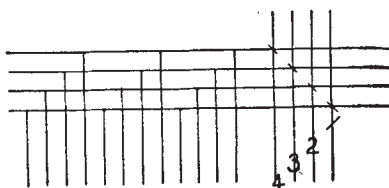


Fig. 72.

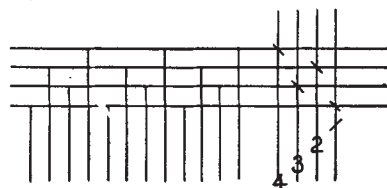


Fig. 73.

nasses as are required to be raised or depressed at once. The difference is: the hand-loom weaver depresses one treadle only for one pick, whereas the power loom depresses as many jacks or vibrators as there are harnesses to be acted upon. Thus the hand-loom treadle represents one pick of filling or one horizontal line of the design. This apparent confusion is overcome by reading horizontal for vertical, and *vice versa*. This, however, will be more fully explained later.

Now leaving the plain cloth drafting, let us consider twilled fabrics. What is known as the 3-harness or prunella twill is dealt with in the same manner as the plain weave, but 3 harnesses or sometimes 6 are employed instead of 2, thus simply doubling the number, as has been shown in the plain weave. In working 4-harness twills the same principles apply, but there is a little more complication of detail.

Take first the ordinary 4-harness  $\frac{1}{3}$  twill; suppose we wish to work with the draft given in Figs. 70 and 71, because it is

quite clear that as there are only 4 threads in the design it can be woven on 4 harnesses. We must now look to the order of treading, or building the harness chain, as it is termed, or raising the harnesses. To follow out the principle explained in connection with Figs. 70 and 71 it would be necessary to raise the harnesses in the order shown in Figs. 72 and 73.

It is necessary to follow each thread, and ascertain whether or not they follow in the order required.

Having reduced the design to the least number of requisite harnesses, the working plan or chain is found by taking the consecutive numbers from No. 1 to the highest figure shown beneath the design and placing them side by side in their order, according

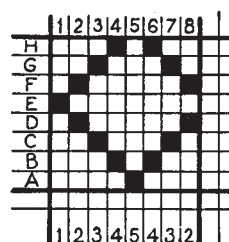


Fig. 74.

to the requirements of the design, so that they shall read 1, 2, 3, 4, 5, 6, 7, 8 and so on. This will be seen in Fig. 74, which is given to show the principle of drafting and reduction in its simplest form. It is, however, the same as applied to the more elaborate patterns. The numbers beneath the design are used for the purpose of obtaining those threads that are working alike, and also to obtain the nature and extent of the draft.

Fig. 75 shows the drafting or the threads drawn through the harnesses, as taken from the design, and the numbers beneath correspond with those found under the design. The horizontal lines represent the harnesses, and the vertical lines represent the threads.

Fig. 74 represents a diamond pattern of which the design stands upon 8 threads. See numbers on top. Begin at the bottom at the left-hand corner, and note the dotted spaces of each thread, which means their manner of working, from the bottom to the top. When 2 or more threads are marked exactly alike, the same number at the bottom represents all of that kind. Thus the 1st thread is marked No. 1, and, of course, will require one harness to work it; the 2d thread is working differently from the 1st, and will require another harness, marked No. 2; the 3d, 4th and 5th threads are also different from any of the others, and so will require different harnesses for each. They are marked Nos.

3, 4 and 5. The 6th thread is marked 4 because it is working like the preceding thread marked 4, the 7th thread is marked 3 because it is like the preceding thread marked 3; and the 8th thread is marked 2 for the reason that it is working like the first thread marked 2. The numbers under the design now read 1, 2, 3, 4, 5, 4, 3, 2; therefore the highest number is 5, which means that the design requires 5 harnesses to weave it. What-

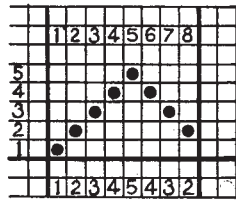


Fig. 75.



Fig. 76.

ever the highest number may be, it represents the number of harnesses required. In this instance five parallel lines are drawn for the harnesses and marked up the side 1, 2, 3, 4, 5. Now proceed to draw vertical lines to represent the threads drawn through the harnesses, indicated by the numbers under the design, and

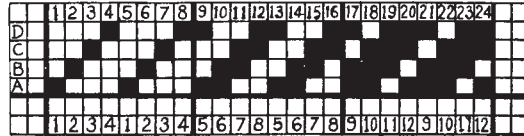


Fig. 77.

just in the order in which they stand. No. 1 is drawn upon the first harness, No. 2 upon the second, No. 3 upon the third, No. 4 upon the fourth, No. 5 upon the fifth, No. 6 again upon the fourth, No. 7 upon the third, and No. 8 upon the second. (See Fig. 75.) Having finished the draft, the next proceeding is to obtain the working plan or chain, which is a reduction of the design, so far as the threads are concerned. In this case the consecutive numbers from 1 to 5 are found together, so that the only requirement is to copy exactly the first 5 threads of the design as they stand, as shown in Fig. 76.

The next examples comprise mixed weaves and are of a more extended and practical character. For the purpose of gaining the working plan from them, use the consecutive numbers from No. 1 to the highest. These are not all together as in Fig. 74.

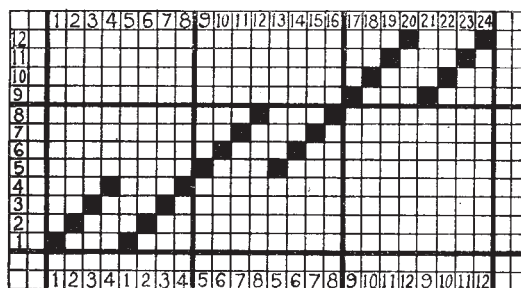


Fig. 78.

Fig. 77 consists of 24 threads and 4 picks, and is made up of three different weaves. Each weave is repeated, so that the first four numbers under each different weave must be taken for the working plan or chain, which gives the numbers consecutively, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. Fig. 78 represents the Drawing Draft. This design requires 12 harnesses to weave it. (See the chain draft of Fig. 79.)

There is another consideration in reference to drafting which ought to be understood, and that is, that frequently the full design is not given, only the draft and working plan, so that the weave intended to be produced is not always intelligible. Many designers adopt this method for the purpose of economizing time, and in practical work in the mill it may be recommended, not only for concealment, but because the draft and working plans are all that are necessary for the pattern weaver, chain builder or loom fixer.

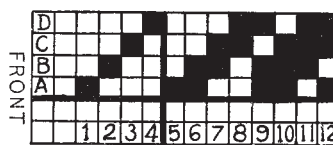


Fig. 79.

In order to obtain the full design from the reduced working plan and drawing-in draft, reverse the method adopted in the previous examples and follow the draft and chain in the same manner as with the design when making a reduction. Number



the threads consecutively at the top of the drawing-in draft, so that the place for each particular thread in the extended design will be indicated. A simple illustration will explain this. In this pattern (see chain draft, Fig. 80), 6 harnesses are required,

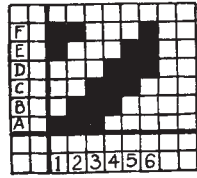


Fig. 80.

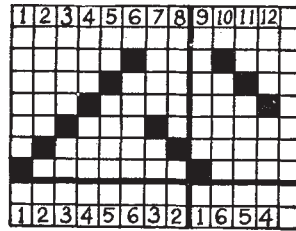


Fig. 81.

on which are drawn 12 threads to complete the pattern. (See drawing draft, Fig. 81.) Thus the working plan contains 6 threads. Another method sometimes adopted shows the working chain of the design, as in Fig. 80, but has the draft indicated by figures, and not on parallel lines.

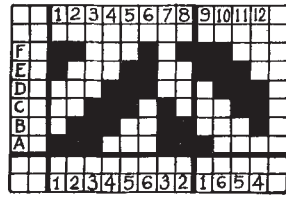


Fig. 82.

For instance, take the draft for Fig. 81, the numbers for which would read 1, 2, 3, 4, 5, 6, 3, 2, 1, 6, 5, 4. To make this clear, draw as many horizontal lines as represented by the highest number, which in this case is 6; then number the lines consecutively, and proceed to draw the vertical lines upon them

according to the numbering of the threads. This gives the draft as in Fig. 81. For design represented by these drafts, see Fig. 82.

Examples. Reduce Figs. 83, 84 and 85 to the fewest possible number of harnesses.

**TWILLING.**

**Flushes.** Diagonal twills or cords that run obliquely across the cloth may vary in size according to the number of harnesses on which they may be drawn in consecutive order. This manner of drawing is technically termed a straight over-draw. Twills are generally named according to the number of threads that will

complete the design. This is technically termed a repeat. Thus, weave  $\frac{1}{2}$  is known as a 3-harness twill, filling flush; the weave  $\frac{2}{1}$  is called the 3-harness twill, warp flush. It may be stated here that when practicable, the smallest number of harnesses

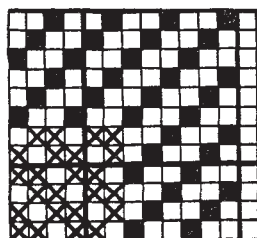


Fig. 83.

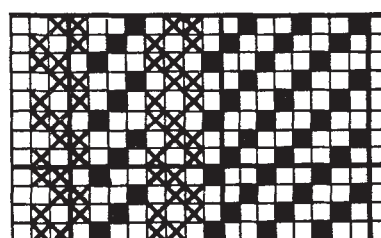


Fig. 84.

should be raised and the greatest number depressed in weaving special makes of cloth. In this manner the wear and tear of the yarn is much reduced; the only objection to this, being that in a warp flush face weave, the surface of the goods is woven face down and cannot be seen by the weaver.

The 4-harness twill, filling flush, is formed by the filling passing over 3 threads of warp and interweaving at the fourth

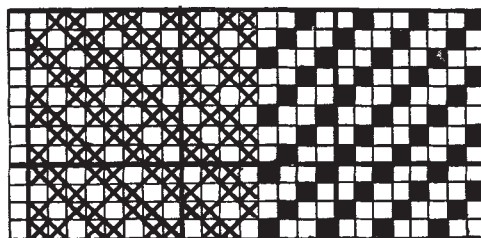


Fig. 85.

thread. The 5-harness twill, warp flush, is formed by the filling passing over only 1 thread of warp, interweaving at the second thread and passing under 4 warp threads. The 5-harness twill, filling flush, is exactly the reverse of the warp flush. Fig. 86, plain weave; Fig. 87, 3-harness twill; Fig. 88, 4-harness

twill ; Fig. 89, 5-harness twill ; Fig. 90, 6-harness twill. It should be understood that all marks, unless otherwise explained, are risers, and all blanks or spaces are sinkers: therefore, in Figs. 87, 88, 89, 90, the fillings predominate on the face and are called respectively 3, 4, 5 and 6 harness filling flush weaves. If the weaves had been reversed, that is, if crosses or black marks had been put in the squares which are now blank, the weaves would be warp flush weaves. We now understand a regular twill to run in small diagonal lines, bars or cords, at an angle of 45 degrees or obliquely across the fabric. It may be a filling flush, warp flush, or an even-balanced twill, according to the weave used.

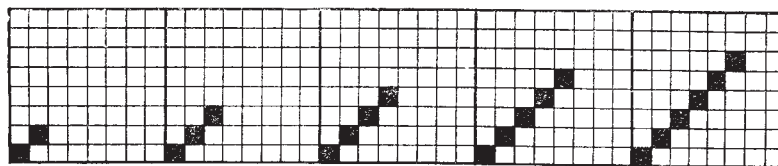


Fig. 86.

Fig. 87.

Fig. 88.

Fig. 89.

Fig. 90.

When the consecutive lifting of the harnesses or scheme of successive interlacing with filling is changed, so as to raise the harnesses at intervals of 1, 2, 3 or more from each other, the twill or diagonal stripe is said to be broken, and it will be observed that the flushing does not run at an angle of 45 degrees, but is broken according to the intervals of interlacing and the disposition of the harnesses.

We must now consider this broken effect as compared with the regular disposition of the harnesses running in consecutive order. When the harnesses can be raised regularly, at intervals of 2, 3 or more from each other, the weave is said to be a Sateen of a perfect order; but if the intervals cannot be so arranged, or the weave will not admit of this regular intermission, then the weave is not a true sateen, although we find many of these imperfect weaves forming the groundwork of many fabrics.

