

KNOWLES JACQUARD SILK LOOM
Crompton & Knowles Loom Works

Textile Design

A Working Manual of

APPROVED PRACTICE IN ALL DETAILS OF THE ART OF DESIGNING THE
VARIOUS KINDS OF TEXTILE FABRICS, TOGETHER WITH PRACTICAL
APPLICATIONS OF THE PRINCIPLES OF TEXTILE COLORING
AND SYSTEMATIC METHODS OF COST FINDING

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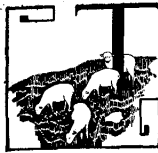
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1909

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Foreword



THE Textile Industry has shared to such an extent the modern tendency toward specialization, and has been marked by the development of such a multiplicity of types of machinery and special mechanical and chemical processes, that the various branches of this great industry to-day constitute in reality distinct though closely related arts. The present volume is intended to supply a practical working guide to the art of designing the various kinds of textile fabrics. The work covers all details from the use of design paper and other mechanical aids, the principles of drafting and reduction, and the designing of the simplest fabrics, to the most complicated applications of the principles of textile coloring and the production of the most elaborate designs of special fabrics. A section is devoted to the important topic of systematic methods of cost finding.

Special stress is laid on the *practical* as distinguished from the merely theoretical or descriptive form of treatment, the book being based on a careful study of conditions and needs as developed in the best American mills.

This volume will be found especially adapted for purposes of self-instruction and home study, fitted not only to meet the needs of the beginner in Textile Design, but also to serve as a

reference work replete with information and suggestions of great practical value to the most advanced and experienced designer.

¶ The method adopted in the preparation of this volume is that which the American School of Correspondence has developed and employed so successfully for many years. It is not an experiment, but has stood the severest of all tests — that of practical use—which has demonstrated it to be the best method yet devised for the education of the busy workingman.

¶ For purposes of ready reference, and timely information when needed, it is believed that this volume will be found to meet every requirement.

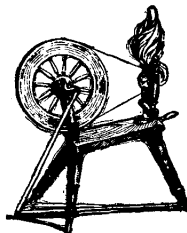


Table of Contents

PRINCIPLES AND METHODS OF DESIGN Page *11

Primary Elements in Design—Use of Design Paper—Warp and Weft or Woof—Plain Cloth—Twills (Plain and Fancy, Steep and Reclining)—Diagonals—Intersections, Interlacing, and Cut Sections—Exercises in Plan Making—Exercises in Spot Weaves—Color Effects—Hair Line—Design from a Written Formula—Harness, Heddles, and Eyes or Mails—Warping and Dressing—Actuating the Harnesses—Drafting and Reduction—Twilling—Flushes—Straight Over-Draw—Fancy Twills—Reverse Twills—Diaper Work and Point Draws—Damask—Double, Triple, and Alternate Drafts—Exercises in Drafts and Chain Plans—Sateen Weaves—Satin—Satinet—Kentucky Jean—Sateen Stripes—Cotton Sateen Stripe—Overchecks—Plain and Irregular Rib Weaves—Warp Effect—Filling Effect—Figured and Oblique Rib Weaves—Basket Weaves—Corkscrew and Double-Twill Weaves

DESIGN OF SPECIAL FABRICS Page 121

Single Cloth—Backed Cloth—Double Cloth—Methods of Backing Cloth (with Filling, with Warp)—Binding of Double Cloths—Laying Out a Double-Cloth Design—Three-Ply or Triple Cloth—"Double Plain" Cloth—Stripe and Check Patterns—Spot Weaves—Pile or Plush—Warp Pile—Filling Pile—Cut and Loop Pile—Corduroy—Velvet—Terry Cloth—Turkish Towel Cloth—Brussels Carpet—Wilton Carpet—Chinchilla—Piqué—Figured Piqué—Jacquard Designing—Principles of the Jacquard Machine—Card Cutting—Casting Out—Distribution of Pattern—Areas—Arrangement of Figure—Figures Formed with Both Warp and Filling—Figures not Square—Diagonals

CROSS-WEAVING Page 237

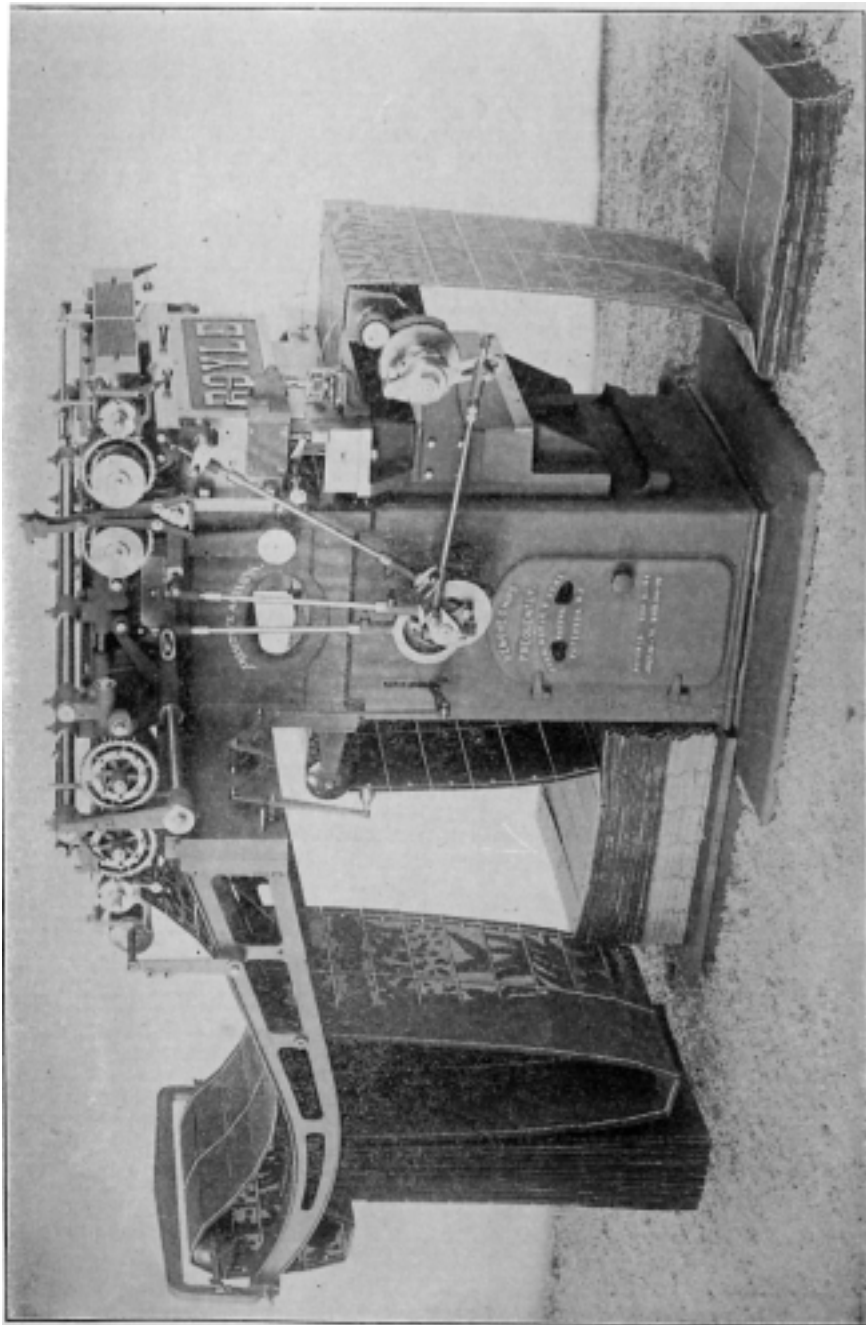
Plain Gauze Fabrics—Ground Threads—Crossing Threads—Standard and Doup—Full Gauze Fabrics—Leno Designs (Simple and Fancy)—Diamond Patterns—Warp and Filling Figures with Gauze—Openness in Gauze and Closeness of Texture in Plain and Figure—Open-Work Leno Designs—One-Thread-Crossing-One and One-Thread-Crossing-More-than-One Systems—Swans-down Weave—Leno Stripes

PRINCIPLES OF TEXTILE COLORING; COST-FINDING Page 281

Elements of Woven Patterns (Weave and Color)—Theories of Color (Pigment Theory, Light Theory)—The Spectrum—Classification of Colors (Simple, Compound)—Primary, Secondary, and Tertiary Colors—Relation of Color to Textiles—Effects of Fibers on Colors—Tones—Tints—Shades—Hues—Broken Colors—Value—Potentiality of a Color—Scaling—Luminous Colors—Neutral Colors—Complementary Colors—Color Combinations—Cost-Finding—Systematic Account-Keeping—Cash Book—Kinds of Accounts—Manufacturing Costs—Manufacturing Labor—Reports of Spinning Room, Weaving Room, etc.—Costs of Maintenance, Power, Administration, etc.—Semi-Annual Cost Sheets—Assembling Sheets

INDEX Page 337

*For page numbers, see foot of pages.



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

TEXTILE DESIGN.

PART I.

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 12×12 . The use of ruled paper is exceedingly simple if the first principles and rudiments are comprehended. To have a clear and proper

conception of the use of design paper, it will be necessary for the student to divide the squares into two distinct systems. *First*, suppose that there is a series of vertical lines and no horizontal lines (see Fig. 2.) *Second*, that there is a series of horizontal lines and no vertical lines (see Fig. 3.)

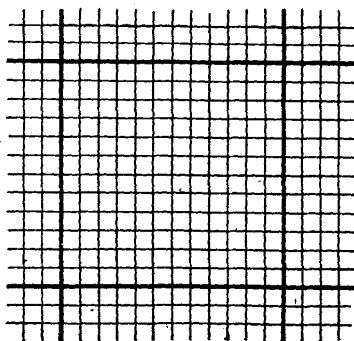


Fig. 1.

It is universally understood that woven fabrics in general have two systems of threads: *first*, the warp threads; *second*, the weft or woof. The weft is commonly called the filling threads. These are the two most important things to form the plainest of woven cloth.

Warp is the set of threads that run *lengthwise* in woven

goods, that is, if you had a piece of cloth four yards long there would be four yards of warp. Warp is represented on the design paper by the *vertical* or perpendicular series of small squares. The weft or filling is the set of threads that interlace the warp at right angles, and is represented on the design paper by the transverse or *horizontal* series of small squares. The weft runs across the width of the cloth. It should be clearly understood that these two systems, warp or vertical squares, and filling or transverse squares, form the fabric or design.

One object of point paper designing is to reproduce an imitation of the cloth and show the method of interlacing in the fabric, another object of the ruled paper is to show a plan of the fabric exactly as it would appear if looking down upon it.

The error that is usually made by beginners is that each small square is considered by itself, without taking into consideration that each *line* of squares, either vertical or horizontal, forms the design. This will be more readily understood by an examination of Fig. 4. Marks of any description—crosses, dots or circles—represent the raised warp threads, unless otherwise specified.



Fig. 2.

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.

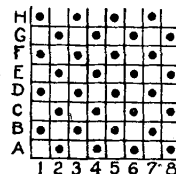


Fig. 4.

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.

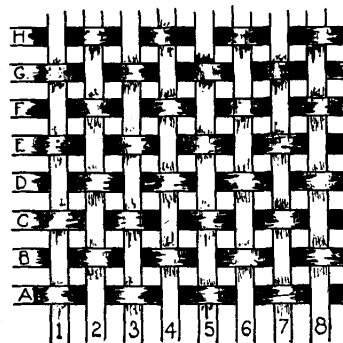


Fig. 5.

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 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;

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.

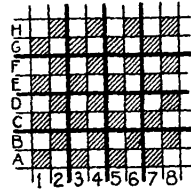


Fig. 6.

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 full 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

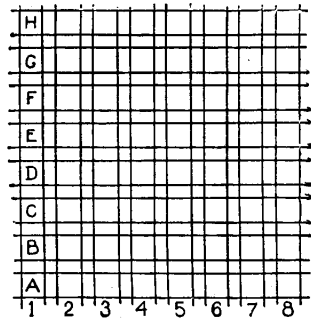


Fig. 7.

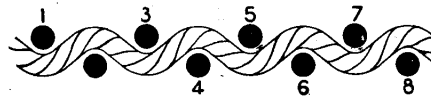


Fig. 8.

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.

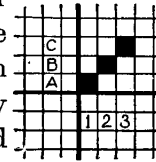


Fig. 9.

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

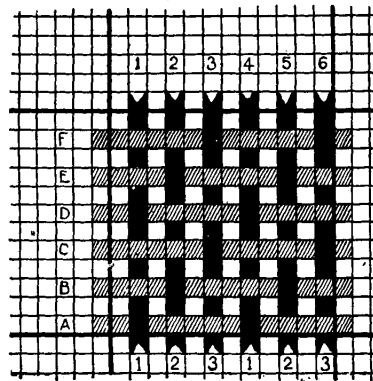


Fig. 10.

lower corner in Fig. 9. 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 un-

broken 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

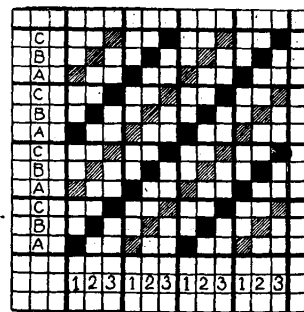


Fig. 11.

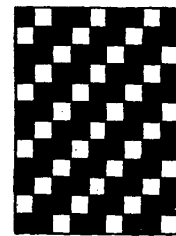


Fig. 12.

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.

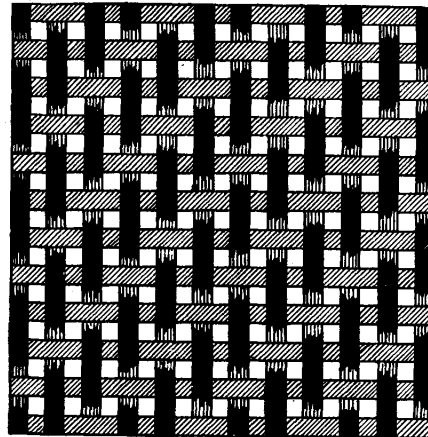


Fig. 13.

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 $\frac{1}{3}$.

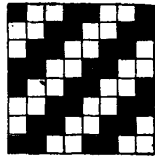


Fig. 14.

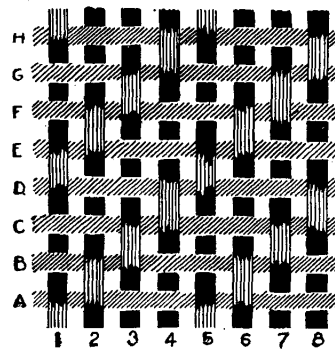


Fig. 15.

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

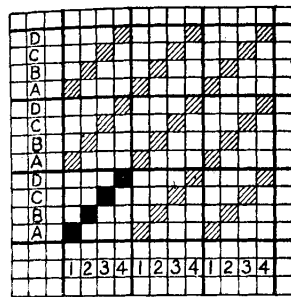


Fig. 16.

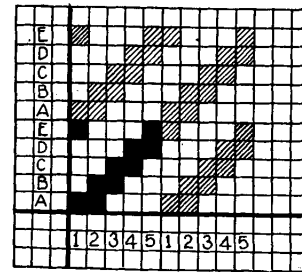


Fig. 17.

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

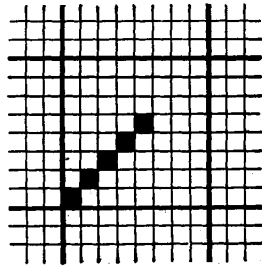


Fig. 18.

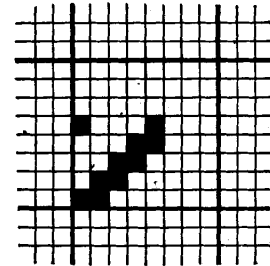


Fig. 19.

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

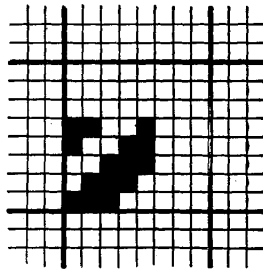


Fig. 20.

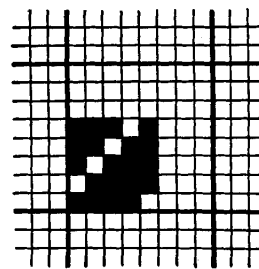


Fig. 21.

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

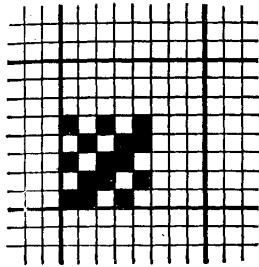


Fig. 22.

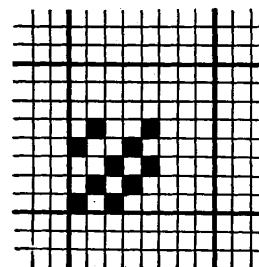


Fig. 23.

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 $\frac{1}{4}/1$.

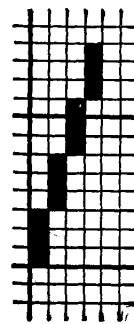


Fig. 24.

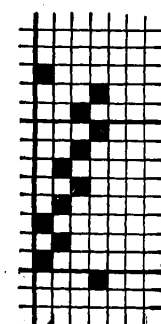


Fig. 25.

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.

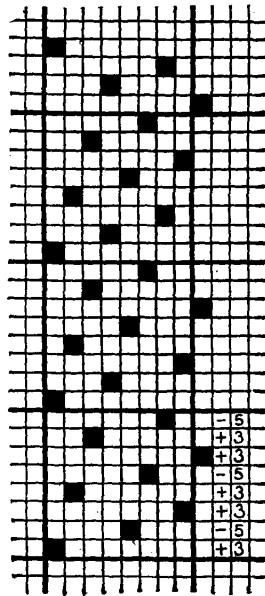


Fig. 26.

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

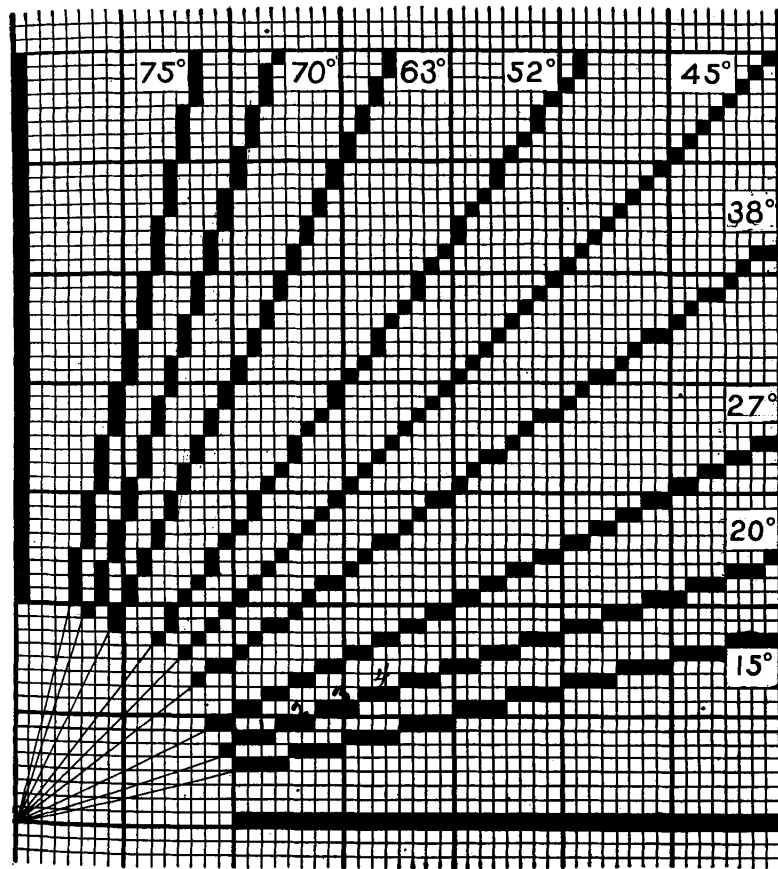


Fig. 27.

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 4 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

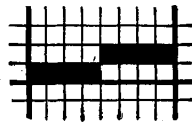


Fig. 28.

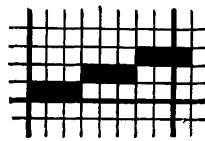


Fig. 29.

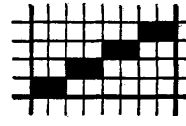


Fig. 30.

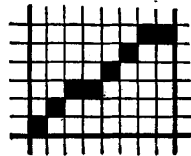


Fig. 31.

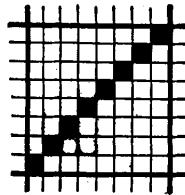


Fig. 32.

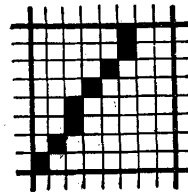


Fig. 33.



Fig. 34.

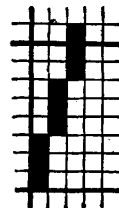


Fig. 35.

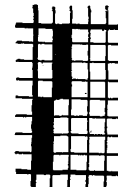


Fig. 36.

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.

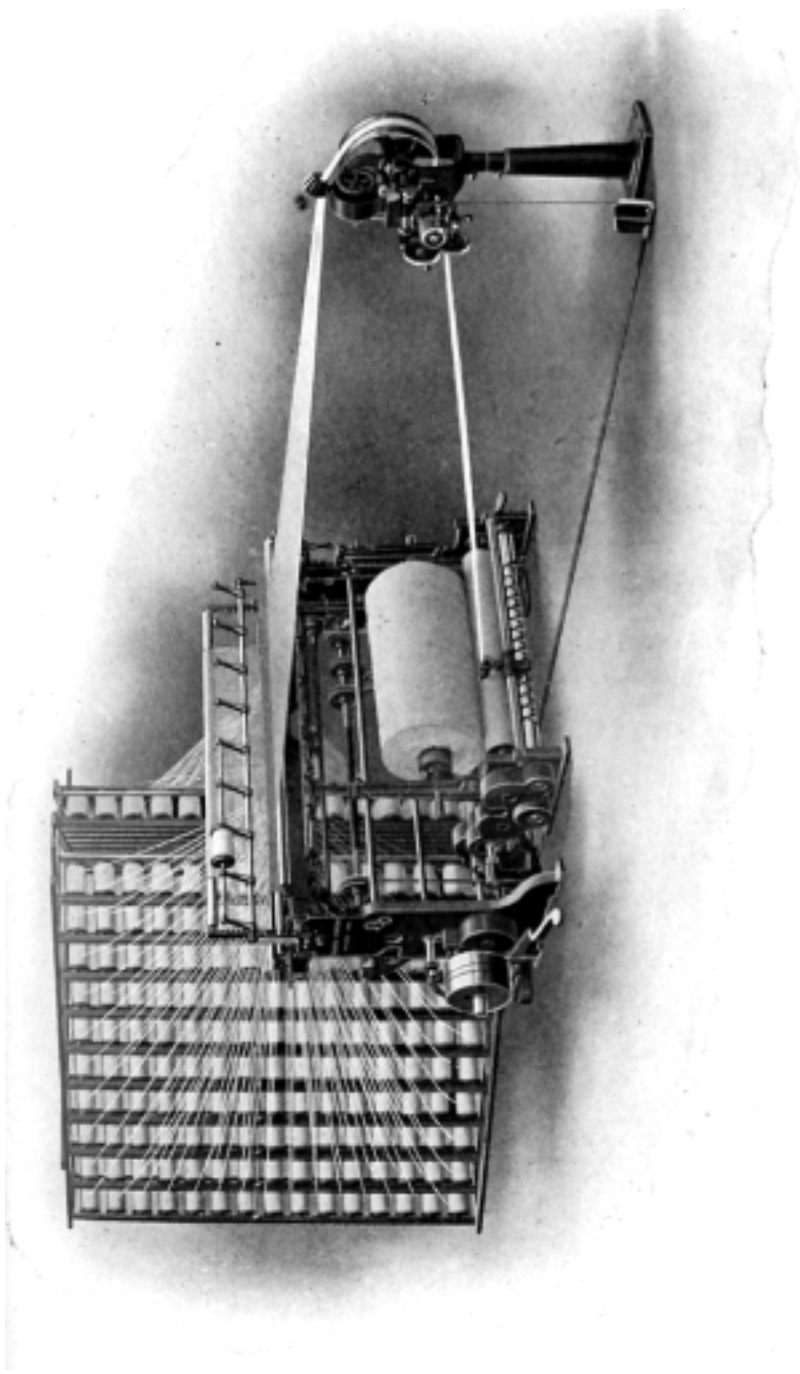
order. That is, if the 1st pick, A, interweaves over the threads Nos. 1 and 2, and under Nos. 3 and 4; the 2nd pick, B, will pass under Nos. 1 over 2 and 3 and under 4; the 3rd pick, C, will pass under 1 and 2, and over 3 and 4; the 4th pick, D, will pass over 1 under 2 and 3, and over 4. The 5th pick, 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.

No. of Threads	SINGLE MOVE NOS.		DOUBLE MOVE NOS.		TREBLE MOVE NOS.		IRREGULAR	
	1	2	1+0	2+0	1+0+0	2+0+0	3+0+0	
2	1		1+0		1+0+0			
3	2		4		6			
4	3		6		9			
5	4		2-1	2+0	2-1+0	2+0+0		2+1+2-1
6	5		8	4	2-2+1	2-1+1		4
7	6		10	10	2-2+2	2+1+0	2+1+1	
8	7		12	10	2+2-1	2+2+0	2+2+1	
9	8		14	14	3-1-1	3-1+0	3+1+1	
10	9		16	16	3-2+0	3-2+1	3+2+2	
	10		18	18	3-3+1	3-3+2	3+3+2	
			20	20	3-4+2	3-4+3	3+4+3	
			22	22	4-1+0	4-1+1	4+1+1	
			24	24	4-2+1	4-2+2	4+2+2	
			26	26	4-3+2	4-3+3	4+3+3	
			28	28	4-4+3	4-4+4	4+4+4	
			30	30	4-5+4	4-5+5	4+5+5	
			32	32	4-6+5	4-6+6	4+6+6	
			34	34	4-7+6	4-7+7	4+7+7	
			36	36	4-8+7	4-8+8	4+8+8	
			38	38	4-9+8	4-9+9	4+9+9	
			40	40	4-10+9	4-10+10	4+10+10	
			42	42	4-11+10	4-11+11	4+11+11	
			44	44	4-12+11	4-12+12	4+12+12	
			46	46	4-13+12	4-13+13	4+13+13	
			48	48	4-14+13	4-14+14	4+14+14	
			50	50	4-15+14	4-15+15	4+15+15	
			52	52	4-16+15	4-16+16	4+16+16	
			54	54	4-17+16	4-17+17	4+17+17	
			56	56	4-18+17	4-18+18	4+18+18	
			58	58	4-19+18	4-19+19	4+19+19	
			60	60	4-20+19	4-20+20	4+20+20	
			62	62	4-21+20	4-21+21	4+21+21	
			64	64	4-22+21	4-22+22	4+22+22	
			66	66	4-23+22	4-23+23	4+23+23	
			68	68	4-24+23	4-24+24	4+24+24	
			70	70	4-25+24	4-25+25	4+25+25	
			72	72	4-26+25	4-26+26	4+26+26	
			74	74	4-27+26	4-27+27	4+27+27	
			76	76	4-28+27	4-28+28	4+28+28	
			78	78	4-29+28	4-29+29	4+29+29	
			80	80	4-30+29	4-30+30	4+30+30	
			82	82	4-31+30	4-31+31	4+31+31	
			84	84	4-32+31	4-32+32	4+32+32	
			86	86	4-33+32	4-33+33	4+33+33	
			88	88	4-34+33	4-34+34	4+34+34	
			90	90	4-35+34	4-35+35	4+35+35	
			92	92	4-36+35	4-36+36	4+36+36	
			94	94	4-37+36	4-37+37	4+37+37	
			96	96	4-38+37	4-38+38	4+38+38	
			98	98	4-39+38	4-39+39	4+39+39	
			100	100	4-40+39	4-40+40	4+40+40	
			102	102	4-41+40	4-41+41	4+41+41	
			104	104	4-42+41	4-42+42	4+42+42	
			106	106	4-43+42	4-43+43	4+43+43	
			108	108	4-44+43	4-44+44	4+44+44	
			110	110	4-45+44	4-45+45	4+45+45	
			112	112	4-46+45	4-46+46	4+46+46	
			114	114	4-47+46	4-47+47	4+47+47	
			116	116	4-48+47	4-48+48	4+48+48	
			118	118	4-49+48	4-49+49	4+49+49	
			120	120	4-50+49	4-50+50	4+50+50	
			122	122	4-51+50	4-51+51	4+51+51	
			124	124	4-52+51	4-52+52	4+52+52	
			126	126	4-53+52	4-53+53	4+53+53	
			128	128	4-54+53	4-54+54	4+54+54	
			130	130	4-55+54	4-55+55	4+55+55	
			132	132	4-56+55	4-56+56	4+56+56	
			134	134	4-57+56	4-57+57	4+57+57	
			136	136	4-58+57	4-58+58	4+58+58	
			138	138	4-59+58	4-59+59	4+59+59	
			140	140	4-60+59	4-60+60	4+60+60	
			142	142	4-61+60	4-61+61	4+61+61	
			144	144	4-62+61	4-62+62	4+62+62	
			146	146	4-63+62	4-63+63	4+63+63	
			148	148	4-64+63	4-64+64	4+64+64	
			150	150	4-65+64	4-65+65	4+65+65	
			152	152	4-66+65	4-66+66	4+66+66	
			154	154	4-67+66	4-67+67	4+67+67	
			156	156	4-68+67	4-68+68	4+68+68	
			158	158	4-69+68	4-69+69	4+69+69	
			160	160	4-70+69	4-70+70	4+70+70	
			162	162	4-71+70	4-71+71	4+71+71	
			164	164	4-72+71	4-72+72	4+72+72	
			166	166	4-73+72	4-73+73	4+73+73	
			168	168	4-74+73	4-74+74	4+74+74	
			170	170	4-75+74	4-75+75	4+75+75	
			172	172	4-76+75	4-76+76	4+76+76	
			174	174	4-77+76	4-77+77	4+77+77	
			176	176	4-78+77	4-78+78	4+78+78	
			178	178	4-79+78	4-79+79	4+79+79	
			180	180	4-80+79	4-80+80	4+80+80	
			182	182	4-81+80	4-81+81	4+81+81	
			184	184	4-82+81	4-82+82	4+82+82	
			186	186	4-83+82	4-83+83	4+83+83	
			188	188	4-84+83	4-84+84	4+84+84	
			190	190	4-85+84	4-85+85	4+85+85	
			192	192	4-86+85	4-86+86	4+86+86	
			194	194	4-87+86	4-87+87	4+87+87	
			196	196	4-88+87	4-88+88	4+88+88	
			198	198	4-89+88	4-89+89	4+89+89	
			200	200	4-90+89	4-90+90	4+90+90	
			202	202	4-91+90	4-91+91	4+91+91	
			204	204	4-92+91	4-92+92	4+92+92	
			206	206	4-93+92	4-93+93	4+93+93	
			208	208	4-94+93	4-94+94	4+94+94	
			210	210	4-95+94	4-95+95	4+95+95	
			212	212	4-96+95	4-96+96	4+96+96	
			214	214	4-97+96	4-97+97	4+97+97	
			216	216	4-98+97	4-98+98	4+98+98	
			218	218	4-99+98	4-99+99	4+99+99	
			220	220	4-100+99	4-100+100	4+100+100	
			222	222	4-101+100	4-101+101	4+101+101	
			224	224	4-102+101	4-102+102	4+102+102	
			226	226	4-103+102	4-103+103	4+103+103	
			228	228	4-104+103	4-104+104	4+104+104	
			230	230	4-105+104	4-105+105	4+105+105	
			232	232	4-106+105	4-106+106	4+106+106	
			234	234	4-107+106	4-107+107	4+107+107	
			236	236	4-108+107	4-108+108	4+108+108	
			238	238	4-109+108	4-109+109	4+109+109	
			240	240	4-110+109	4-110+110	4+110+110	
			242	242	4-111+110	4-111+111	4+111+111	
			244	244	4-112+111	4-112+112	4+112+112	
			246	246	4-113+112	4-113+113	4+113+113	
			248	248	4-114+113	4-114+114	4+114+114	
			250	250	4-115+114	4-115+115	4+115+115	
			252	252	4-116+115	4-116+116	4+116+116	
			254	254	4-117+116	4-117+117	4+117+117	
			256	256	4-118+117	4-118+118	4+118+118	
			258	258	4-119+118	4-119+119	4+119+119	
			260	260	4-120+119	4-120+120	4+120+120	
			262	262	4-121+120	4-121+121	4+121+121	
			264	264	4-122+121	4-122+122	4+122+122	
			266	266	4-123+122	4-123+123	4+123+123	
			268	268	4-124+123	4-124+124	4+124+124	
			270	270	4-125+124	4-125+125	4+125+125	
			272	272	4-126+125	4-126+126	4+126+126	
			274	274	4-127+126	4-127+127	4+127+127	
			276	276	4-128+127	4-128+128	4+128+128	
			278	278	4-129+128	4-129+129	4+129+129	
			280	280	4-130+129	4-130+130	4+130+130	
			282	282	4-131+130	4-131+131	4+131+131	
			284	284	4-132+131	4-132+132	4+132+132	
			286	286	4-133+132	4-133+133	4+133+133	