The smallest number of threads that can be arranged to make a true sateen is the 5-harness twill, the arrangement of which is 1, 3, 5, 2, 4. Six harnesses do not admit of such a disposition. The 7-harness twill is perfect, admitting an interval of

1 or 2 harnesses. Eight harnesses is the lowest number used in making an evenly numbered weave that can be transformed into a true sateen. By experimenting we find that by an interval of 2 we have a most perfect sateen. The 9-harness twill is perfect, each alternate harness lifting. The 10-harness twill is a good sateen, every third harness being raised. The same order of interweaving is shown by the 11-harness twill, which makes a perfect sateen. The 13-harness weave is formed by raising every third. The 15 is made by lifting every other third harness. The 16-harness sateen is made by omitting 2 or 4 threads. It may

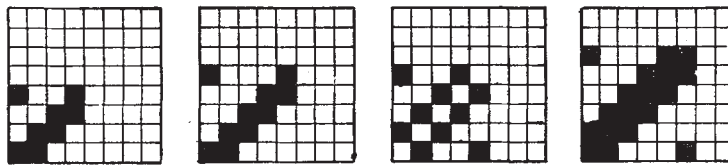


Fig. 91.

Fig. 92.

Fig. 93.

Fig. 94.

be remarked here that all twills of an uneven number, except the 3-harness twill, will produce perfect sateen arrangements. With the even numbers imperfections are often found. The preceding remarks apply either to the filling or warp flush weaves, where 1 thread is either up or down and the remaining number covered either by filling or warp.

Our next consideration will be *fancy twills*, or effects that are obtained by using any number of harnesses in any fixed weave. For instance, to make the 4-harness twill, 1 up and 3 down, into another variety or effect, we can take 2 up and 2 down. This is called the 4-harness Cassimere or Shalloon twill. With a larger twill the flushing can be varied by interspersing the weave with plain texture, as, for instance, the 7-harness changed to 1 up 1 down 1 up 1 down 2 up and 1 down, and so on.

**Fancy Twills.** Examples are here given (Figs. 91 to 100) of what are termed fancy twills, and it will be seen how an endless variety of patterns may be obtained from them.

Twills that run obliquely will form the groundwork for wave effects, either in the direction of the filling, across the fabric, or in the direction of the warp, that is, with the length of the

fabric. Take, for example, the 4-harness twill, filling flush; draw this straight over on 4 harnesses and raise the harnesses as shown in Fig. 101. By studying this wave weave, we find that it is the common 45-degree twill for 4 picks and that it then twills to the left, thus: 1, 2, 3, 4, 3, 2, which makes a zigzag or wave effect in the direction of the warp. If we use the 4-harness  $\frac{1}{3}$  twill and draw the threads through the harness, 1, 2, 3, 4, 3, 2 (see Fig. 102), which is the same order as given in the preceding example,

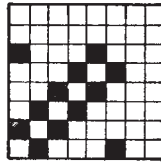


Fig. 95.

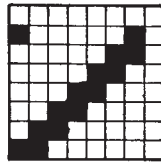


Fig. 96.

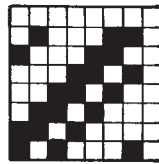


Fig. 97.

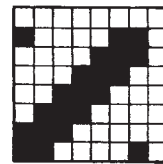


Fig. 98.

the effect or result in the fabric is a zigzag across the piece or in the direction of the filling.

**Reverse Twills.** In all the regular twills, as shown in Figs. 87 to 90, the filling predominates on the face of the cloth, and the warp on the back of the cloth. Take the 5-harness twill for an example; if the warp is of one color and the filling another, as there is 1 thread up and 4 threads down, it follows that four-fifths of the filling will be on the face and one-fifth on the back, thus changing the appearance of the filling from one side of the fabric

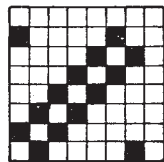


Fig. 99.

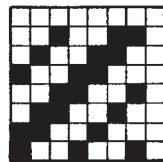


Fig. 100.

to the other. This is called *reversing the twill*. It is very extensively applied in different branches of weaving, particularly in the cotton and linen trades. We will take for example the reversing of the 4-harness twill, and make

a stripe of 12 threads warp flush and 12 threads filling flush. In this example (Fig. 103) we notice that it takes 4 extra harnesses, that is, 4 harness for the filling flush and 4 harness for the warp flush weaves. Patterns of this description may be extended to any width of stripe, as they are formed and regulated

entirely by the quantity of warp drawn on each set of harnesses. These examples will be sufficient to show the nature of reversed twill stripes, the varieties of which may be increased at pleasure by means of additional harnesses, and by varying the size of one or both stripes.

The next variation of the reversed twill is to form on the same stripe, the warp flush and filling flush effect alternately. (Fig. 104.)

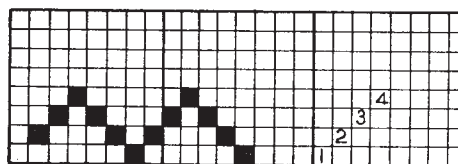


Fig. 101.

We find that there are 12 picks filling flush

weave and 12 picks warp flush weave. We will now go a little farther with these examples, combining the two systems so as to make a checker or dice board effect. In making designs of this character, attention should be drawn to the divisions of the two

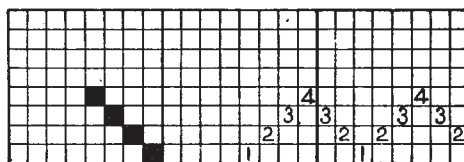


Fig. 102.

weaves. Where they unite, the line must be distinctly defined, that is, to make them unite in a perfect cut. This will be better understood by referring to Fig. 104,

at the extreme sides of which, top and bottom, it will be found that the raising marks of

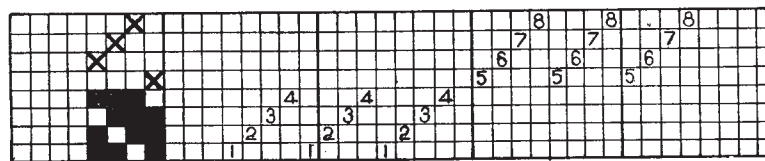


Fig. 103.

one division fall exactly on the sinking marks of the other compartment. This figure represents a perfect cut.

**DIAPER WORK AND POINT DRAWS.**

**Damask.** From what has been said in regard to fancy twills,

and from examples that have been worked out, it will not be difficult to understand the drafting of the cloth known as Damask. Instead of straight-over drafts, damask designs are usually woven by means of what is termed a diamond draft; that is, a draft that runs from the front harness to the back harness and then returns to the front in the opposite order, thus forming a zigzag figure on the harness. Sometimes there are patterns of a more complex character woven on this system of drafting. This will be explained under the head of double, triple and alternate diamond drafts.



Fig. 104.

The length or number of picks in the repeat of the design is worked out on the same principle as the draft for the warp. (See Fig. 105.) Whatever variety, therefore, is adopted for the ground work or plan, according to the foregoing explanations, the result of the extended pattern will be nearly double the number of

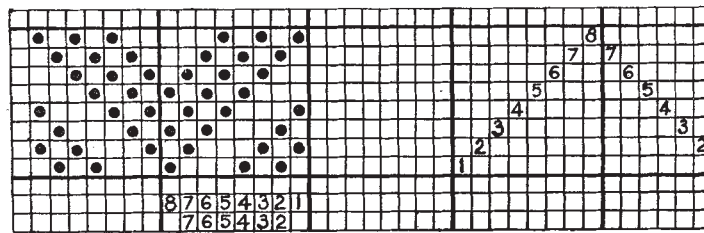


Fig. 105.

ends in the warp. The additional threads and formation of twill will be in direct opposition to the original ground plan. As the filling is also carried out on the same principle as the warp, the design is nearly doubled by the picks, the resulting design or twill

being run in the opposite direction. Thus a square or diamond figure is commonly produced. It must be particularly noticed that there is only one thread drawn on the first and last harness, and that the filling returns on the same scheme, so the whole design will be nearly four times the original figure.

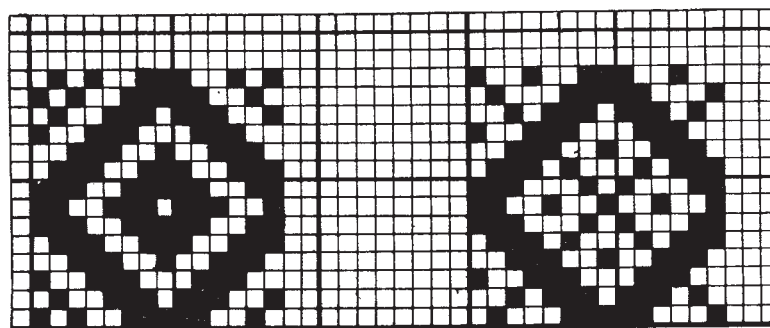


Fig. 106.

Fig. 107.

The smaller weaves of this kind produce only a limited number of figures, generally a small diamond with a dot in the center, which gives the resemblance of an eye; hence this variety of design is called a Bird's-eye. But when we use 8 harnesses or more, they admit of considerable diversity in flushing, twilling and the addition of plain texture, thus deviating from the formal

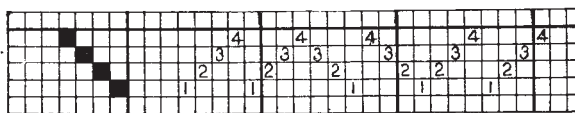


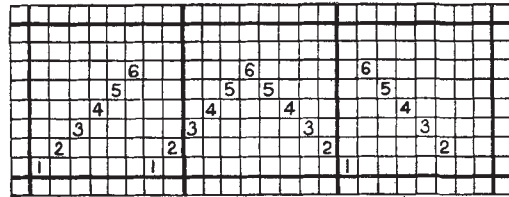
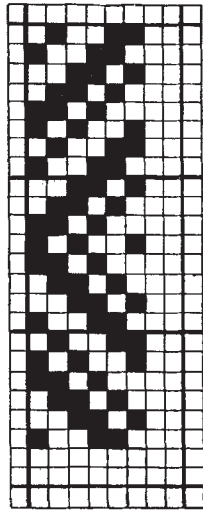
Fig. 108. DOUBLE DRAFT.

Bird's-eye. The design now assumes the appearance of damask work.

**Double Draft.** These examples show what a great variety of figures can be woven on the damask work principle, especially those of a large ground or original figure. All of these figures are produced by the extension of the diamond draft. As the resources of fancy weaving are inexhaustible, various other changes can be effected by merely diversifying the order or succession of the draft independently of the position of the filling.



As every extension of the draft in this manner enlarges the figure in a duplicate proportion, that is, as the square of the number of threads in one set of the draft, such patterns, when the harnesses are numerous, will occupy a considerable space on design paper. In all double drafts it should be understood that the filling or picks are extended in the same order as the warp draft.



DOUBLE DRAFT.

Fig. 109.

The double draft, Figs. 108 and 109, with any system that may be adopted, always produces two square or diamond effects. These are formed one within the other, and are again surrounded by others of the same character.

**Triple Drafts.** Fig. 110. A triple draft enlarges the dimensions of these patterns still further, producing three similar designs, one within the other. These figures are generally termed concentric designs. From this example it will appear that any number of concentric figures may be formed by repeating the draft any number of times straight over the harnesses in one direction, and by returning in the opposite direction an equal number of times.

**Alternate Drafts.** Fig. 111. Another method of diversifying the drafts of lined work patterns is by dividing the harnesses into two sets. Take 10 harnesses, for example, which, when divided,

should form 2 sets of 5 each. On either set we can make a diamond point, double or triple draft. This arrangement throws the group of small figures produced by each set of harnesses into alternate squares, somewhat resembling the draft-board pattern, each square again being composed of diaper or damask work. The

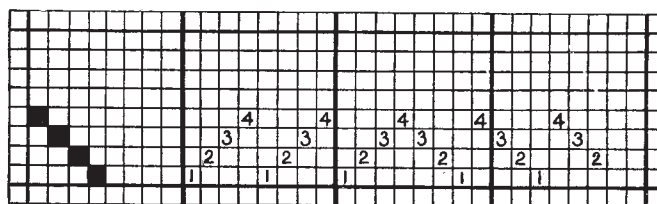


Fig. 110. TRIPLE DRAFT.

following draft is an explanation in itself. To find the number of harnesses required for any lined work design, either from the fabric or design paper, count the threads from the center of one figure to the center of the surrounding figure. This will give the number of harnesses. If a square be formed of which this is a diagonal, and is repeated four times, but inverted so that any one

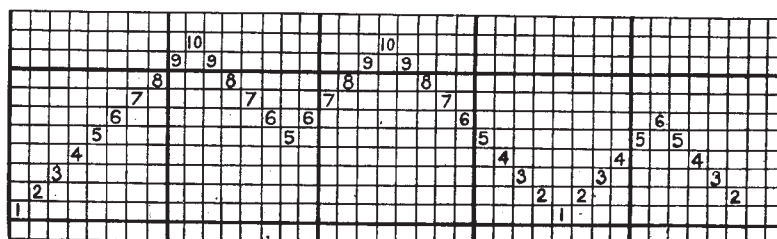


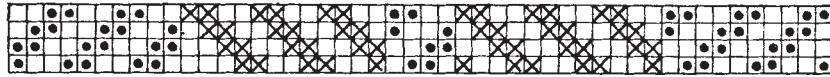
Fig. 111. ALTERNATE DRAFT.

corner of the design may be a common center, and allowing only one thread for each of the points, both by the warp and filling it will give one complete set of the design.