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	$\frac{2}{2}$				$\frac{2}{2} \& \frac{11}{11}$		$\frac{2}{2} \& \frac{11}{11} \& \frac{2}{2}$	$\frac{11}{11} \& \frac{2}{2} \& \frac{11}{11}$
5	$\frac{2}{3}$	$\frac{11}{12}$			$\frac{2}{3} \& \frac{11}{12}$		$\frac{2}{3} \& \frac{11}{12} \& \frac{2}{3}$	$\frac{11}{12} \& \frac{2}{3} \& \frac{11}{12}$
6	$\frac{3}{3}$	$\frac{21}{12}$			$\frac{3}{3} \& \frac{21}{12}$	$\frac{21}{12} \& \frac{21}{21}$	$\frac{3}{3} \& \frac{21}{12} \& \frac{3}{3}$	$\frac{21}{12} \& \frac{3}{3} \& \frac{21}{21}$
7	$\frac{3}{4}$	$\frac{21}{13}$	$\frac{21}{22}$	$\frac{111}{112}$	$\frac{21}{13} \& \frac{21}{31}$	$\frac{21}{13} \& \frac{21}{22}$	$\frac{21}{13} \& \frac{21}{22} \& \frac{31}{31}$	
8	$\frac{4}{4}$	$\frac{22}{13}$	$\frac{31}{13}$	$\frac{211}{121}$	$\frac{31}{13} \& \frac{31}{31}$	$\frac{22}{13} \& \frac{211}{121}$	$\frac{31}{13} \& \frac{22}{22} \& \frac{31}{31}$	$\frac{211}{112} \& \frac{211}{121}$
9	$\frac{4}{5}$	$\frac{22}{23}$	$\frac{221}{211}$	$\frac{1111}{1112}$	$\frac{31}{32} \& \frac{31}{23}$		$\frac{31}{14} \& \frac{22}{23} \& \frac{31}{41}$	
10	$\frac{5}{5}$	$\frac{41}{14}$	$\frac{32}{23}$	$\frac{221}{122}$	$\frac{41}{14} \& \frac{41}{41}$	$\frac{1121}{1112}$	$\frac{221}{113} \& \frac{31}{131} \& \frac{212}{311}$	

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

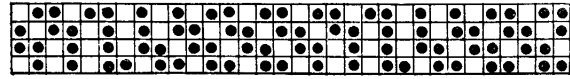
(19—21) $\frac{4}{2} \frac{1}{2} \frac{1}{2} / 1, 2, 3.$

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

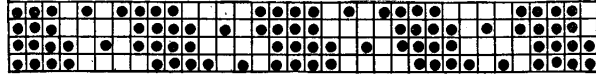
(26—29) $\frac{3}{2} \frac{2}{1} \frac{2}{2} / 1, 2, 3, 4. \quad 3-2+2, 4-3+2, 4-2+1.$

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

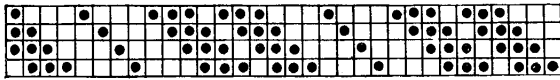
MAKE ONE COMPLETE REPEAT OF EACH OF THE FOLLOWING DESIGNS.



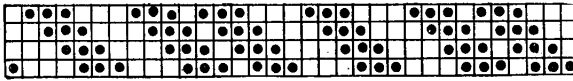
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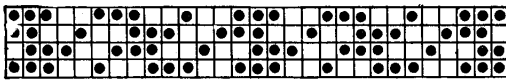
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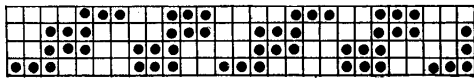
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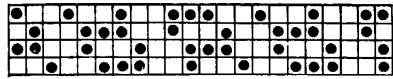
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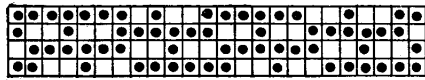
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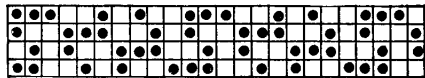
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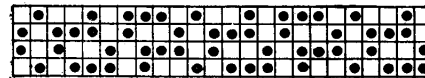
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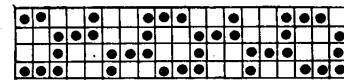
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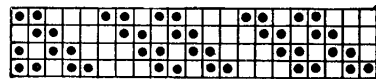
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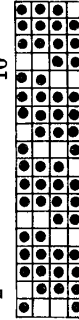
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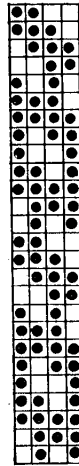
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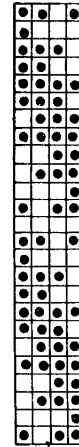
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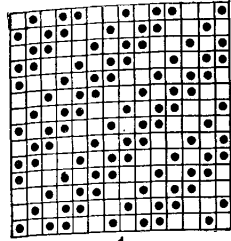


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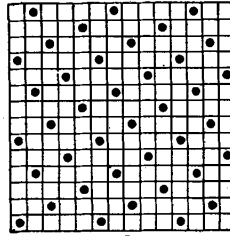


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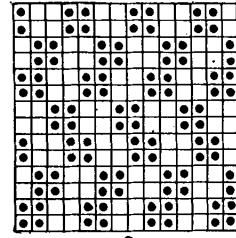
MAKE ONE COMPLETE PATTERN WITHOUT REPEAT OF EACH OF THE FOLLOWING.



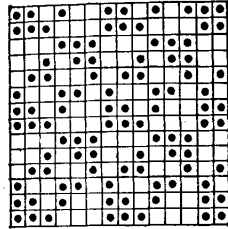
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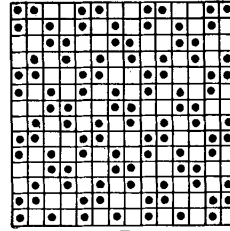
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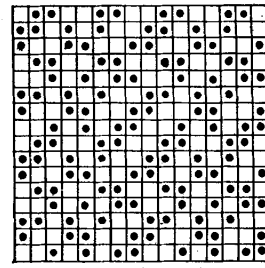
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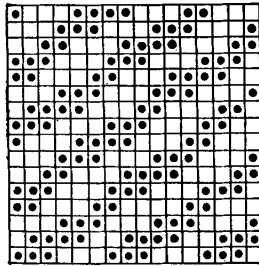
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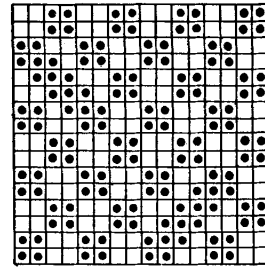
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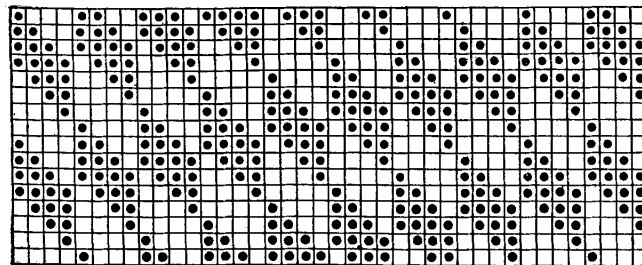


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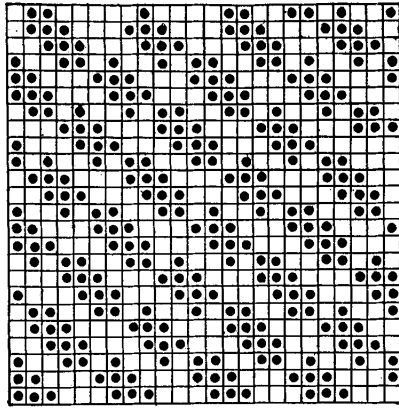


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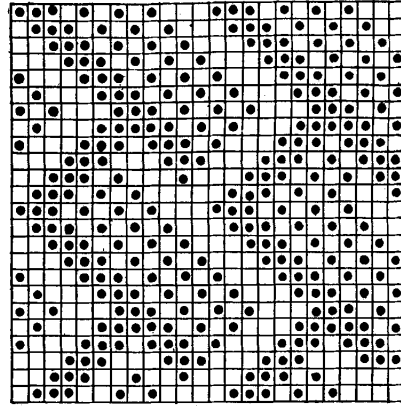
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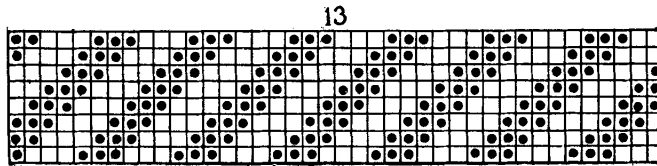
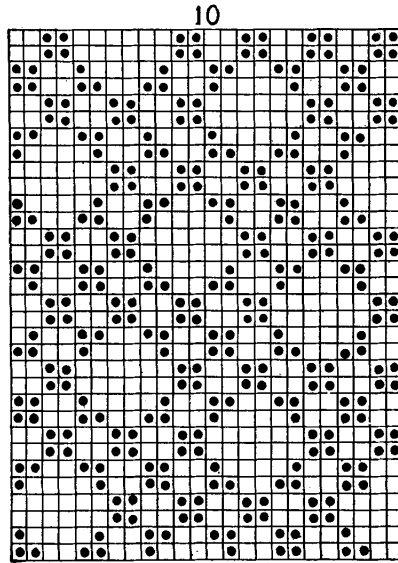
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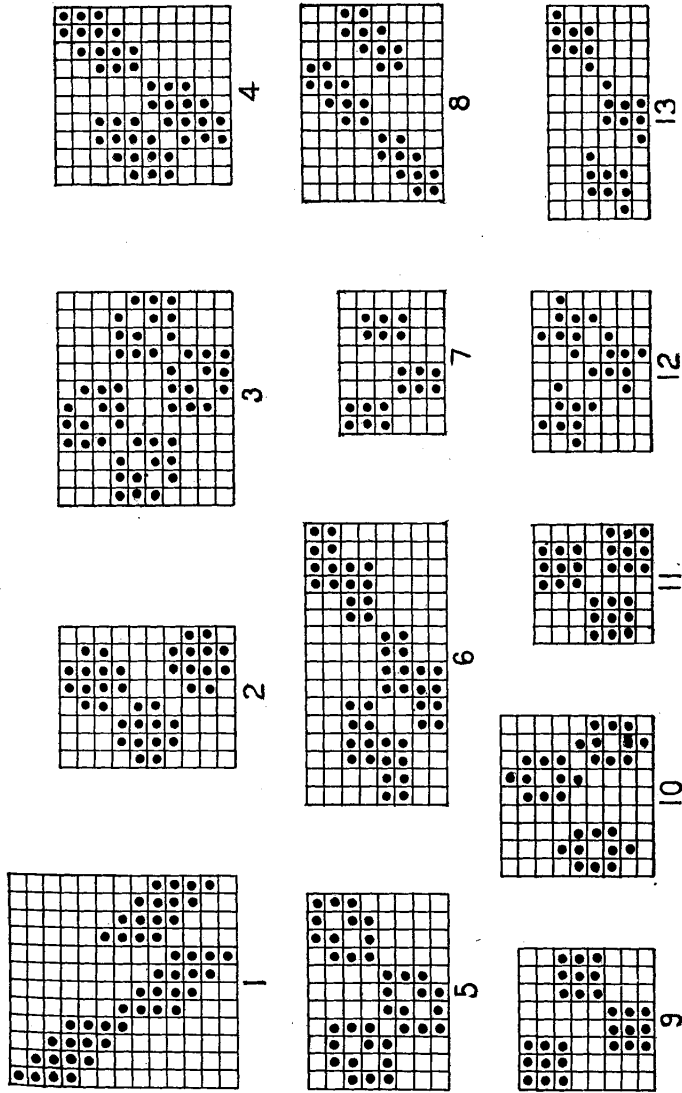


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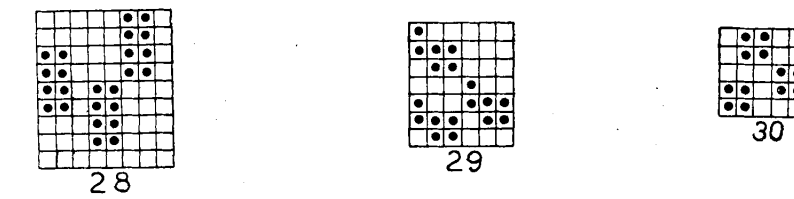
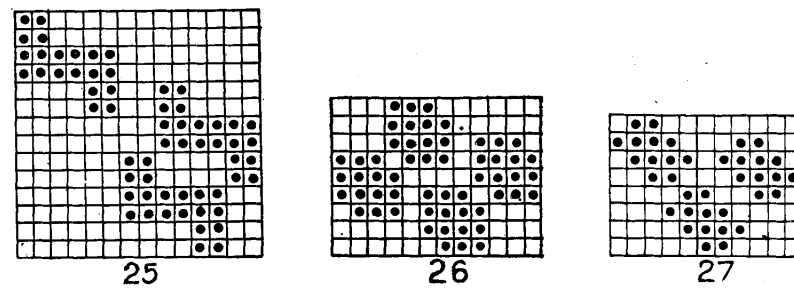
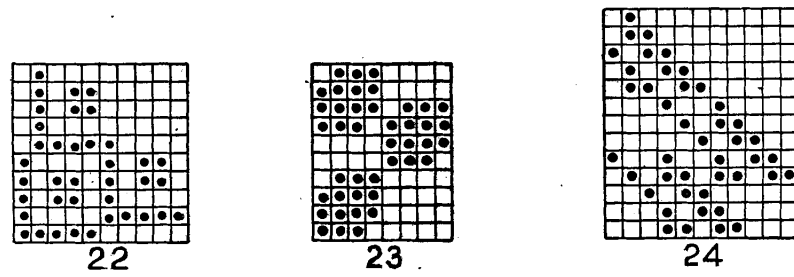
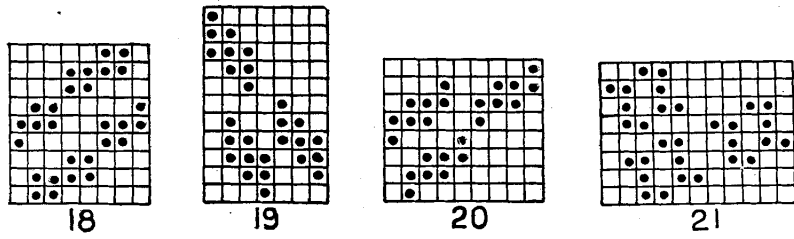
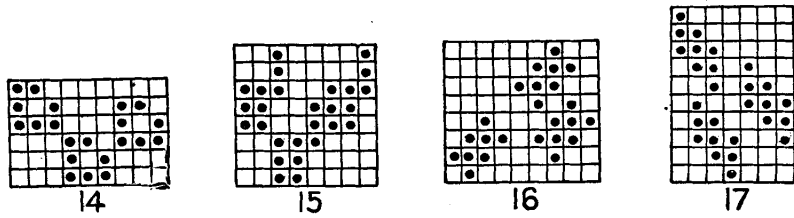


30 EXERCISES IN SPOT WEAVES.

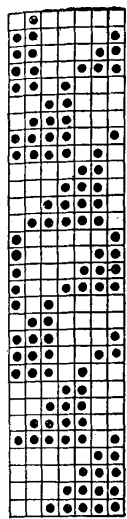
COMPLETE THE WEAVES FROM THE ACCOMPANYING PORTIONS.



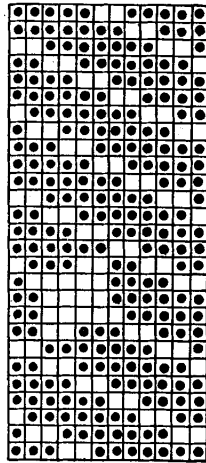
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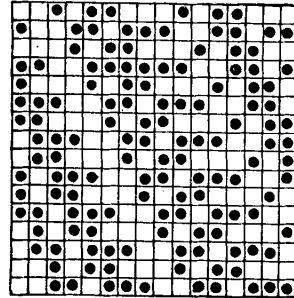
MAKE ONE COMPLETE REPEAT OF EACH OF THESE DESIGNS.



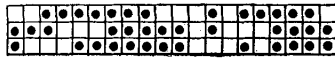
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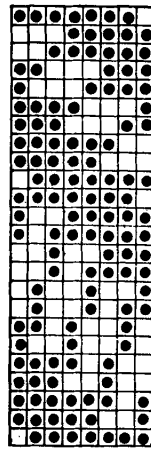
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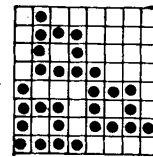
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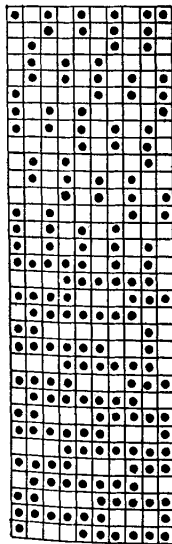
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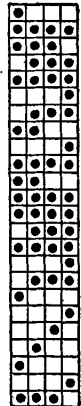
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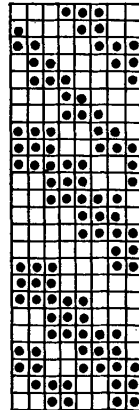
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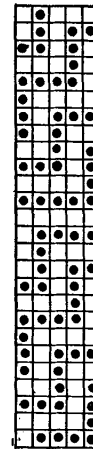
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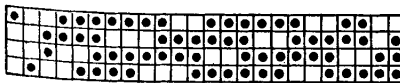
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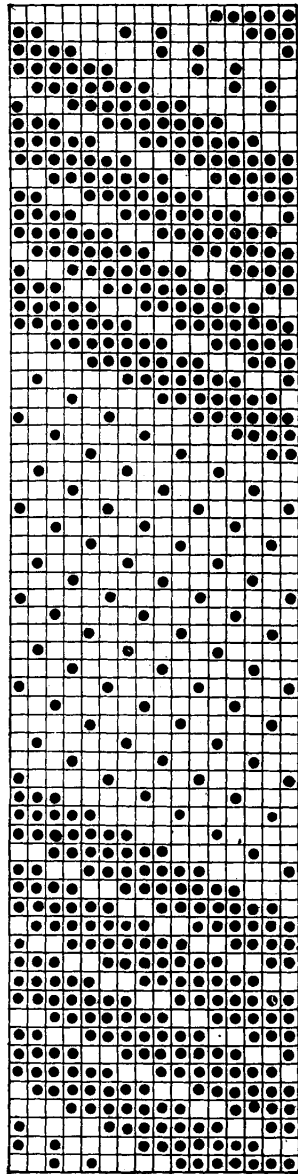


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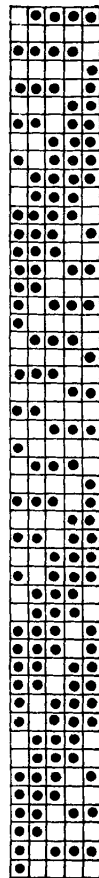


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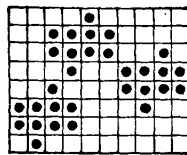
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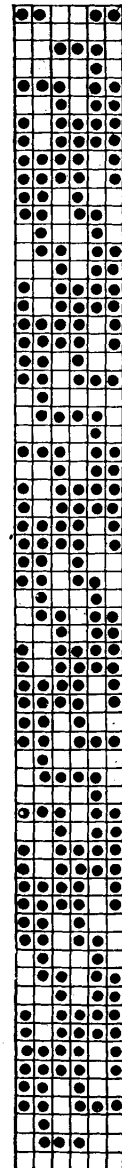
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14



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.

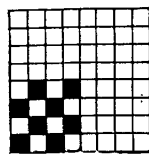


Fig. 46.

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

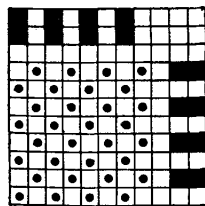


Fig. 47.

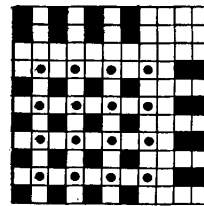


Fig. 48.

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

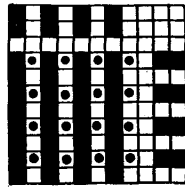


Fig. 49.

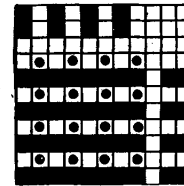


Fig. 50.

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

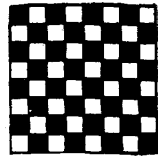


Fig. 51.

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:

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

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

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.

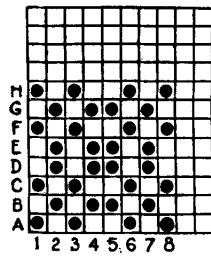


Fig. 52.

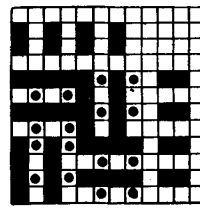


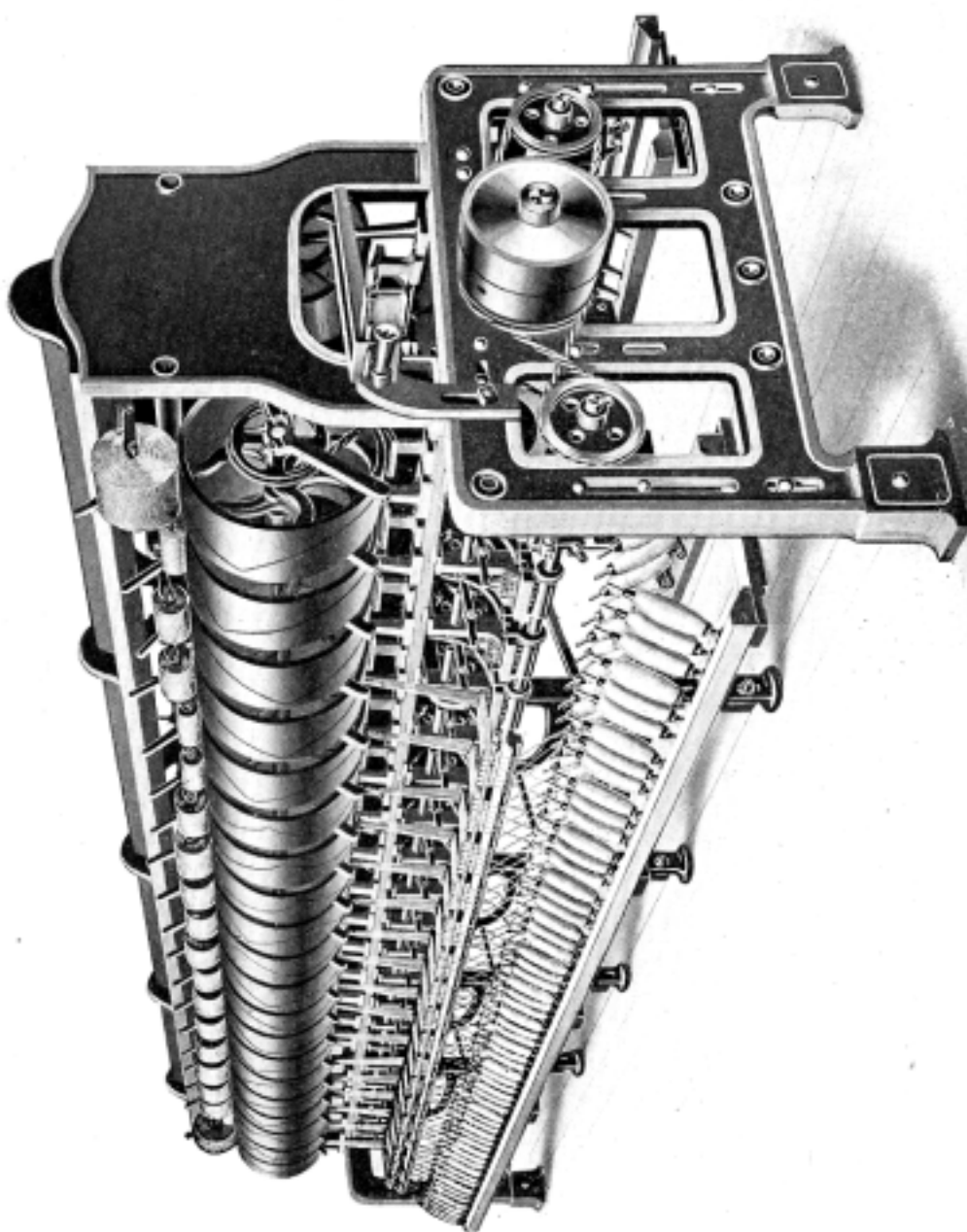
Fig. 53.

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:

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

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.

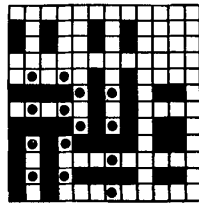


Fig. 54.

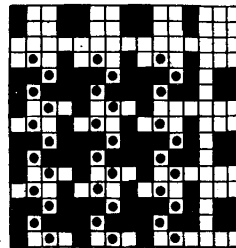


Fig. 55.

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.


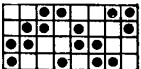
EXERCISES FOR PRACTICE.

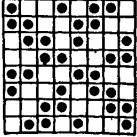
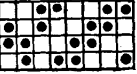
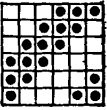

All on the Plain Weave.

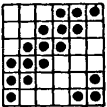
	WARP.		FILLING.	
1.	1 Red } 1 Black }	16 Threads.	1 Black } 2 Red }	16 Picks.
2.	1 Red } 1 Black }	16 Threads.	1 Red } 1 Black }	16 Picks.
3.	1 White } 1 Black } 2 White } 1 Black }	20 Threads.	1 Black } 1 White } 1 Black } 2 White }	20 Picks.
4.	2 White } 1 Black }	12 Threads.	2 White } 1 Black }	12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

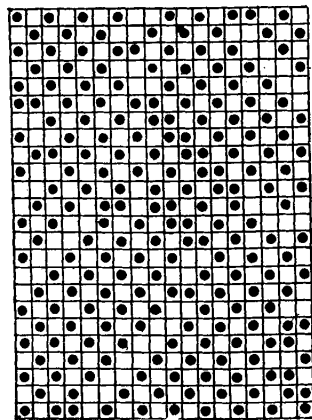
	WEAVE.	WARP.	FILLING.
(1)		Color— 1 } Ground—1 }	=2 as warp
(2)	same as (1)	Color— 2 } Ground—2 }	=4 as warp
(3)	same as (1)	Color— 2 } Ground—2 }	=4 as warp
(4)	same as (1)	Color— 4 } Ground—4 }	=8 as warp
(5)	same as (1)	Color— 2 2 } Ground—1 3 }	=8 Color— 1 3 } Ground—4. }
(6)		Color— 4 } Ground—4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

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

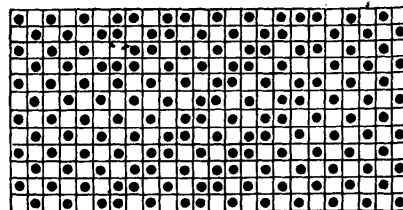
WEAVE.	WARP.	FILLING.
(23) 	$\left. \begin{array}{l} \text{No. 1 Color— } 1\ 2\ .\ 2 \\ \text{No. 2 " } 1\ .\ 1\ 1\ . \\ \text{No. 3 Ground— } 1\ 1\ 2\ 2\ 1 \end{array} \right\} = 24$ <p style="text-align: center;">4 times</p>	$\left. \begin{array}{l} \text{No. 1 Color— } 1 \\ \text{No. 3 Ground— } 2 \end{array} \right\} = 3$
(24) same as (23)	$\left. \begin{array}{l} \text{No. 1 Color— } 1\ 3 \\ \text{No. 2 Ground— } 1\ 1\ 3\ 2 \end{array} \right\} = 36$ <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?

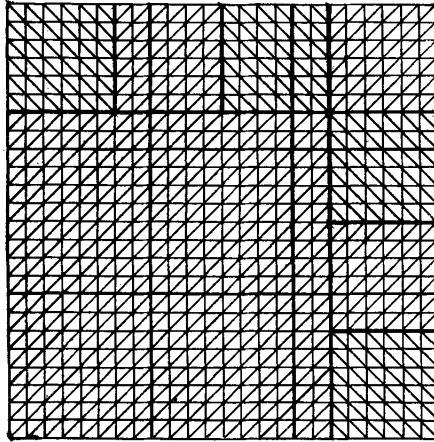


Fig. 56.

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.

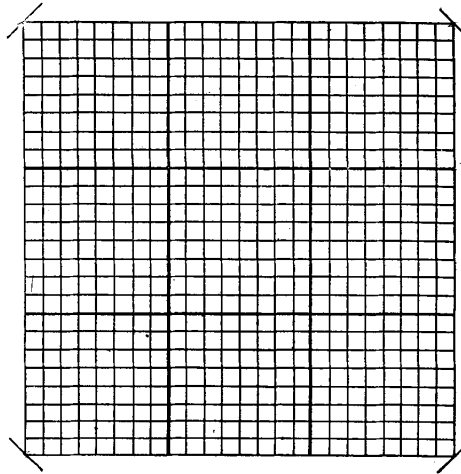


Fig. 57.

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 18×18 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).

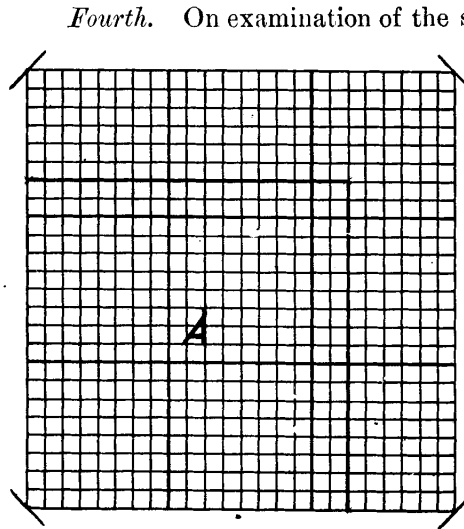


Fig. 58.

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.

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/>	
	24	
Section 2.	6 " 24 "	B1. See second " " " "
	<hr/>	
	18	
Section 3.	6 " 18 "	B1. See third " " " "
	6 " 6 "	B2.
	<hr/>	
	24	
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.