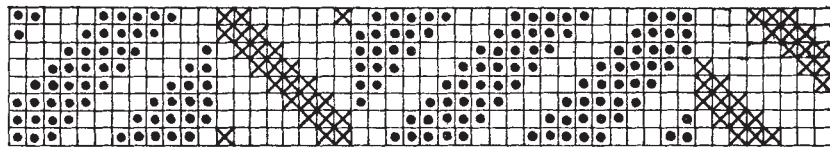
Damask work designs are used to considerable advantage in the linen trade, and also to some extent in cottons. This class of work makes good designs for the shawl trade, provided the warp is of one color and the filling of some darker shade of another color.

EXERCISES ON DAMASK PATTERNS.

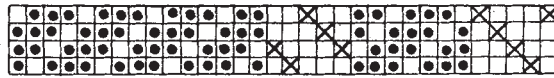
1. Form a check from the accompanying damask stripes *a b c d e f*.



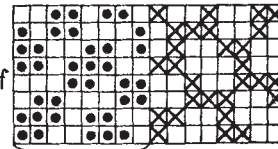
c



e

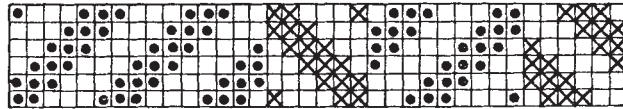


a

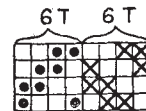


f

5 TIMES

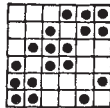


b

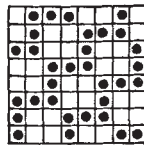


d

2. Make damask stripe designs on 48 ends from weaves *g* and *h*.
3. Make check designs from three stripes (Question 2).
4. Make two original damask stripe and corresponding check designs.



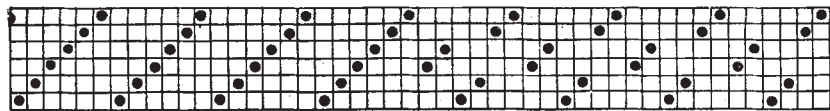
g



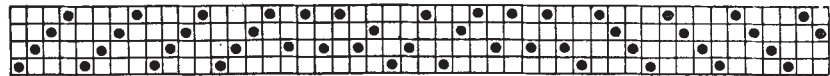
h

EXERCISES FOR PRACTICE.

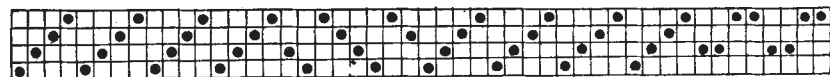
1. Work out the designs from the following drafts and chain plans.
2. Work out the designs obtained by using chain plan M with drafts G, H, K, L.
3. As No. 2, but with chain plan N.



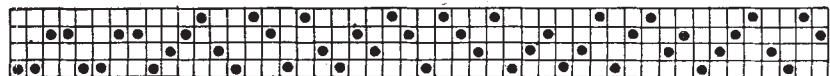
A



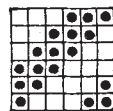
B



C



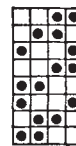
D



A



B

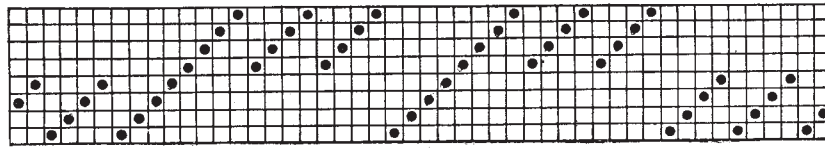


C

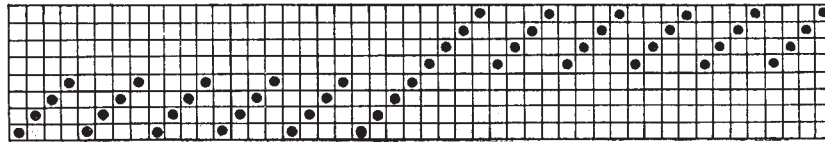


D

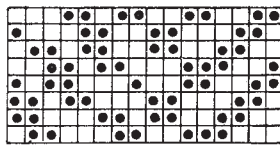
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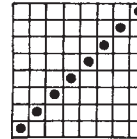
L



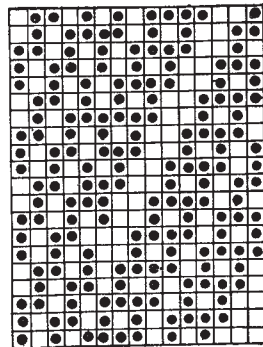
K



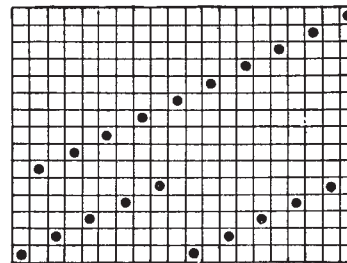
E



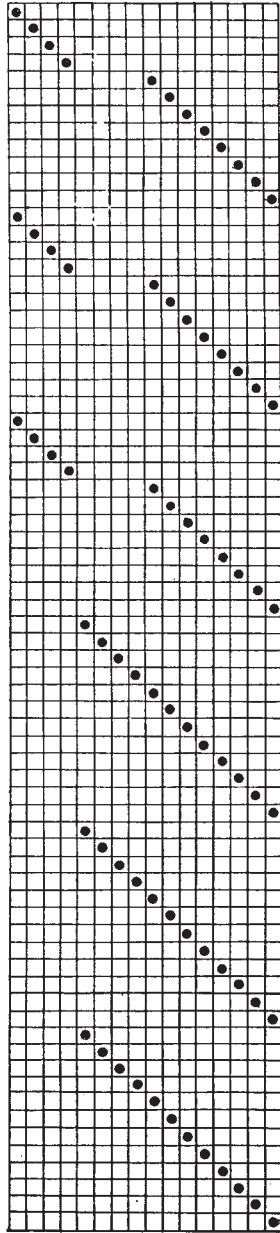
G



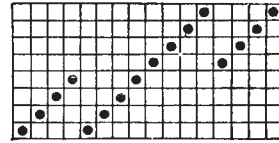
F



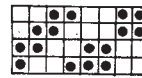
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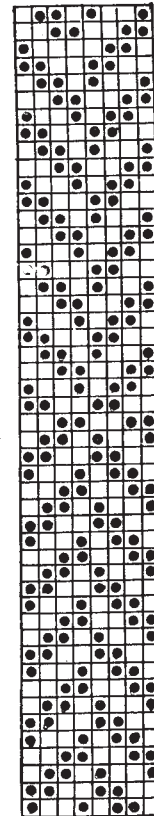
E



H



M



N

## EXERCISES IN DRAFTING.

Reduce each of the following designs to weave on the fewest possible number of shafts, giving draft and chain.



1



2



4



6



7



3



5



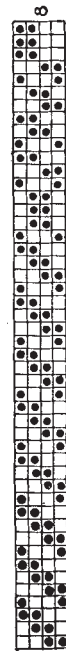
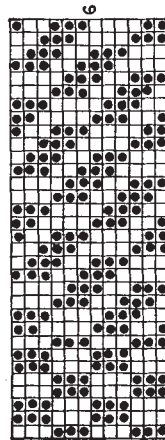
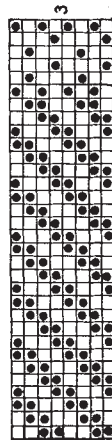
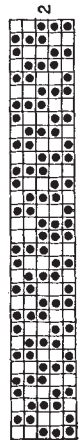
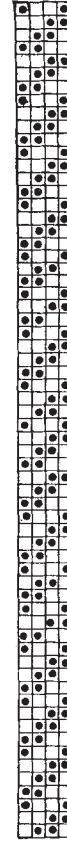
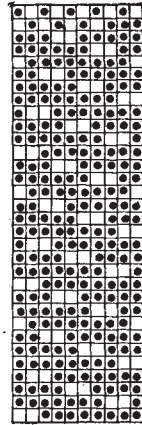
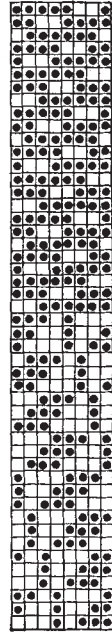
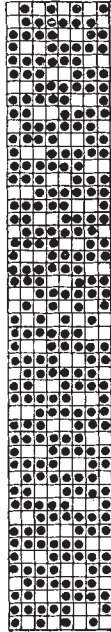
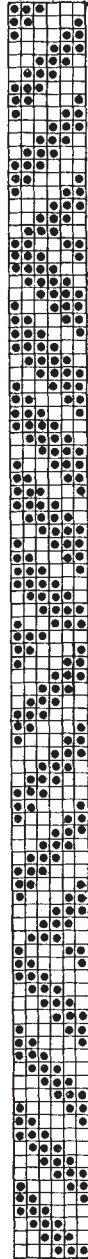
8



9

EXERCISES FOR PRACTICE.

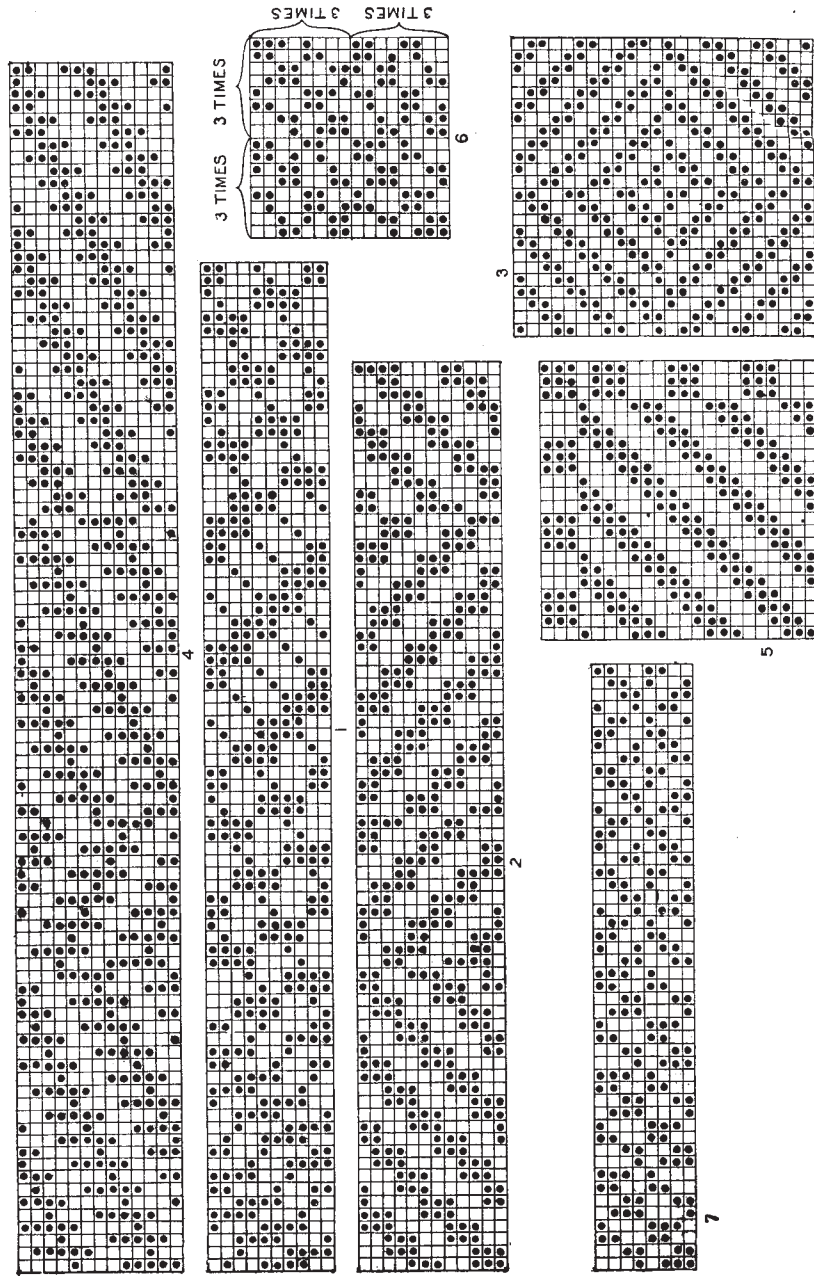
Draft each of the following designs on fewest possible shafts and give chain.





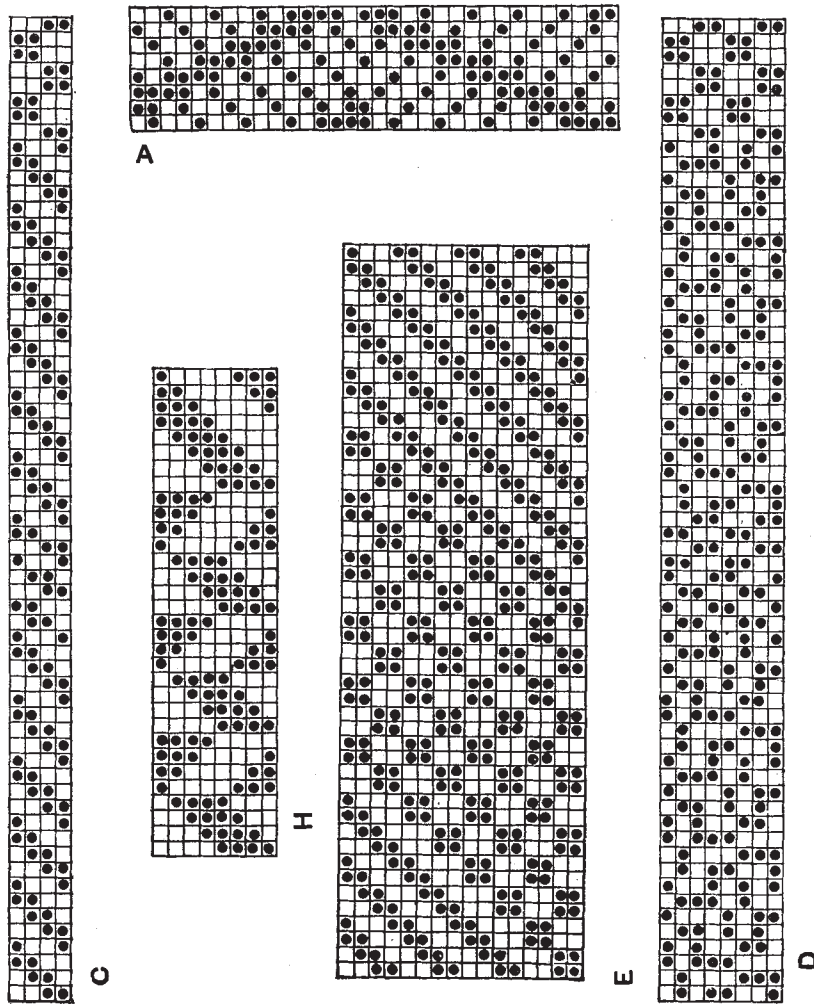
EXERCISES FOR PRACTICE.

Make draft and chain plan for each of the following designs, giving good workable drafts.



EXERCISES FOR PRACTICE.

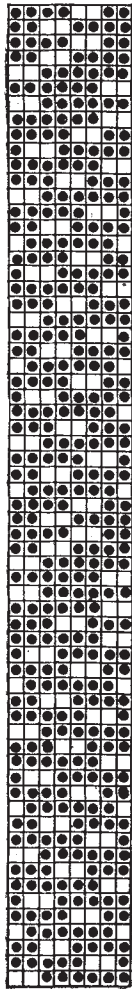
1. Make good working drafts and chain plans for designs A and B and supply chain plans for two original designs to weave in the same draft.
2. Make one draft to work the two accompanying designs C and D and give the chain plan for each.
3. Run out the accompanying design E until complete, then draft on 28 shafts and give chain plan.



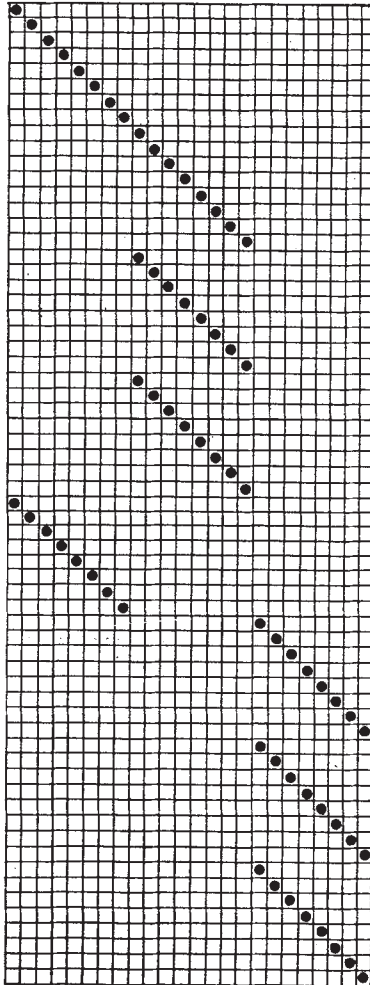
4. Give draft and chain plan to weave design F on the fewest possible shafts; also give chain plan to weave it with draft G.

5. Give two original designs and chain plans to weave with draft G.

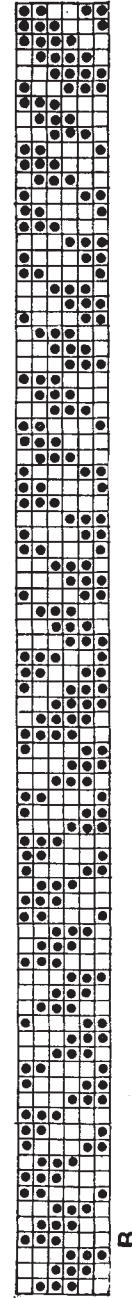
6. Give chain plan to weave design H with draft G.



F



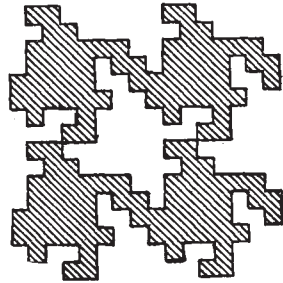
G



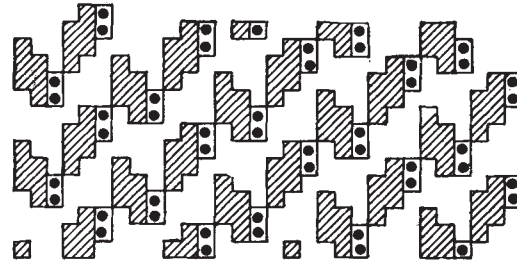
B

EXERCISES FOR PRACTICE.

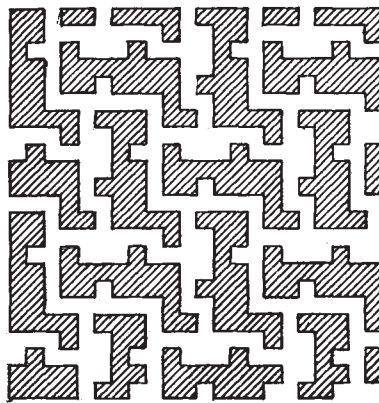
Give designs and warping and wefting plans to produce the following effects in single cloth.



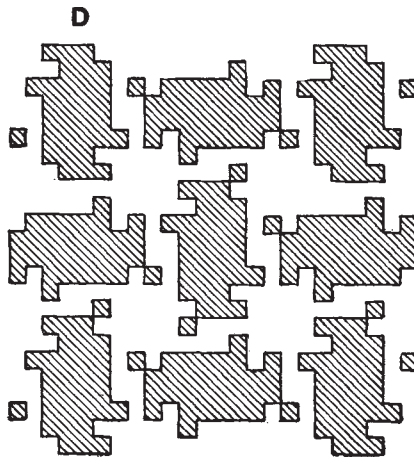
A



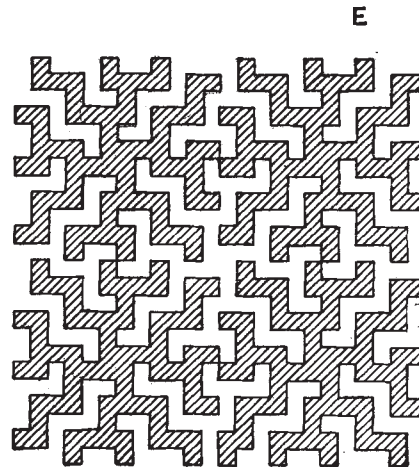
B



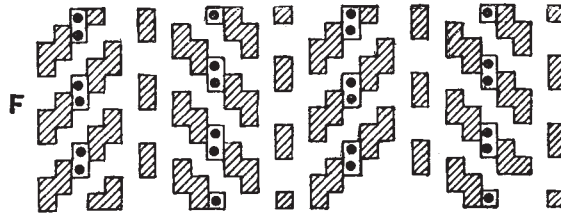
C



D



E



### EXERCISES FOR PRACTICE.

1. Make designs, drafts and chain plans for two-stripe patterns, thus:

1. 39 ends of plan "a," 13 ends of plan "a" reversed in twill  
13 ends of plan "a," 13 ends of plan "a" reversed in twill
2. 24 ends of plan "b," 12 ends of plan "b" reversed in twill  
24 ends of plan "b," 48 ends of plan "b" reversed in twill

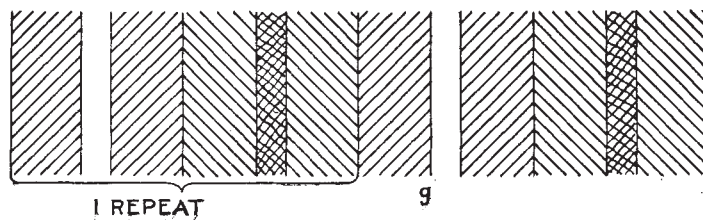
2. Make designs, drafts and chain plans for two-stripe patterns, thus:

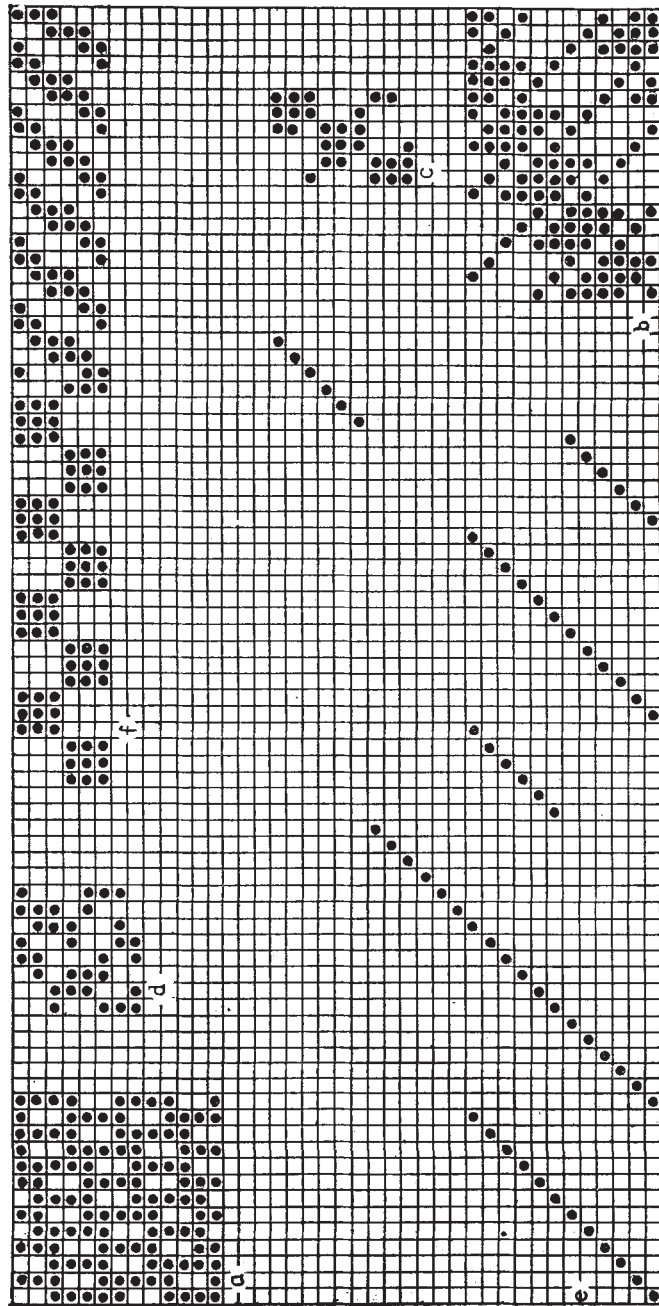
1. 24 ends of plan "c," 12 ends of plan "c" reversed back to face  
24 ends of plan "c," 12 ends of plan "c" reversed back to face
2. 8 ends of 2 and 2 twill, 16 ends of plan "d"  
8 ends of 2 and 2 twill, 8 ends of plan "d"  
16 ends of plan "d" reversed back to face, 8 ends of plan "d"

3. Give designs and chain plans for three-stripe figures to weave in the accompanying draft "e," supplying your own weaves.