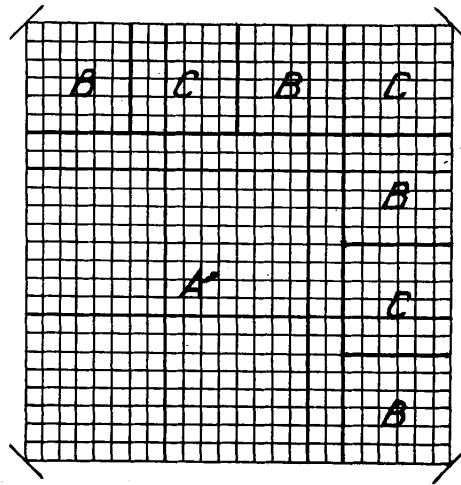


Fig. 59.

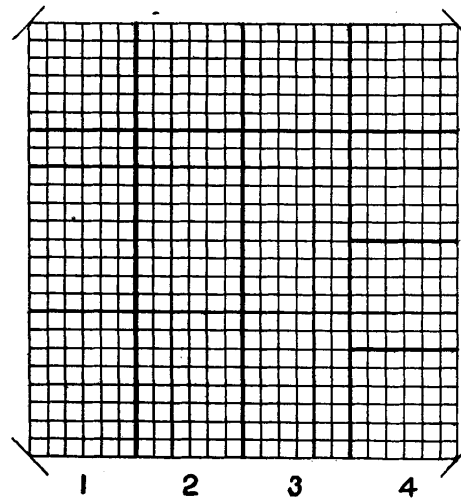


Fig. 60.

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

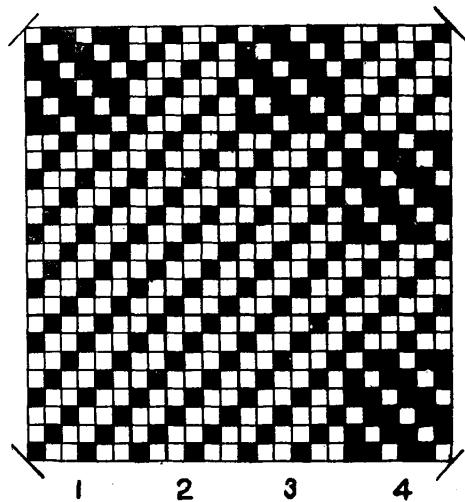


Fig. 61.

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

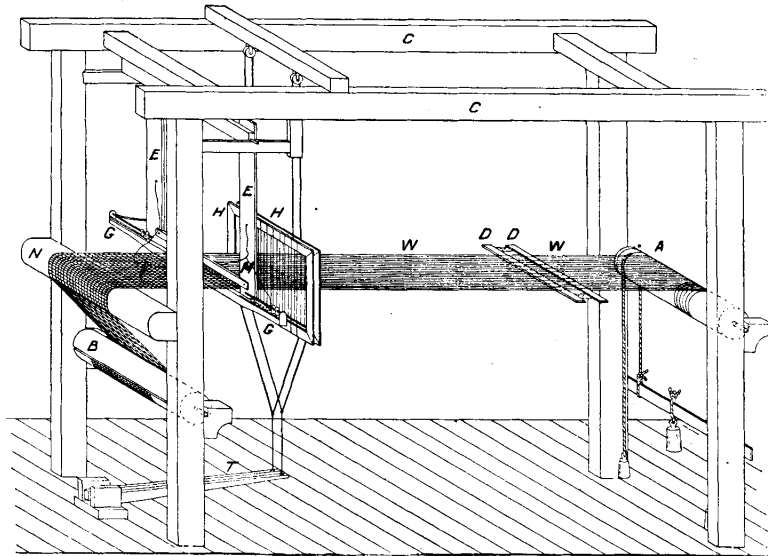


Fig. 62.

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

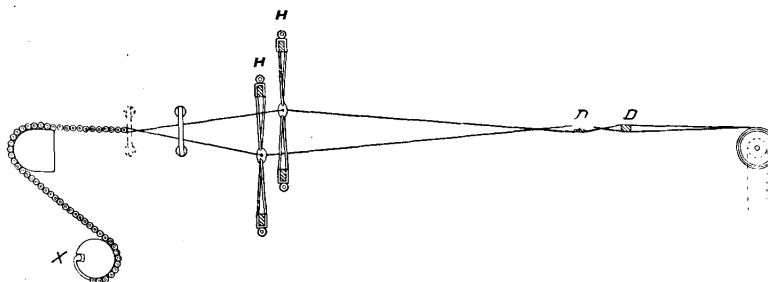
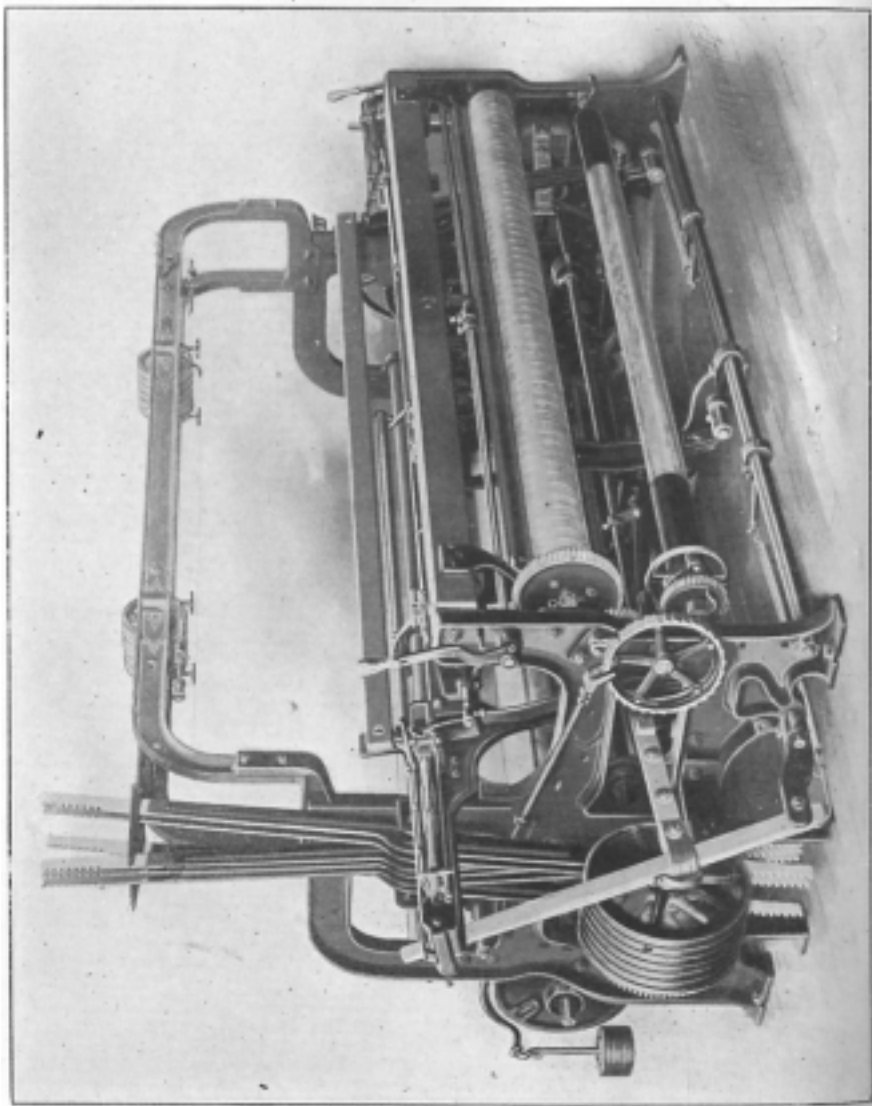


Fig. 63.

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

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

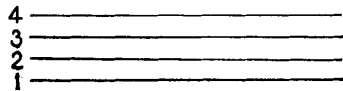


Fig. 65.

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

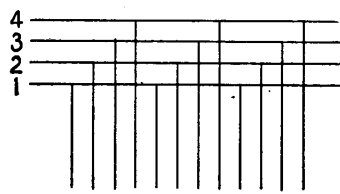


Fig. 66.

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.

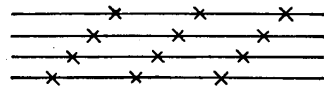


Fig. 67.

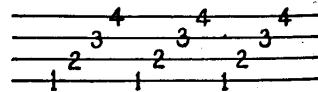


Fig. 68.

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.

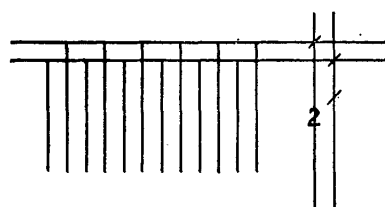


Fig. 69.

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.

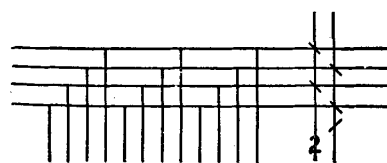


Fig. 70.

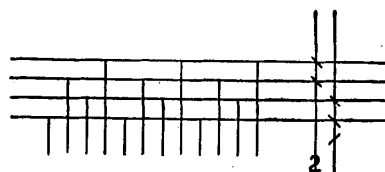


Fig. 71.

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-

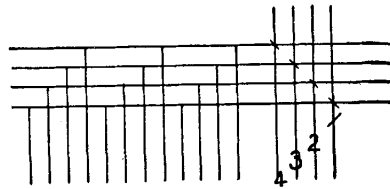


Fig. 72.

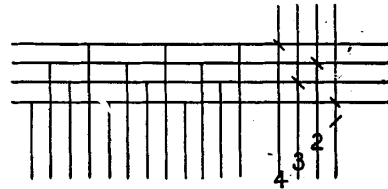


Fig. 73.

nesses 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

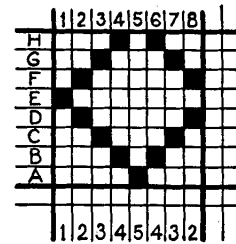


Fig. 74.

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.

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.

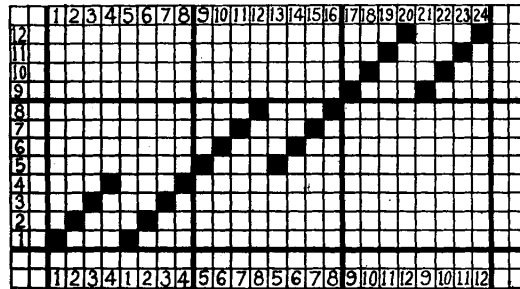


Fig. 78.

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.

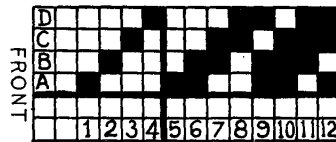


Fig. 79.

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,

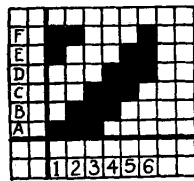


Fig. 80.

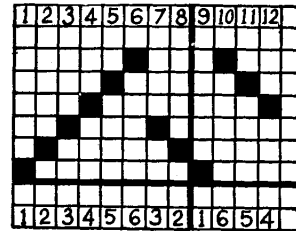


Fig. 81.

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

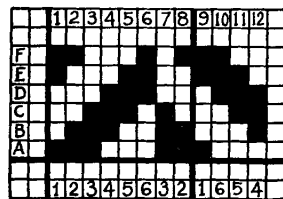


Fig. 82.

figures, and not on parallel lines. 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

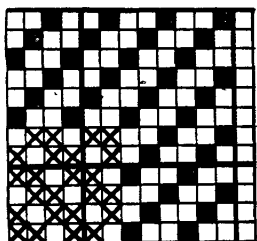


Fig. 83.

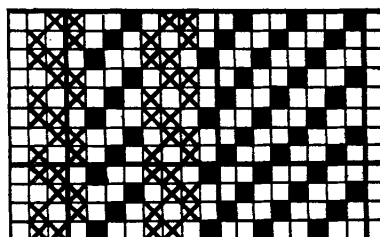


Fig. 84.

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

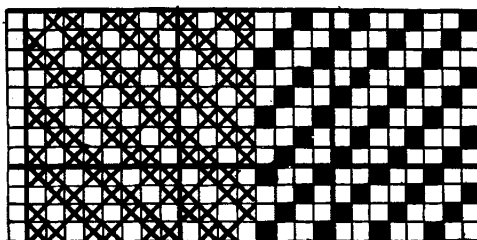


Fig. 85.

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.

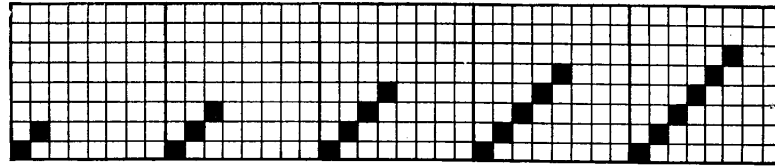


Fig. 86.

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

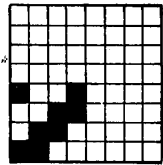


Fig. 91.

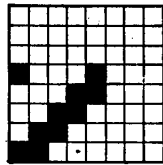


Fig. 92.

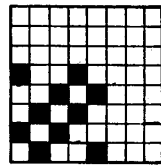


Fig. 93.

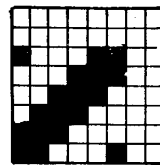


Fig. 94.

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,

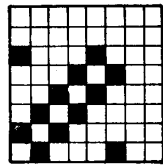


Fig. 95.

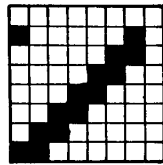


Fig. 96.

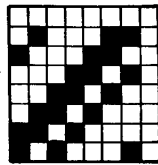


Fig. 97.

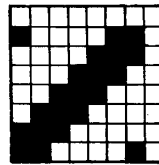


Fig. 98.

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

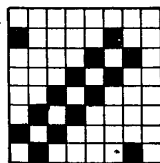


Fig. 99.

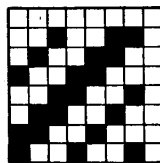


Fig. 100.

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.)

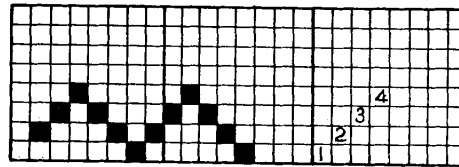


Fig. 101.

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

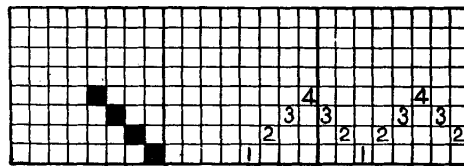


Fig. 102.

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

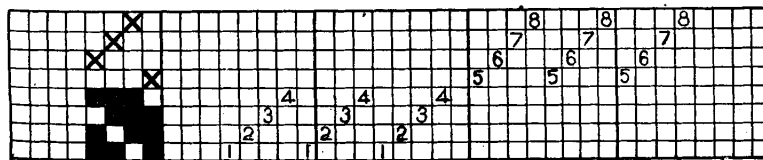


Fig. 103.

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.

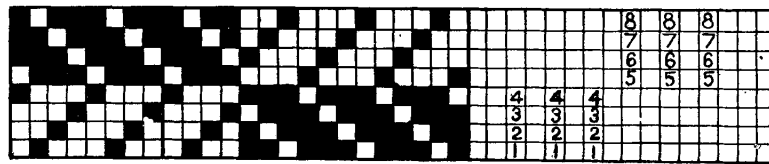


Fig. 104.

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

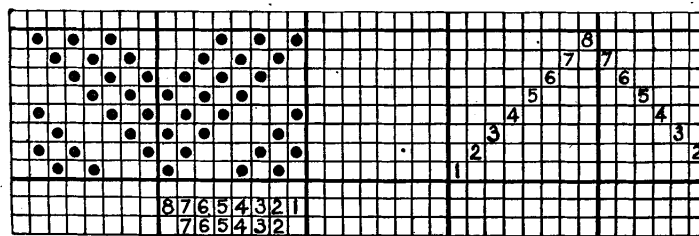


Fig. 105.

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.