4. Do you consider that the following combination "f" would give a perfect cloth? If not, give two perfect combinations introducing one of these weaves in each.

5. Give design, draft and chain plan to produce a stripe figure similar to the accompanying suggestion "g," supplying your own weaves.





## EXERCISES FOR PRACTICE.

1. Fill in the accompanying Fig. 1 with the following weaves: A: 2 and 2 twill to right. B: 2 and 2 twill to left. C: 2 and 2 hopsack. Make clean cuts at the joinings and give draft and chain plan for your design.

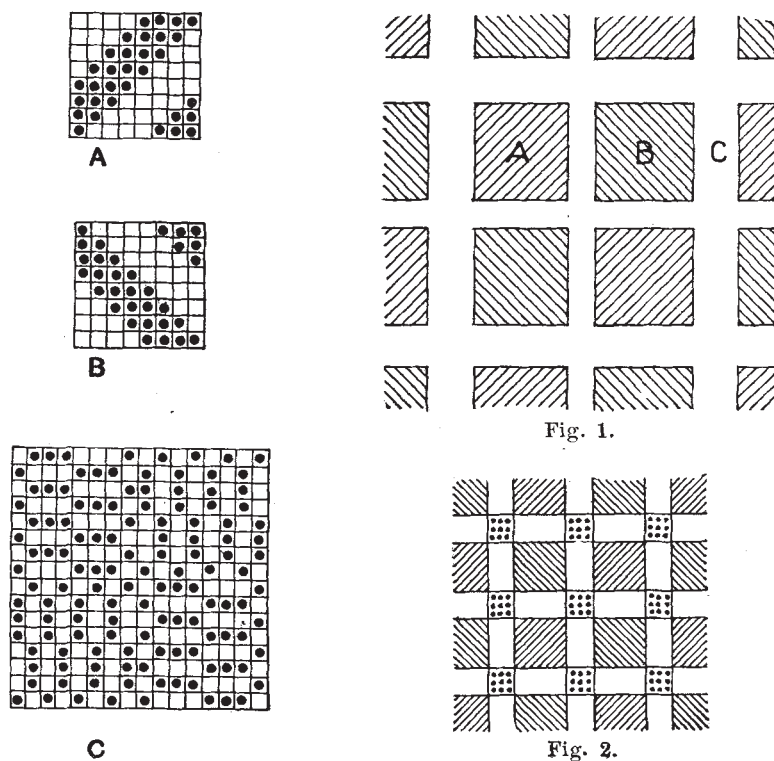
2. Make a design with draft and chain-plan to produce the accompanying Fig. 2, using your own weaves.

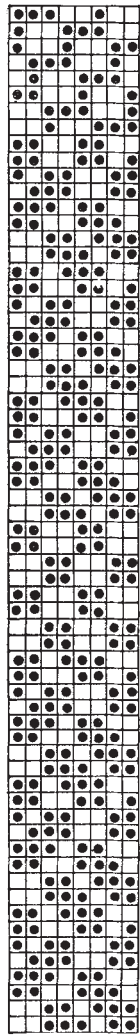
3. Make a check figure by a combination of plans A, B, C, giving draft and chain plan for your design.

4. Make a design for a check figure to weave in same draft and to be composed of same weaves as accompanying stripe design D.

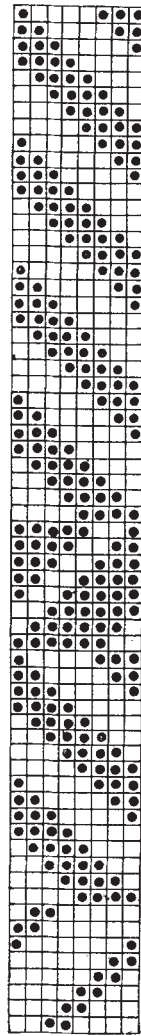
5. As No. 4, but with stripe design E.

6. Make one check and one stripe design to weave in the accompanying draft F and to have the same weaves.

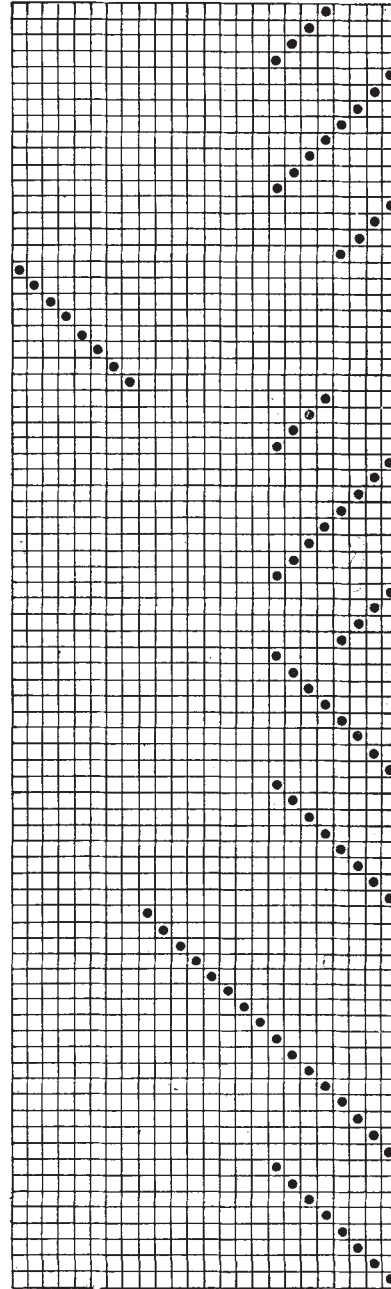




D



E

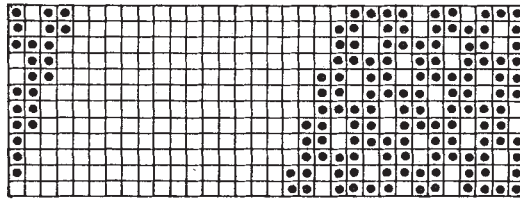


F

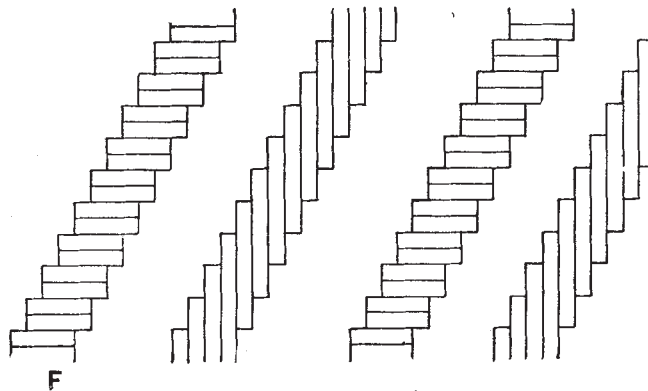


## EXERCISES FOR PRACTICE.

1. Fill up the vacant space in plan B with weave A, joining equally at both edges, and run out to form a diagonal figure.
2. Make two designs for diagonal figures, using plan C as the basis for each.
3. Make a design to produce a diagonal figure on 24 ends and 48 picks by a combination of weaves D and E.
4. Give design to produce diagonal Fig. F, supplying your own weaves.
5. Make an original design for diagonal figure to weave on 36 threads.



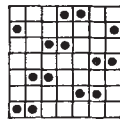
B



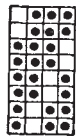
F



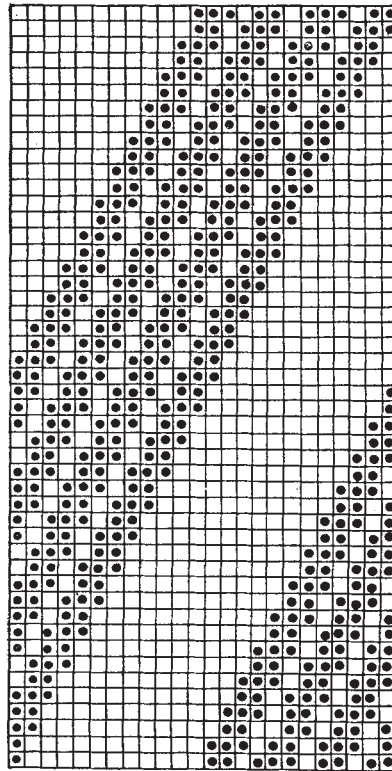
A



D



E



C

## SATEEN WEAVES.

**Satin.** Real satin is a silk fabric in which the warp is allowed to float over the filling in such a manner as to cover it entirely and present a smooth, lustrous face.

*Satinet* is a mixture or union cloth in which the face shows only a woolen filling, the cotton warp being covered by it. Fig. 113 is the weave for a cheap imitation satin, known in some districts as "Kentucky Jean."

These weaves produce what their name implies, a satin effect. They are very extensively used in cotton, linen and silk goods, also in woolen and worsted fabrics. In the manufacture of

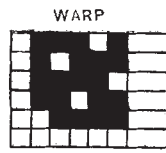


Fig. 112.



Fig. 113.

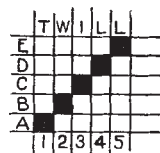


Fig. 114.



Fig. 115.

damask and linen table-covers they form nine-tenths of the product. In cotton goods they are used for making stripes, and in woolen goods they form such cloths as venetians, doeskins, beavers and kerseys. They are constructed usually from a twill weave, and this principle of interweaving is sometimes employed where the object is partly ornamental, as in satins that are used largely for trimmings and for ladies' dress goods. In such cases the first object is to produce a highly lustrous surface, perfectly smooth and showing no pattern.

If we take one class as typical, in order to show the peculiar arrangement and its effects upon the fabric, it may serve as a guide to us when dealing with patterns for ornamentation. These weaves are of two distinct classes; those in which the warp predominates on the face, called the warp flush sateen, and those in which the filling predominates on the face, known as the filling flush sateen.

The peculiarity of this kind of weave is that the order of interweaving the two sets of threads does not follow consecutively, but at definite intervals; especial care is taken that they do not follow consecutively at any point.

An example of the simplest kind, and one most commonly employed, is derived from the 5-harness common twill (Fig. 114), where the filling predominates on the face and runs to the right at an angle of 45 degrees. Consecutively this is 1, 2, 3, 4, 5, but by changing this weave over to a sateen weave (see Fig. 115), it will be observed that the order of interweaving is at set intervals.

To obtain the combination from which to design a sateen, take the number of harnesses of the original twill weave on which it can be woven; and divide it into two parts. These must be neither equal nor must one be the multiple of the other, nor should they be divisible by a third number. In constructing the weave (Fig. 115) in accordance with the rule, the number of harnesses on which the twill (Fig. 114) is woven, in this case five, is divided into two parts, thus giving two and three.



Fig. 116.

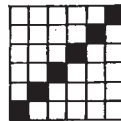


Fig. 117.

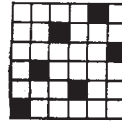


Fig. 118.

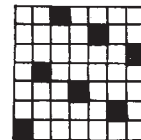


Fig. 119.

The method of constructing sateen by means of these two figures is to use either the two or the three as the number with which to count. If we use three as the number, it will be found that the picks of the twill would be used in the following order: A, D, B, E, C., which produces the sateen weave shown in Fig. 115. This is a filling flush sateen weave and the reverse of the warp flush weave (Fig. 116). This latter is constructed after the same manner as the filling flush weave, except that the one down and four up warp flush weave is used.

From a 6-harness twill no regular sateen can be made, the number of harnesses not being divisible according to the rule. An irregular weave can be produced, but it is not desirable, as there will be two threads or two picks running consecutively in some parts of the weave. The best combination is made by using the threads of the twill in the following order: 1, 3, 5, 2, 6, 4. (See Figs. 117 and 118.)

The 7-harness sateen can be obtained according to rule. (See Figs. 119 and 122.)