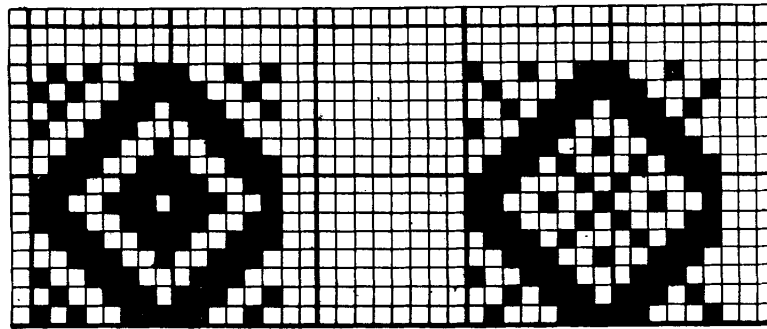


Fig. 106.

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

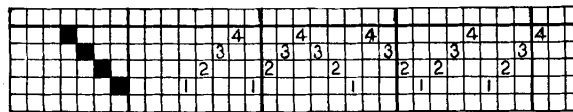
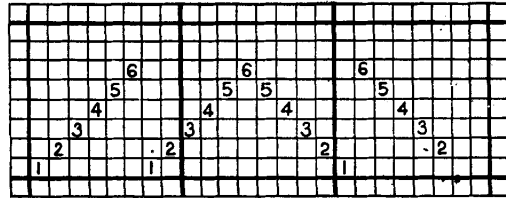
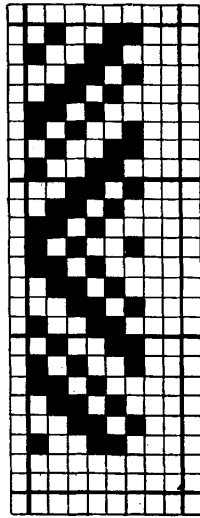


Fig. 108. DOUBLE DRAFT.

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

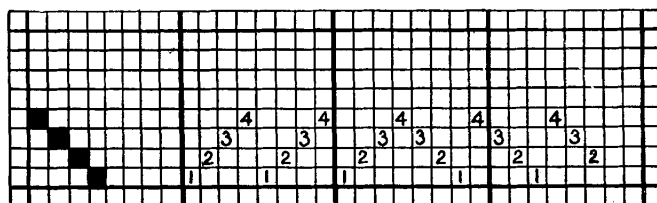


Fig. 110. TRIPLE DRAFT.

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

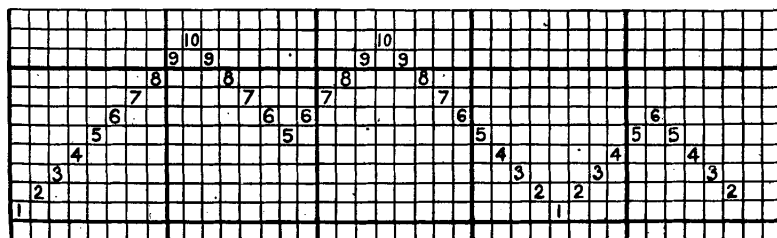


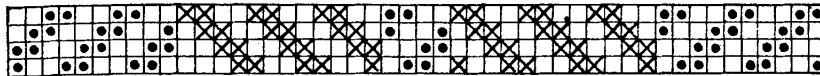
Fig. 111. ALTERNATE DRAFT.

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.

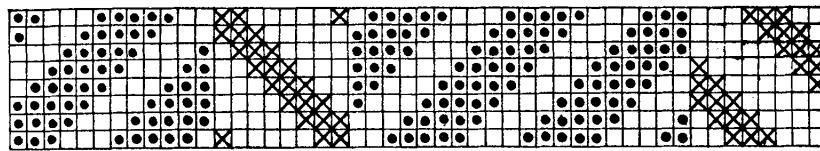
Damask work designs are used to considerable advantage in the linen trade, and also to some extent in cottons. This class of work makes good designs for the shawl trade, provided the warp is of one color and the filling of some darker shade of another color.

EXERCISES ON DAMASK PATTERNS.

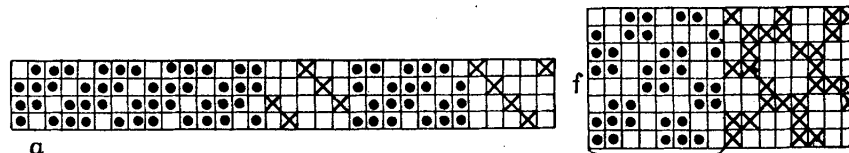
1. Form a check from the accompanying damask stripes *a b c d e f*.



c



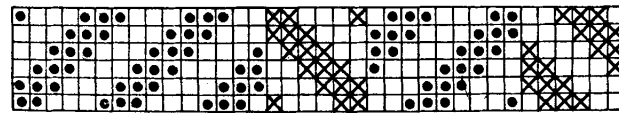
e



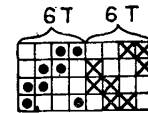
a

f

5 TIMES

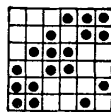


b

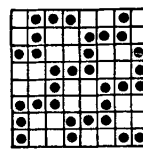


d

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



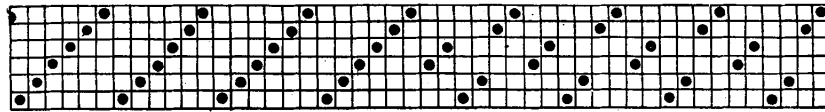
h

EXERCISES FOR PRACTICE.

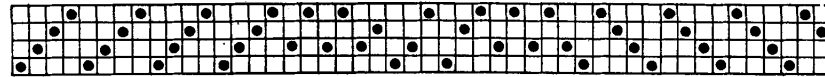
1. Work out the designs from the following drafts and chain plans.

2. Work out the designs obtained by using chain plan M with drafts G, H, K, L.

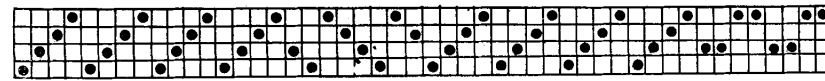
3. As No. 2, but with chain plan N.



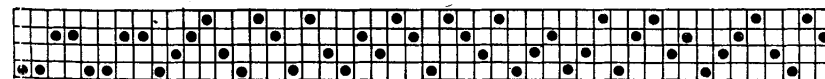
A



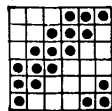
B



C



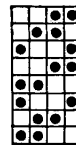
D



A



B

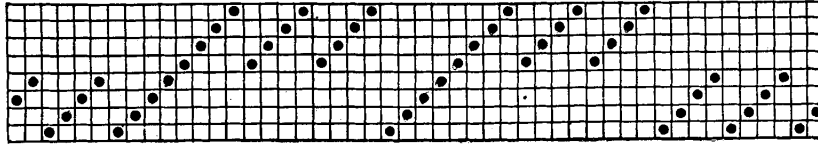


C

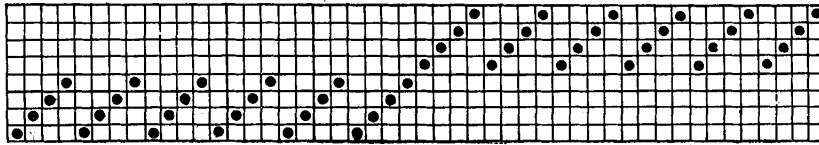


D

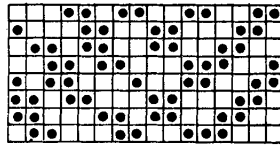
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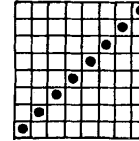
L



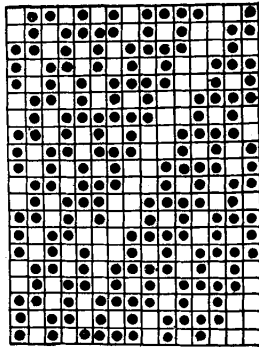
K



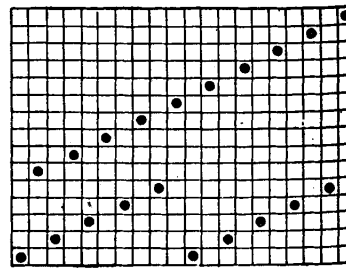
E



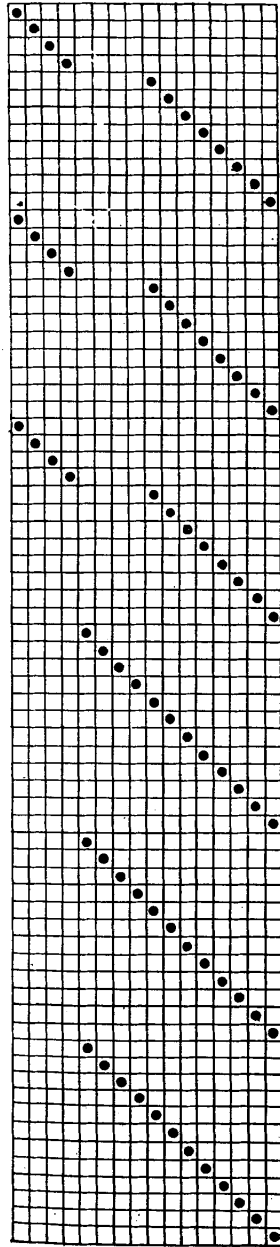
G



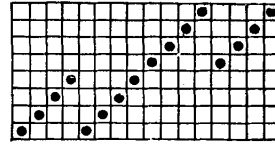
F



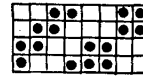
F



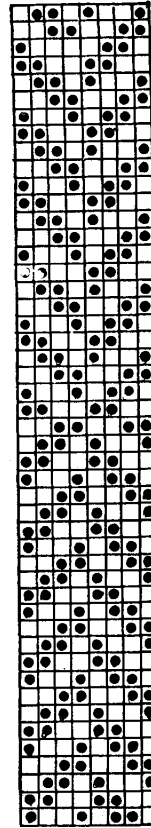
E



H



M



N

EXERCISES IN DRAFTING.

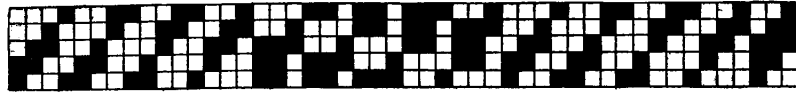
Reduce each of the following designs to weave on the fewest possible number of shafts, giving draft and chain.



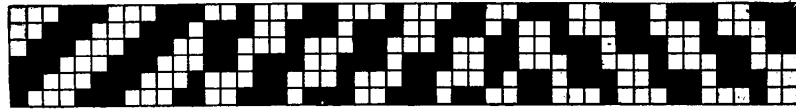
1



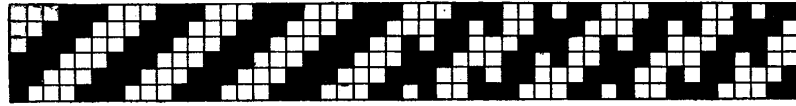
2



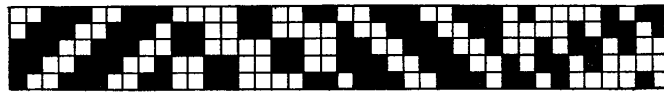
4



6



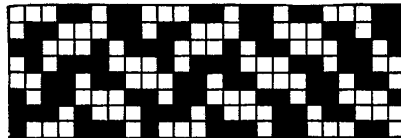
7



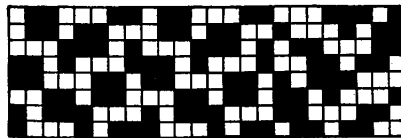
3



5



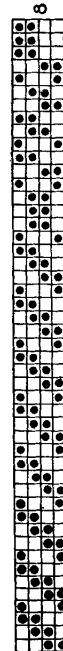
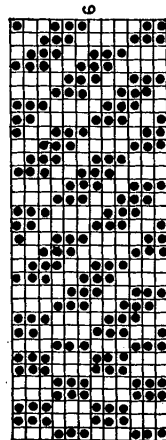
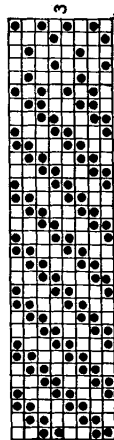
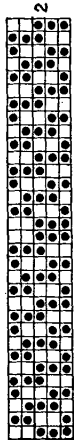
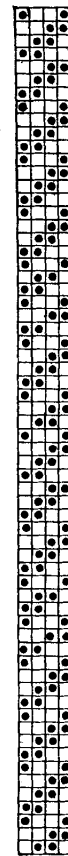
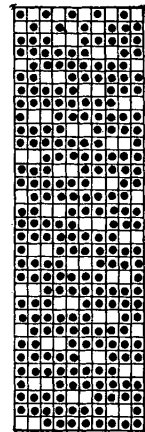
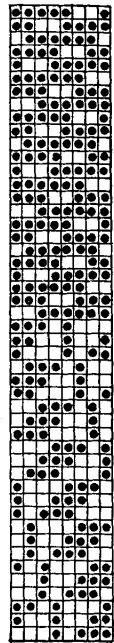
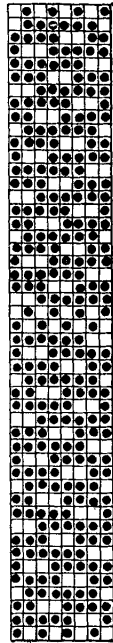
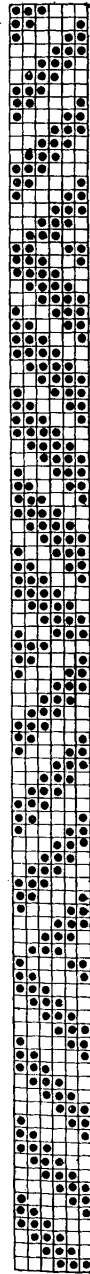
8



9

EXERCISES FOR PRACTICE.

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



1

5

7

4

3

6

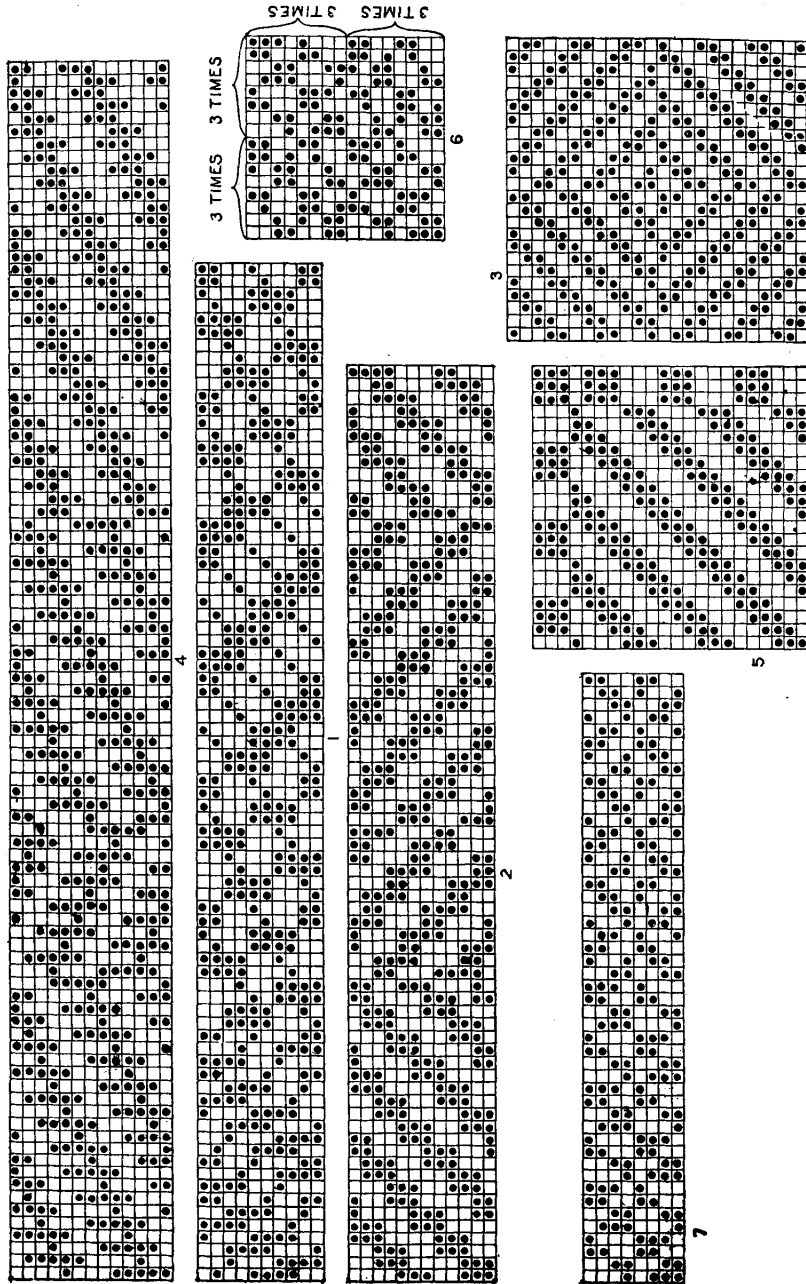
2

3

6

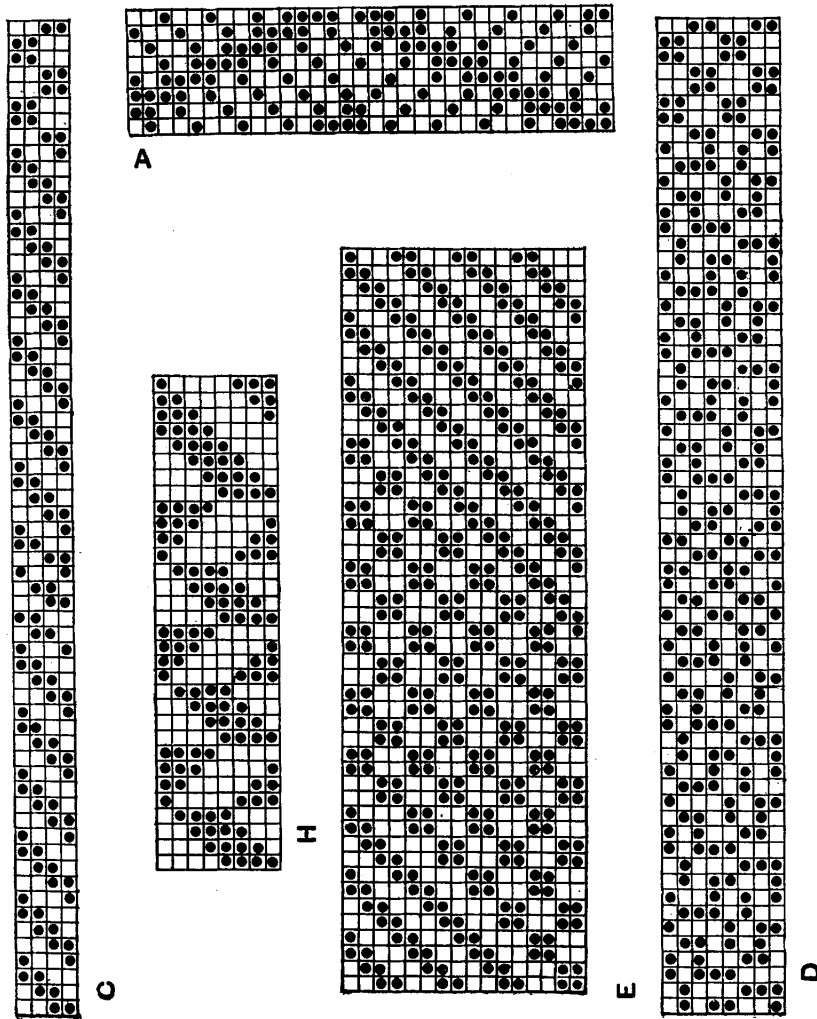
EXERCISES FOR PRACTICE.

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



EXERCISES FOR PRACTICE.

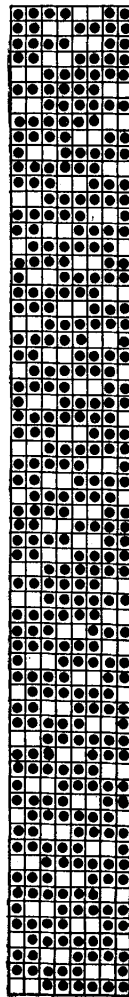
1. Make good working drafts and chain plans for designs A and B and supply chain plans for two original designs to weave in the same draft.
2. Make one draft to work the two accompanying designs C and D and give the chain plan for each.
3. Run out the accompanying design E until complete, then draft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



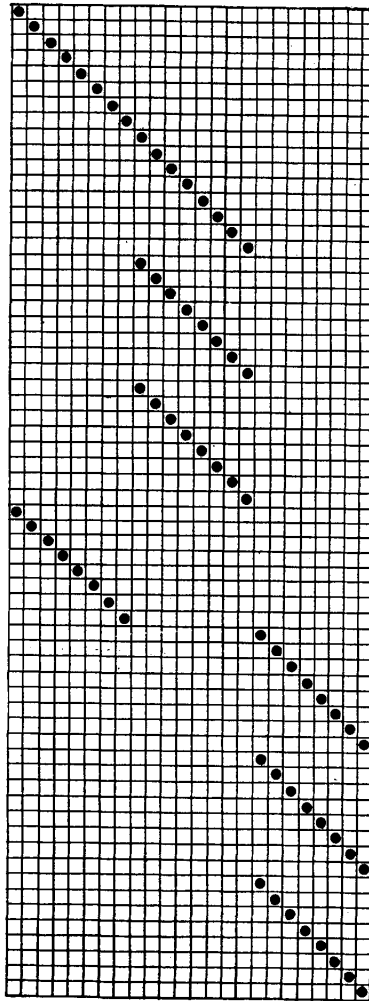
4. Give draft and chain plan to weave design F on the fewest possible shafts; also give chain plan to weave it with draft G.

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

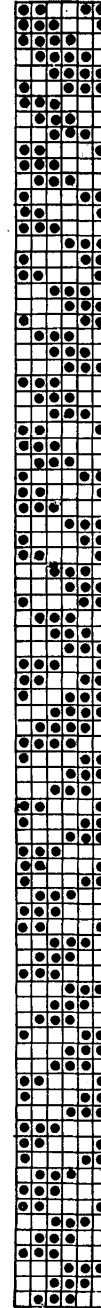
6. Give chain plan to weave design H with draft G.



F



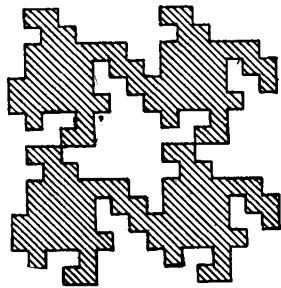
G



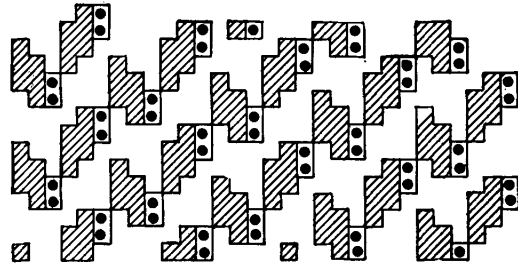
B

EXERCISES FOR PRACTICE.

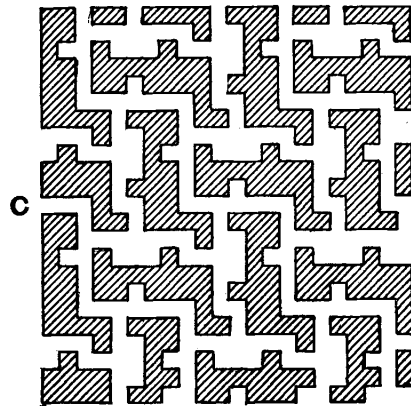
Give designs and warping and wefting plans to produce the following effects in single cloth.



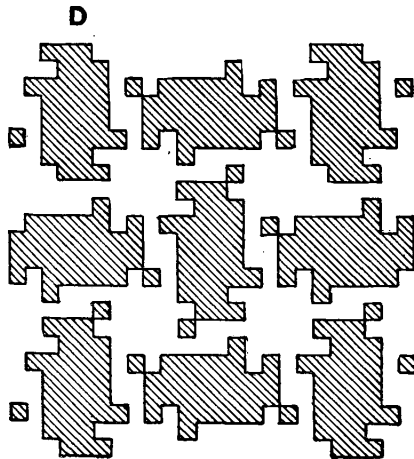
A



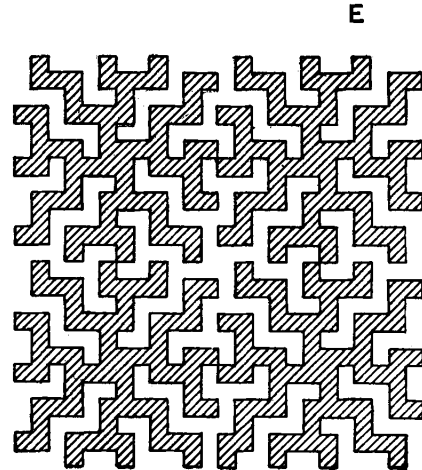
B



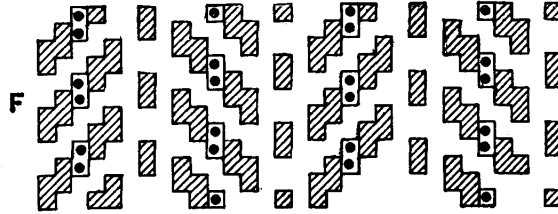
C



D

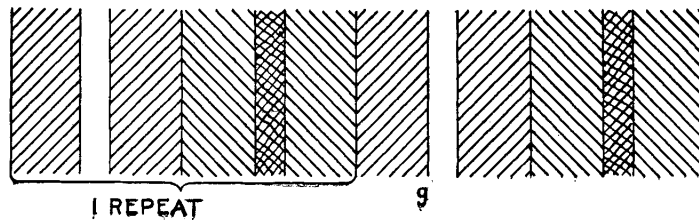


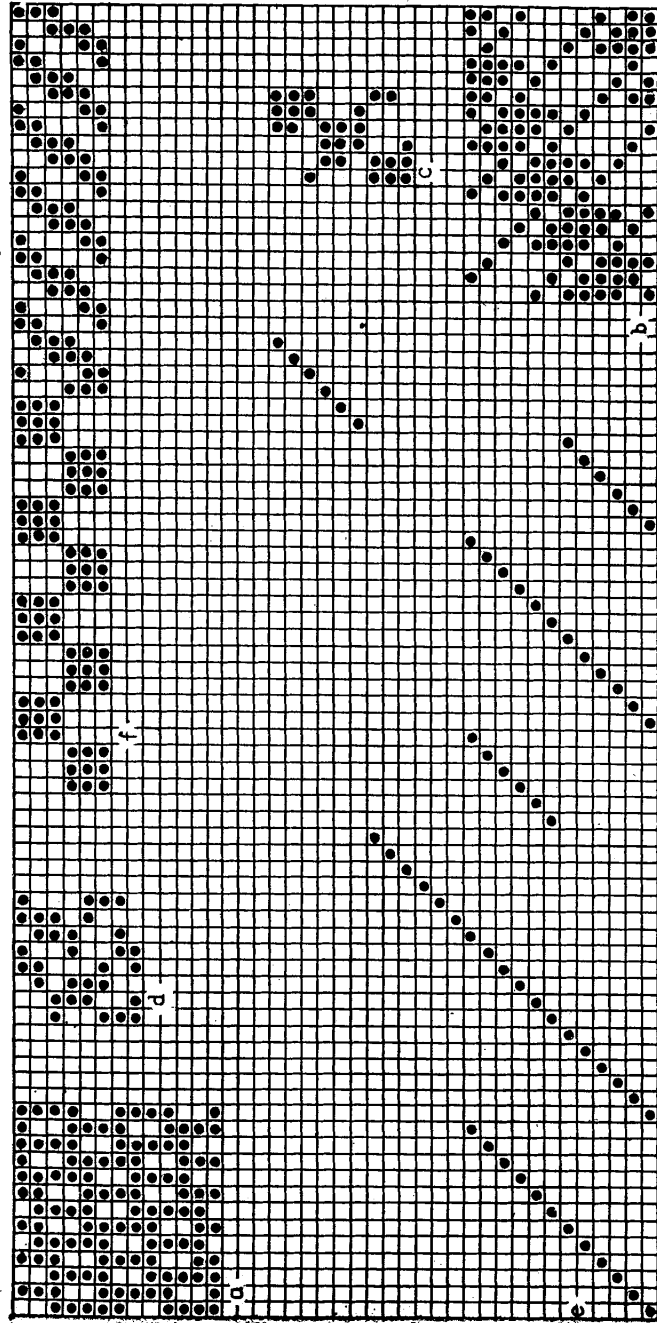
E



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.

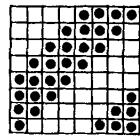
2. Make a design with draft and chain-plan to produce the accompanying Fig. 2, using your own weaves.

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

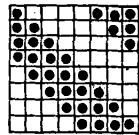
4. Make a design for a check figure to weave in same draft and to be composed of same weaves as accompanying stripe design D.

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

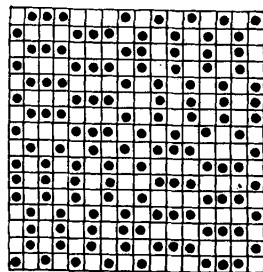
6. Make one check and one stripe design to weave in the accompanying draft F and to have the same weaves.



A



B



C

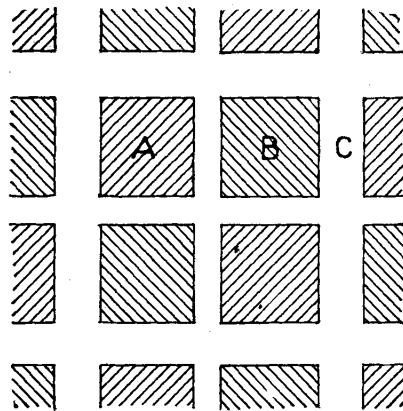


Fig. 1.

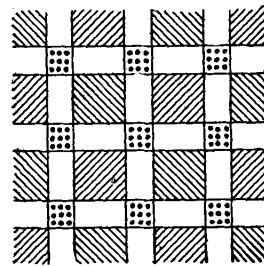
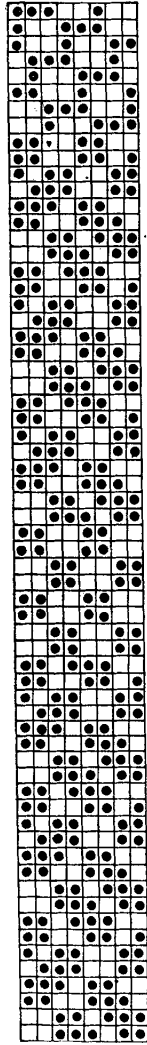
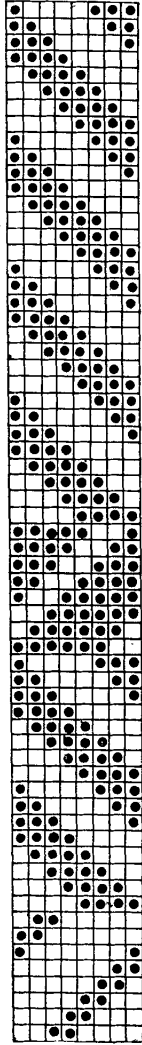


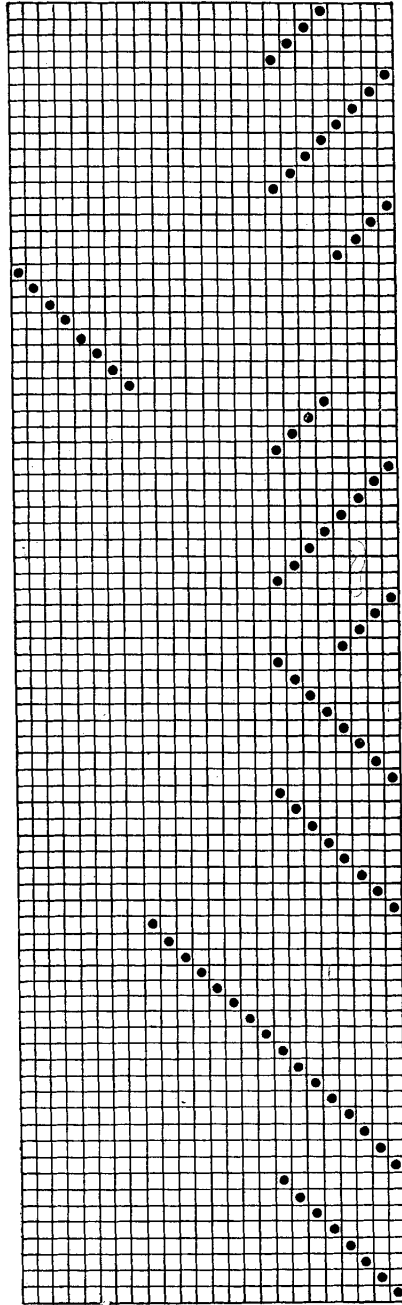
Fig. 2.