As a further demonstration, let us take the 8-harness filling flush twill, 1 up and 7 down. (Fig. 120.)

According to the rule the numbers in this case are 3 and 5. Four and 4 would be equal, 6 and 2 would be divisible by a third number; consequently they would not be correct. Take 3 as the number for counting. The first pick of the sateen is the first pick of the twill; the second pick is found by adding 3 to the first pick, which makes it the fourth pick of the regular twill; then add 3 to 4, which makes it the seventh pick of the twill; to this 7, 3 is added, which shows that the fourth pick of the sateen is the tenth of the twill, but as the twill repeats on 8 picks, the second corresponds to

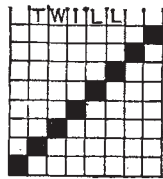


Fig. 120.

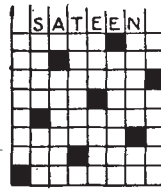
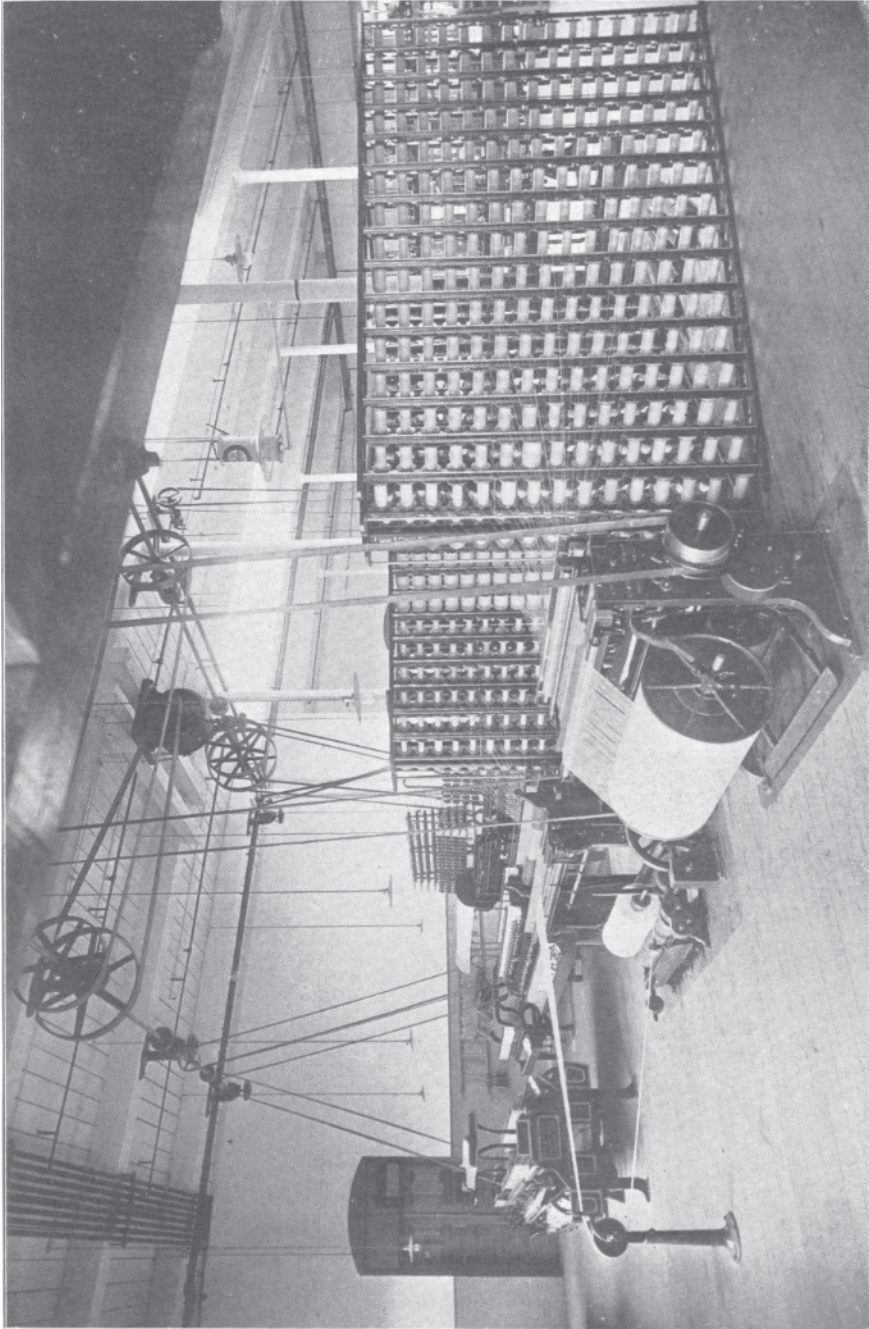


Fig. 121.

the tenth and is the fourth of the sateen; to the second pick 3 is added, which makes it the fifth of the twill and also the fifth of the sateen; to the fifth pick 3 is added, which makes the eighth of the twill the sixth of the sateen; to the eighth 3 is added, which makes 11; the third pick is equivalent to the eleventh and seventh of the sateen; to the third 3 is added, so that the sixth of the twill is the eighth of the sateen. If 3 is again added, the first pick of the twill will be the next one to be used, thus showing that the repeat of the weave has been obtained. The 8-harness sateen is formed by using the picks of the twill in the following order: 1, 4, 7, 2, 5, 8, 3, 6. (See Fig. 121.)

In laying out a cloth of this description the number of threads in both the warp and filling is of the greatest importance. The warp threads in a warp flush weave should be placed as close together as their diameters will permit, and as the filling is inserted, one thread will be withdrawn from the surface of the fabric and will bend around the filling at the back. As the next pick is inserted, another thread will be withdrawn, the first one



VIEW IN WARPING AND SPOOLING DEPARTMENT, BRADFORD-DURFEE TEXTILE SCHOOL

returning to its original position. As the threads are not withdrawn in regular or consecutive order, the filling does not bend around the warp in a great degree, but remains straight, the warp only being drawn out of its course. Under this condition the filling threads cannot be made to lie close together, but are always separated from each other by at least the diameter of the warp thread; therefore, in this class of fabric, we should always have a greater number of warp threads per inch than filling picks.

If the fabric is to be durable, we must take care that the material which is present in least quantity, whether it be filling or warp, shall be of sufficient strength to compensate for the absence of quantity, otherwise the fabric will be able to bear strain in one direction only, whereas by proper attention to the strength of the material employed we may make it able to bear the requisite strain in both directions. If it is desired to produce on the fabric a smooth, unbroken surface with no visible pattern, the warp threads may be placed so closely together that as one is withdrawn to bend around the filling, those on each side of it will close over the vacancy and completely hide the point where it has interwoven with the filling.

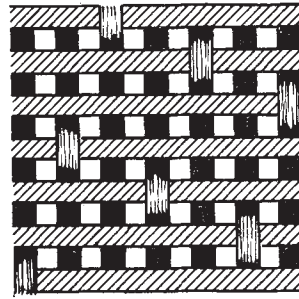


Fig. 122.

In that case the number of warp threads should be increased in proportion to the number in the filling, and consequently the fabric will be capable of bearing an increased strain upon the warp, but a decreased strain in the direction of the filling. Exactly the same principle will apply to fabrics where a filling surface is desired; the warp threads are then set such a distance apart as will permit of the filling threads passing readily between and bending around them. The filling threads are inserted as closely as their diameters will allow, and in some cases pass over and hide the point where the filling has bent around the warp; and again, in many cases, they are inserted so closely that the filling is compressed and loses its cylindrical form. In such fabrics the greatest strength is in the direction of the filling just in proportion to the quantity of material employed.

## EXERCISES IN SATEEN WEAVES.

(A) Work out weaves from the following:

(1)  $\frac{3}{2} \frac{2}{1} \frac{3}{1} / 1$  (2)  $\frac{2}{2} \frac{2}{1} \frac{2}{2} / 5$  (3)  $\frac{1}{1} \frac{2}{2} \frac{3}{3} / 1$

(4)  $\frac{1}{1} \frac{2}{2} \frac{3}{3} / 5$  (5)  $\frac{2}{1} \frac{2}{1} \frac{2}{4} / 1$  (6)  $\frac{2}{1} \frac{2}{1} \frac{2}{4} / 5$

(7)  $\frac{3}{3} \frac{3}{2} \frac{1}{2} / 1$  (8)  $\frac{3}{3} \frac{3}{2} \frac{1}{2} / 2$  (9)  $\frac{3}{3} \frac{3}{2} \frac{1}{2} / 3$

(10)  $\frac{3}{3} \frac{3}{2} \frac{1}{2} / 4$  (11)  $\frac{3}{3} \frac{3}{1} \frac{1}{2} / 5$  (12)  $\frac{3}{3} \frac{3}{2} \frac{1}{2} / 6$

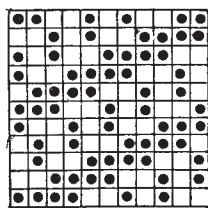
(13)  $\frac{2}{1} \frac{2}{1} \frac{2}{3} / 1$  (14)  $\frac{2}{1} \frac{2}{1} \frac{2}{3} / 2$  (15)  $\frac{2}{1} \frac{2}{1} \frac{2}{2} / 3$

(16)  $\frac{2}{1} \frac{2}{1} \frac{2}{3} / 4$  (17)  $\frac{2}{1} \frac{2}{1} \frac{2}{3} / 5$  (18)  $\frac{3}{1} \frac{3}{2} \frac{1}{2} / 5$

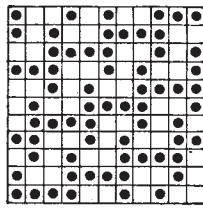
(19)  $\frac{3}{2} \frac{1}{1} \frac{1}{2} / 3$  (20)  $\frac{4}{2} \frac{2}{2} / 2$  (21)  $\frac{3}{1} \frac{1}{3} \frac{1}{1} / -3$

(22)  $\frac{3}{2} \frac{3}{4} / -5$  (23)  $\frac{3}{2} \frac{3}{4} / 2$  (24)  $\frac{3}{2} \frac{3}{3} / -3$

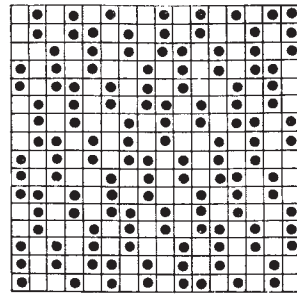
(B) Write the order of weaving, and move numbers for each of the following weaves 25—30, both warp way and filling way.



25



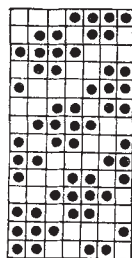
26



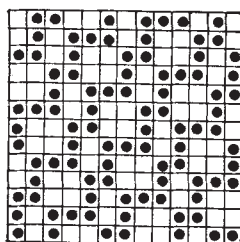
27

(Exercise continued on next page.)

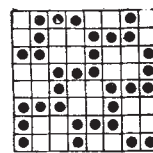




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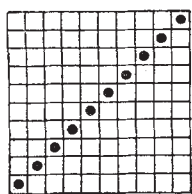


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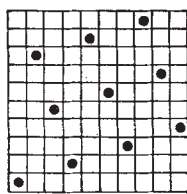


30

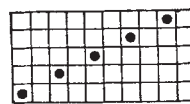
(C) Make plans with bases 31—33 and order of weaving  $\frac{4}{2} \frac{2}{2}$  and with bases 34—38 and order of weaving  $\frac{4}{1} \frac{1}{3} \frac{1}{1}$ .



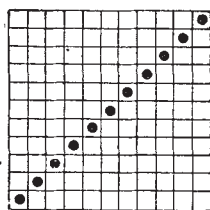
31



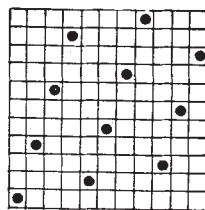
32



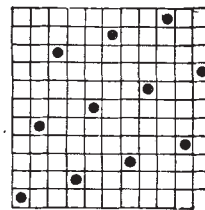
33



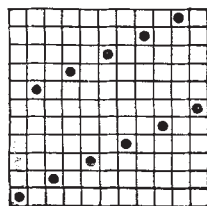
34



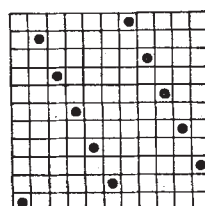
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36



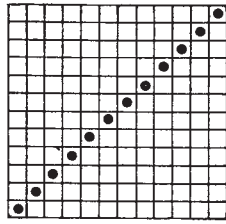
37



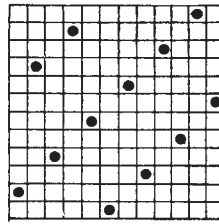
38

(Exercise continued on next page.)

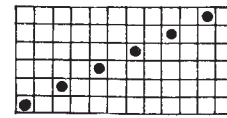
(D) Make two plans on each of the accompanying bases 39—41.



39

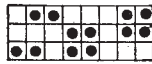


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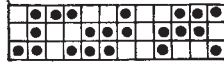


41

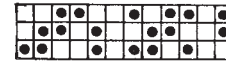
(E) Run out plans 42—45 to one complete pattern of each.



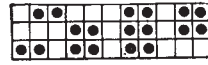
42



43



44



45

(F) Give two bases on 13 threads and run out two plans on each base.

(G) Make plans as follows:

$$(1) \frac{4}{2} \frac{1}{2} \frac{1}{2} / 3 - 1$$

$$(2) \frac{4}{2} \frac{1}{2} \frac{1}{2} / 4 - 2$$

$$(3) \frac{4}{2} \frac{1}{2} \frac{1}{2} / 5 - 3$$

$$(4) \frac{2}{1} \frac{2}{1} \frac{2}{4} / 2 + 0$$

$$(5) \frac{2}{1} \frac{2}{1} \frac{2}{4} / 3 - 1$$

$$(6) \frac{2}{1} \frac{2}{1} \frac{2}{4} / 4 - 1$$

$$(7) \frac{2}{1} \frac{2}{1} \frac{2}{4} / 5 - 3$$

$$(8) \frac{3}{2} \frac{2}{1} \frac{2}{2} / 5 - 1 - 1$$

$$(9) \frac{3}{2} \frac{2}{1} \frac{2}{2} / 3 - 2 + 2$$

$$(10) \frac{3}{2} \frac{2}{1} \frac{2}{2} / 4 - 3 + 2$$

(H) Give order of weaving and move of the following plans

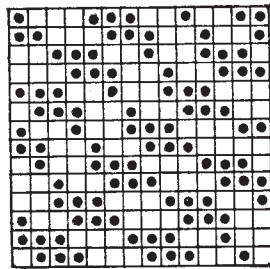
(11)  $\frac{3}{2} \frac{2}{1} \frac{2}{2} / 4 - 2 + 1$       (12)  $\frac{2}{2} / 0 + 2$

(13)  $\frac{3}{3} / 0 + 0 + 3$       (14)  $\frac{3}{3} / 0 + 3$

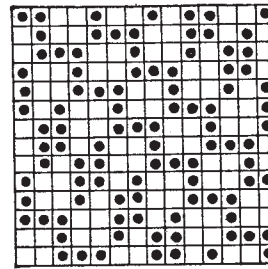
(15)  $\frac{3}{1} \frac{1}{3} \frac{1}{1} / -1 + 3$       (16)  $\frac{3}{1} \frac{1}{3} \frac{1}{1} / -3 + 5$

(17)  $\frac{4}{2} \frac{1}{2} \frac{1}{2} / 5 - 1 - 1$       (18)  $\frac{3}{3} \frac{2}{2} \frac{1}{1} / 5 - 1 - 1$

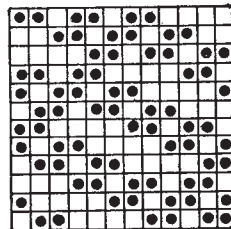
(19)  $\frac{2}{1} \frac{2}{1} \frac{2}{4} / 5 - 1 - 1$       (20)  $\frac{1}{1} \frac{3}{1} \frac{1}{5} / 5 - 1 - 1$



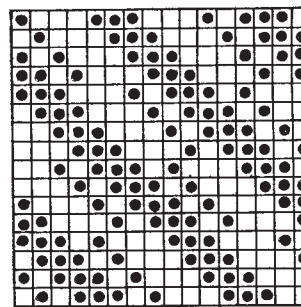
A



B



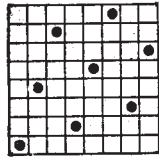
C



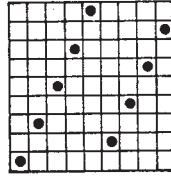
D

(Exercise continued on next page.)

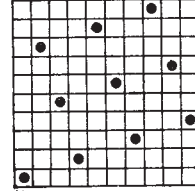
(I) Make two plans on each of the accompanying bases 31—40.



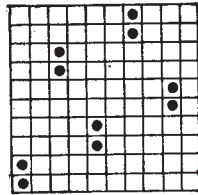
31



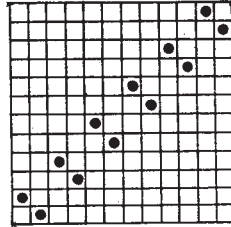
32



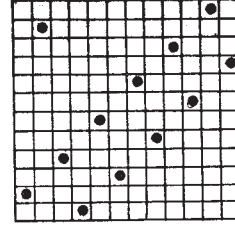
33



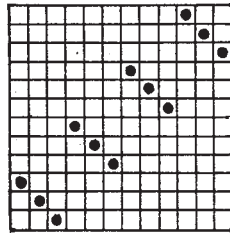
34



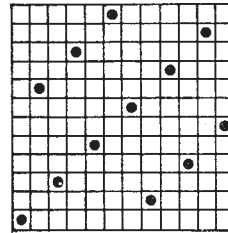
35



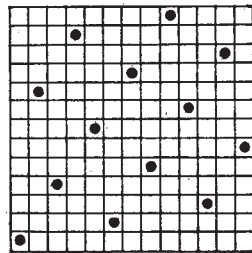
36



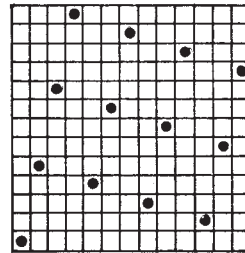
37



38



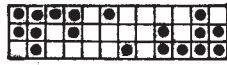
39



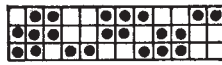
40

(Exercise continued on next page.)

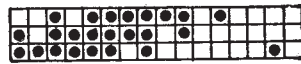
(J) Run out plans 41—46 until complete.



41



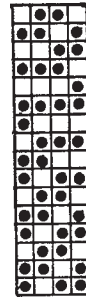
42



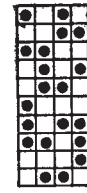
43



44

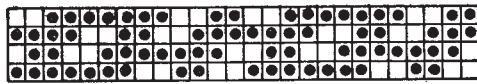


45

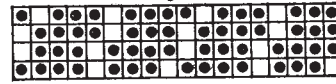


46

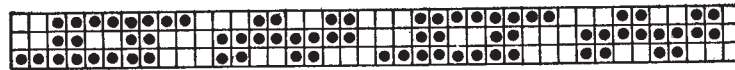
(K) Give one complete repeat of plans 47—53 and write order of weaving and move number for each.



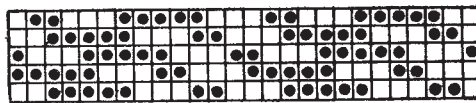
47



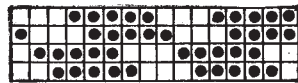
48



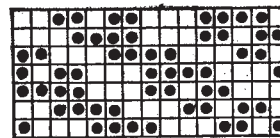
49



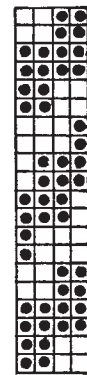
51



52



53



50

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**SATEEN STRIPES.**

In designing fancy fabrics for the white cotton trade the designer is frequently compelled to depend almost entirely upon the weave to obtain different effects. When the warp and filling are both white, this becomes a necessity. There is another method, however, and it is one that is often useful, namely, the manner in which the warp is reeded. In some patterns it is necessary to have some parts of the warp reeded in greater numbers than in other sections, that is, in some parts of the reed each dent contains 2 threads, while in other sections the reed may contain 3, 4, 5 or even 6 in one dent. Six is generally considered the highest number, but in some rare cases even 8 or 10 threads are put in the same dent.

Nearly all the fancy white goods that are made have for the body or groundwork of the fabric the regular plain or cotton weave, 1 up and 1 down. The stripe in the warp will be either a twill, broken twill, or sateen weave, warp flush, and the overcheck will be a sateen weave, filling flush. The sateen weave is generally combined with other weaves to make stripes and checks.

Stripes consist of bands or lines, varying in width and color, running lengthwise of the cloth, viz., in the direction of the warp. The distinctive character of this make of goods is its line-like composition. All patterns of this order are nothing more than a blend of lines of various shades and weaves. They are of varying widths and extend from one end of the fabric to the other. Although this form of pattern is well adapted to trouserings, shirtings and some styles of dress and mantle cloths, it is not suitable for coatings and even suitings when extended beyond a very minute stripe of the hair line description.

The variety of these stripes is very extensive, both as to shade and color, commencing with the single thread hair line, and increasing in size until a stripe or band several inches wide is obtained.

The prominence of the different weaves employed, the bands or lines of color, their distinctness, solidity, their intermittent character, and their subdued tone aspect, are all qualities depending on the structure of the fabric and its weave composition.

The pattern in striped styles is principally a warp product and the filling in such cases only of secondary consideration. The filling is employed, first, to bind the warp threads together and thus form a wearable fabric; second, to constitute an appropriate groundwork on which the warp colorings may be correctly exposed.

Proper emphasis of the colors composing the stripes is acquired by employing a suitable shade of filling, and by adopting that system of crossing or interweaving which will, in addition to yielding the requisite strength and firmness of fabric, sufficiently interfere with the continuity of the fancy shades introduced into the warp.

Some are mere lines, no wider than the diameter of the threads employed, while others are several inches wide. Two colors may be introduced to form stripes of different widths; for example, black and a dark mix may be combined to give stripes of many descriptions.

We could use 1 thread of black and 1 thread of dark mix, which would make a stripe of the hair-line description, using the plain weave for the intercrossing; or 2 threads of black and 1 thread of dark mix, using the 3-harness twill for the interweaving. Thus we might continue on these principles and form sets of stripes of variable widths or sizes. The character of these styles to a very great extent is governed by the class of texture in which they appear. Examples of this occur in the various fabrics produced by the loom. Take, for example, stripes for trouserings, which are generally small to medium size, softly and neatly toned in coloring. In dress goods, mantlings and ulsterings are found much broader effects, more elaborate in arrangement, and which require much greater force of coloring.

In cotton shirtings small, neat styles are considered the best, but in cotton dress goods there appears to be no definite limit, either as to the width of the stripe or to the radical plan of coloring. For aprons, children's dress goods and such fabrics as tickings and awnings, stripes are used to a considerable extent. To form a practical idea of what is meant by a sateen stripe the following particulars should be thoroughly understood.

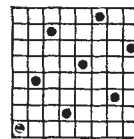
**Sateen Tick Stripe.** When the name "Sateen Tick" is used, the general impression is that of a line of goods or a fabric

which in some way resembles a sateen. But a sateen tick is in no way like a satin, being used for an entirely different purpose. These goods are made entirely of cotton, and are used for upholstery; the name "Sateen Tick" being taken from the weave, which is a sateen weave.

There is quite a demand for this fabric, but the manufacture of it is chiefly in the hands of a few large mills, which monopolize the industry. In many mills in which this fabric has been attempted a 2-ply yarn has been used for the warp, and this has made the goods harsh in feeling, and unfit for this purpose. The only proper way to make them feel soft is to use combed cotton yarn for the warp and the same stock for the filling, but having the filling twisted harder than the warp. The best fabrics on the market have 98 threads to the inch of single 7's and about 52 picks of single 14's. The weave which is used, and from which the fabric obtained its name, is the sateen weave, warp flush, which throws the warp entirely on the face. It makes a smooth face, free from twill lines, with the points of intersection evenly distributed. The 5 harness sateen is the simplest kind. As before stated (see page 37) these weaves are constructed by taking the number of harnesses to be used for the sateen, and dividing it into two parts, neither of which are equal, nor one a divisor of the other; still further, neither divisible by a third number.

The stitching for the weave, or the interlacing of the warp, is obtained in the following manner:

The first intersection will be on warp thread No. 1; the next intersection will be either on the third or fourth warp thread, according to whether the weave is counted by twos or by threes. If counted by twos the intersections will be as follows: 1, 3, 5, 2, 4. Almost all of these goods are woven on this weave, but in some cases the 8-harness sateen shown in Fig. 121 is used. The intersections are as follows: 1, 4, 7, 2, 5, 8, 3, 6. This is constructed on the same principle as the 5-harness sateen, but there are fewer intersections of the warp; consequently this allows more picks and makes a heavier fabric. These sateens are very desirable



8 H. Sateen.



goods, as they may be woven easier and faster on account of the weave. The line of colors should be as simple as possible, because the fewer the colors the less the expense. The following is a line of colors in use in one of the largest mills in the country: black, white, red, very light tan, medium tan, dark blue, brown and light brown. These colors, if made in light shades, can be combined in a great variety of effects and produce innumerable patterns.

The following will give good results and splendid combinations, and will also give the size and style of the stripes. An attractive effect having a very broad stripe can be produced by 120 threads of red, 10 white, 60 light tan, 4 dark blue, 10 medium tan, 4 dark blue, 10 medium tan, 4 dark blue, 10 medium tan, 4 dark blue, 60 light tan and 10 white.

This can be varied and will make another very effective style by using 120 threads of dark blue in place of red, the rest remaining the same. Another good coloring is made as follows: 10 threads red, 10 dark blue, 88 red, 10 dark blue, 10 red, 50 white, 6 dark blue, 10 dark tan, 6 dark blue, 10 dark tan, 6 dark blue, 10 dark tan, 6 dark blue, 50 white, 2 dark blue, 16 red, 2 dark blue, 50 white.

In all these dressings the color can be varied; the number of threads may also be increased or decreased at pleasure. The principle effect desired is contrast of color, combined with harmony. There is no limit in the range of design.

#### COTTON SATEEN STRIPE.

The yarn used for this class of fabric varies from 40's to 70's, although a large proportion is between 50's and 60's. There are also large quantities of 2-ply, 4-ply and sometimes 6-ply yarn used in cotton cords and stripes. The filling for such goods will range from 60's to 90's.

The texture of the fabric in the plain part, that is, the part between the sateen stripes, will vary from 60 threads  $\times$  60 picks to 96 threads  $\times$  80 picks. The width of the goods is generally from 27 to 28 inches, though goods made especially for aprons will run from 40 to 42 inches.

For an illustration let us make a cloth 28 inches wide, having

for the design a sateen stripe, with plain stripe ground for 1 inch; sateen or broken 6-harness twill,  $\frac{1}{4}$  inch; plain ground,  $\frac{1}{4}$  inch; broken twill,  $\frac{1}{4}$  inch. Total width of stripe to be  $1\frac{3}{4}$  inches.

$28 \text{ inches} \div 1.75 \text{ inches} = 16$  repeats or designs across the cloth. Suppose we make the body of the warp, or what we have already called the plain or ground work, 80 threads to the inch. Then we have:

$\frac{1}{4}$  inch broken twill  
 $\frac{1}{4}$  inch groundwork  
 $\frac{1}{4}$  inch broken twill  
 1 inch groundwork

It is to be divided into a reed with 40 dents to the inch, or as is usually understood, a 40's reed; 2 threads in one dent = 80 threads per inch. When making a pattern with one part of the design larger than the other, divide the larger portion into two parts, so that the design will commence at one side of the cloth and will be equal to the design at the extreme edge or other side of the cloth. Our typical design has one inch of plain or ground which we divide into two equal parts.

The way to lay out this piece of cloth will be as follows:

$\frac{1}{2}$ inch plain	20 dents	2 threads in one dent = 40 threads
$\frac{1}{4}$ inch stripe	10 dents	6 threads in one dent = 60 threads
$\frac{1}{4}$ inch plain	10 dents	2 threads in one dent = 20 threads
$\frac{1}{4}$ inch stripe	10 dents	6 threads in one dent = 60 threads
$\frac{1}{2}$ inch plain	20 dents	2 threads in one dent = 40 threads
	<u>70</u>	<u>220</u>

Thus it will be seen that one pattern occupies 70 dents, and as we have already decided that there are to be 16 repeats of the pattern, we shall require  $16 \times 70 = 1,120$  dents exclusive of selvedge. Add 10 dents on each side for selvedge, this making total of 1,140 dents.

$$1,140 \text{ dents} \div 40 = 28\frac{1}{2} \text{ inches.}$$

The reed must be  $28\frac{1}{2}$  inches wide.

Two hundred and twenty threads in one pattern  $\times 16 = 3,520$  threads. The selvedge is composed of 20 double threads, 2 in a dent on each side.

Left selvedge 20 double threads =	40
Body of warp =	3,520
Right selvedge 20 double threads =	40
Total number of threads =	3,600

Fig. 123 represents a good weave for a 6-harness broken twill. This weave is especially recommended for this purpose.

The next thing to make is the drawing-in draft, or harness draft and chain.

Also leave for selvages 10 empty heddles on the right and left sides of the 4 front harnesses.

The first 40 threads on the 4 front harnesses, which are forming a plain weave; the second section of threads which are drawn on the 6 back harnesses, and are weaving a 6-harness broken twill; the third section of the threads, which are drawn on the 4 front harnesses; the fourth section of threads, which are drawn on the 6 back harnesses; and the last section of 40 threads on the 4 front harnesses, make one repeat of the pattern or 220 threads. This operation is repeated 16 times, and when finished will have completed the body of the warp, or 3,520 threads. Now

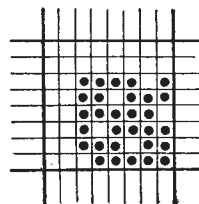


Fig. 123.

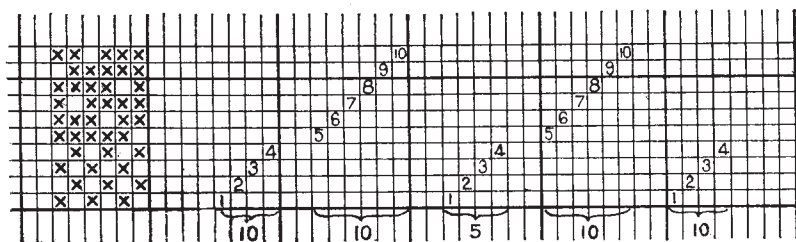


Fig. 124.

Fig. 125.

draw in the double threads for the selvages on each side of the warp. The foregoing is a systematic way of obtaining the layout of a design, chain, and harness draft; but in some mills the drawing-in or harness draft would be laid out as follows :

		10 double threads on 1. 2. 3. 4.	for selvages
Repeat 16 times	}	40 threads on 1. 2. 3. 4.	for plain weave
		60 threads on 5. 6. 7. 8. 9. 10	for broken twill
		20 threads on 1. 2. 3. 4.	for plain weave
		60 threads on 5. 6. 7. 8. 9. 10	for broken twill
		40 threads on 1. 2. 3. 4.	for plain weave
		220 x 16	
		10 double threads for 1. 2. 3. 4.	for selvages

There is another very important matter to which particular attention must be paid; that is, the question of how many wires or heddles must be placed on each harness shaft, thus preventing any possibility of overcrowding the wires or heddles on any or all of the harnesses. Take our previous example for illustration.

On the 1st harness	25 threads $\times$ 16 patterns = 400 heddles	
On the 2nd harness	25 threads $\times$ 16 patterns = 400 heddles	
On the 3rd harness	25 threads $\times$ 16 patterns = 400 heddles	
On the 4th harness	25 threads $\times$ 16 patterns = 400 heddles	
On the 5th harness	20 threads $\times$ 16 patterns = 320 heddles	
On the 6th harness	20 threads $\times$ 16 patterns = 320 heddles	
On the 7th harness	20 threads $\times$ 16 patterns = 320 heddles	
On the 8th harness	20 threads $\times$ 16 patterns = 320 heddles	
On the 9th harness	20 threads $\times$ 16 patterns = 320 heddles	
On the 10th harness	20 threads $\times$ 16 patterns = 320 heddles	
		3,520 heddles
Also on the 4 front harness 5 extra for selvages		20 heddles
	Total	3,540 heddles

In this cloth we will suppose there are 72 picks per inch.

In weaving this class of fabric, there is often much trouble caused by filling kinks. The filling is apt to catch on the sateen stripe, and unless the shed is perfect and clear there will be trouble of this kind. Under these circumstances it is necessary that the harnesses are properly hung, and that they are making a clear, even, open shed. Almost all mills engaged in weaving this class of goods use a head motion known as the dobbie. The Crompton, Knowles and Stafford being the most popular. As the goods are woven with one shuttle the looms can be run at a very high rate of speed, for which the dobbie or head motion is especially adapted. These dobbies are made to fit any kind of loom, and it is quite common for mills to put them on their plain looms, to be used thereafter for fancy weaving. But as the loom can weave with but one shuttle, it is confined to striped goods.

**Overchecks.** In making patterns for plaids, proceed in the same manner as with the stripes to find the number of warp threads. It is the filling check or overplaid that will give most of the trouble in these patterns.

To get the stripe or overcheck in the filling of the same density as the broken twill or sateen stripe in the warp, the take-up motion must be prevented from working, so that the filling

threads may be beaten up closely, to correspond with the broken twill in the warp. To accomplish this a wire is attached to the pawl that pushes or pulls the ratchet gear, and is fastened at the other end to one of the levers that work the harnesses. Wherever the take-up motion should stop, a pin is inserted in the chain at the proper place. The pin, in lifting the lever, pulls the wire that is fastened to the pawl, thus lifting it up and thereby stopping the take-up motion.



Fig. 126.

The question now arises of how often the take-up motion should be stopped while weaving the check.

We will again take our example: to make the filling compare with the warp, there will need be as many picks in  $\frac{1}{4}$  inch as there are in the corresponding stripes in the warp, which is 60. It will be found, however, in practice, that 54 will be sufficient. Supposing there are 72 picks per inch, in  $\frac{1}{4}$  of an inch there would be 18, but the overplaid calls for 54. The ratchet gear is taking up 1 tooth every 2 picks, thus moving 9 teeth for every  $\frac{1}{4}$  of an inch of cloth woven; therefore, to get 54 picks in that space, there

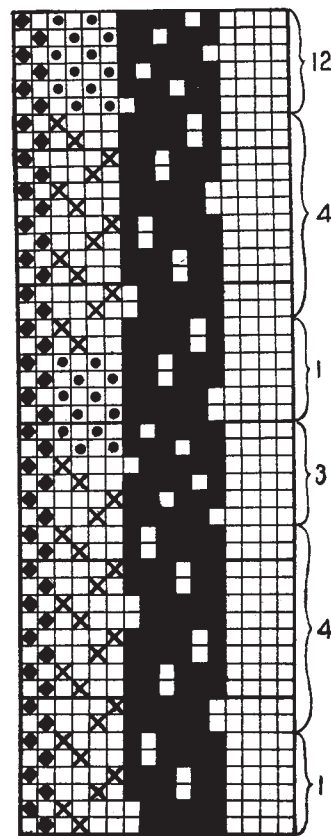


Fig. 127.

must be 6 picks for every tooth taken up, so it follows then that out of every 6 bars in the pattern chain, 4 of them will have to contain pins in order to stop the take-up motion.

The best weave for the stripe or overplaid, when there are an

even number of threads in a dent, is the 4-harness broken twill, or Crowfoot weave. In making the design for a filling stripe of this description, and in order to have the warp stripe pass smoothly over the filling check, the weave must be made double what it is in the plain part; if we are using a 5 up and 1 down weave, it must be made to run exactly double; that is, 10 up and 2 down, when it comes to the filling stripe. Fig. 126 will explain.

There must be 2 extra harnesses allowed for selvages on patterns of this nature, otherwise there will be a bad selvage where the filling stripe is being woven. Fig. 127 shows the harness chain complete for weaving a plaid from the stripe pattern just explained.

#### PLAIN AND IRREGULAR RIB WEAVES.

After the plain, twill, and sateen weaves have been studied, the next class is the derivative weaves, or those which are designed by using one of the foregoing weaves as a basis. The simplest class of these weaves is the ribbed. This is formed by using the plain or cotton weave as a foundation.

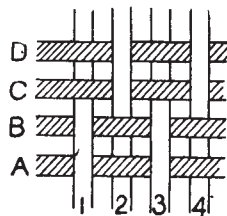


Fig. 128.

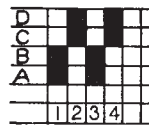


Fig. 129.

Fig. 128 is an enlarged diagram of a fabric woven on the simplest rib weave that can be constructed. It is made by raising 1 warp thread for 2 consecutive picks, and lowering the same warp thread under the next 2 picks; the second thread being exactly the reverse of the first.

By a careful study of Fig. 128 and Weave 129, a clear idea of the designing of these weaves will be obtained. The warp thread No. 1 is raised when the pick A is inserted, and the same position of warp threads is obtained in the case of the second pick, B. When C and D are woven, the warp thread No. 1 passes under them, the warp thread No. 2 passes under A and B and over C and D, which is the reverse of the intersections on thread No. 1.

It will be seen that this weave is nothing more than the