D



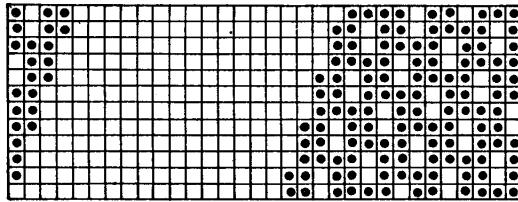
E



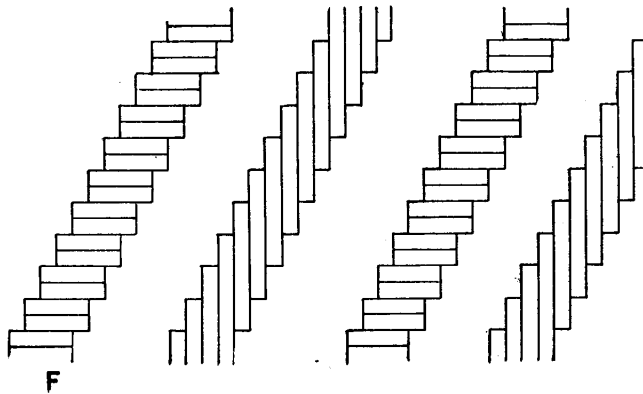
F

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.



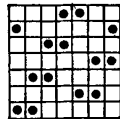
B



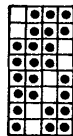
F



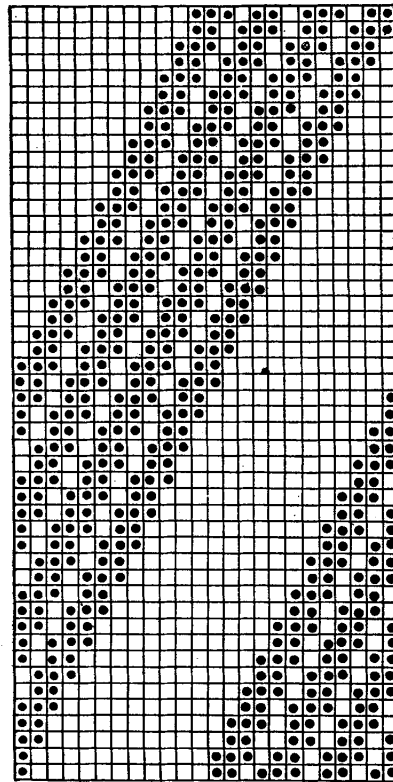
A



D



E



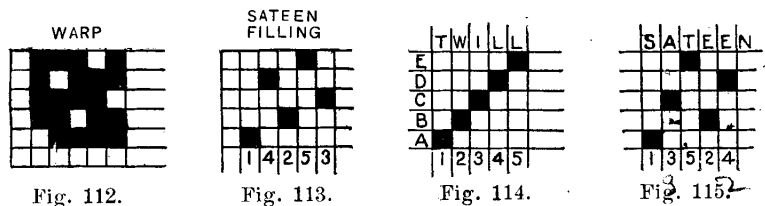
C

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



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.

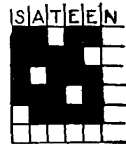


Fig. 116.

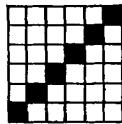


Fig. 117.

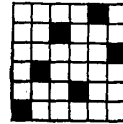


Fig. 118.

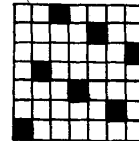


Fig. 119.

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,

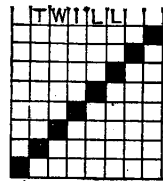


Fig. 120.

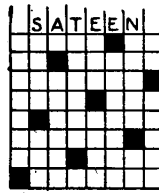
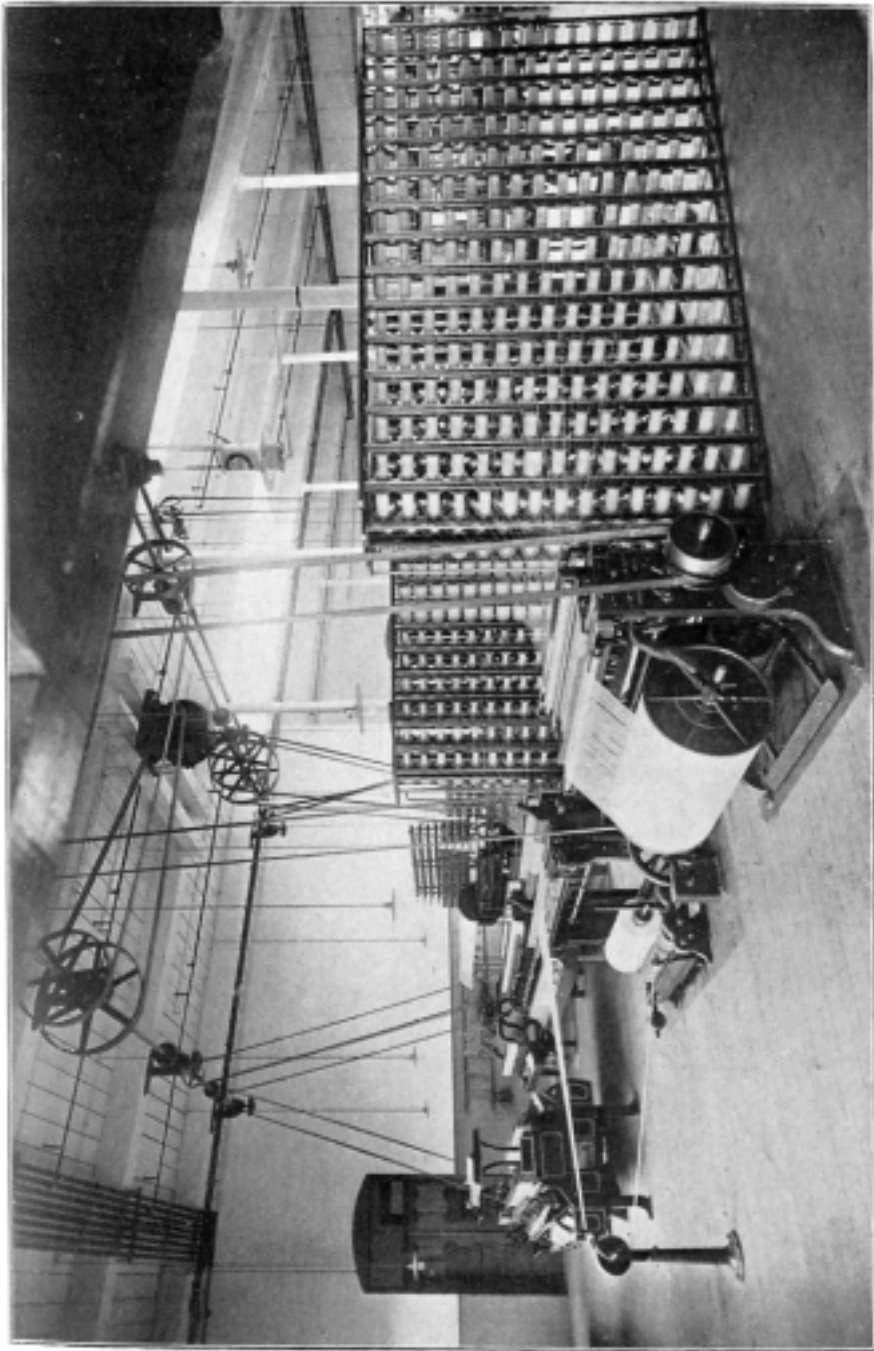


Fig. 121.

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

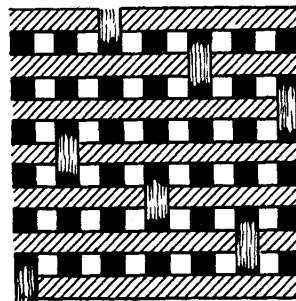


Fig. 122.

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.

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

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

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

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

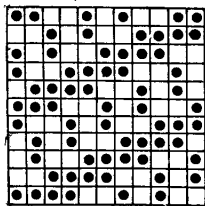
(13) $\frac{2 \ 2 \ 2}{1 \ 1 \ 3} / 1$ (14) $\frac{2 \ 2 \ 2}{1 \ 1 \ 3} / 2$ (15) $\frac{2 \ 2 \ 2}{1 \ 1 \ 2} / 3$

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

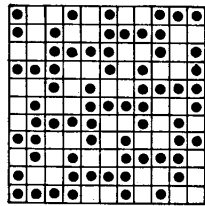
(19) $\frac{3 \ 1 \ 1}{2 \ 1 \ 2} / 3$ (20) $\frac{4 \ 2}{2 \ 2} / 2$ (21) $\frac{3 \ 1 \ 1}{1 \ 3 \ 1} / -3$

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

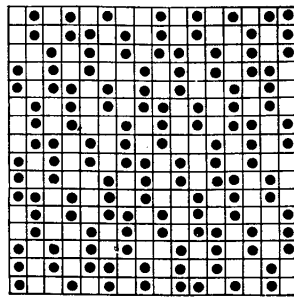
(B) Write the order of weaving, and move numbers for each of the following weaves 25—30, both warp way and filling way.



25

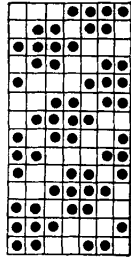


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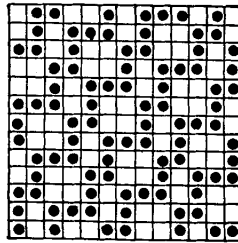


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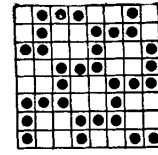
(Exercise continued on next page.)



28

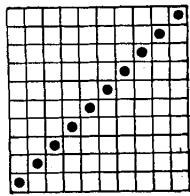


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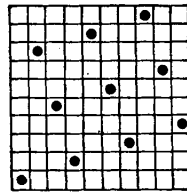


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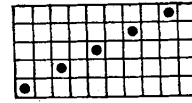
(C) Make plans with bases 31—33 and order of weaving $\frac{4}{2} \frac{2}{2}$ and with bases 34—38 and order of weaving $\frac{4}{1} \frac{1}{3} \frac{1}{1}$.



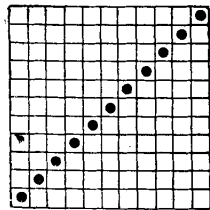
31



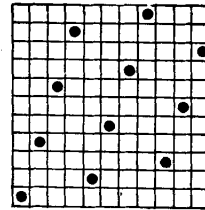
32



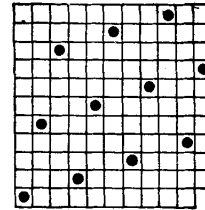
33



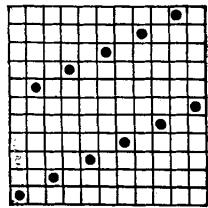
34



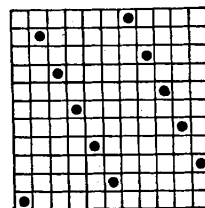
35



36



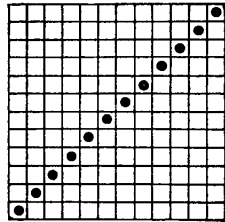
37



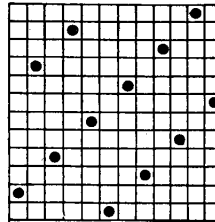
38

(Exercise continued on next page.)

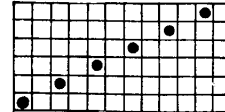
(D) Make two plans on each of the accompanying bases 39—41.



39

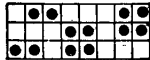


40

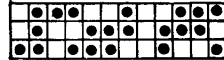


41

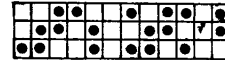
(E) Run out plans 42—45 to one complete pattern of each.



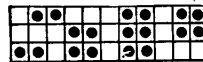
42



43



44



45

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

(G) Make plans as follows:

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

$$(3) \frac{4}{2} \frac{1}{2} \frac{1}{2} / 5 - 3 \quad (4) \frac{2}{1} \frac{2}{1} \frac{2}{4} / 2 + 0$$

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

$$(7) \frac{2}{1} \frac{2}{1} \frac{2}{4} / 5 - 3 \quad (8) \frac{3}{2} \frac{2}{1} \frac{2}{2} / 5 - 1 - 1$$

$$(9) \frac{3}{2} \frac{2}{1} \frac{2}{2} / 3 - 2 + 2 \quad (10) \frac{3}{2} \frac{2}{1} \frac{2}{2} / 4 - 3 + 2$$

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

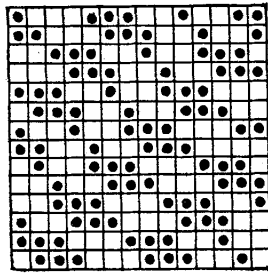
(11) $\frac{3 \ 2 \ 2}{2 \ 1 \ 2} / 4 - 2 + 1$ (12) $\frac{2}{2} / 0 + 2$

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

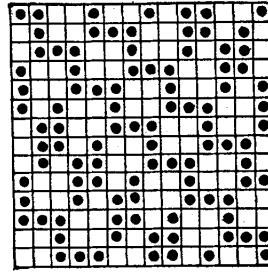
(15) $\frac{3 \ 1 \ 1}{1 \ 3 \ 1} / -1 + 3$ (16) $\frac{3 \ 1 \ 1}{1 \ 3 \ 1} / -3 + 5$

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

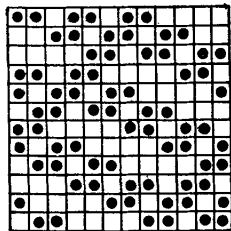
(19) $\frac{2 \ 2 \ 2}{1 \ 1 \ 4} / 5 - 1 - 1$ (20) $\frac{1 \ 3 \ 1}{1 \ 1 \ 5} / 5 - 1 - 1$



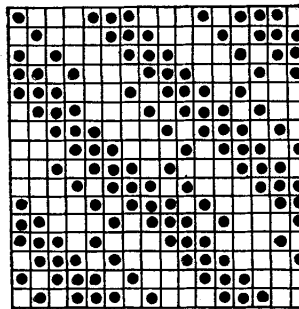
A



B



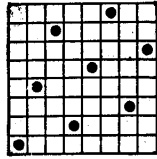
C



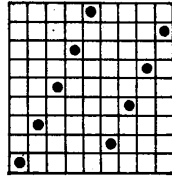
D

(Exercise continued on next page.)

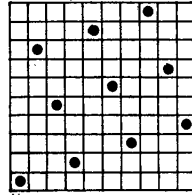
(I) Make two plans on each of the accompanying bases 31—40.



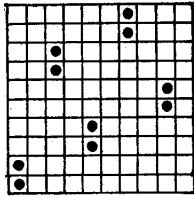
31



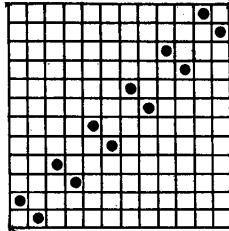
32



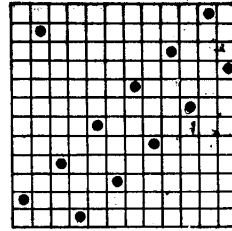
33



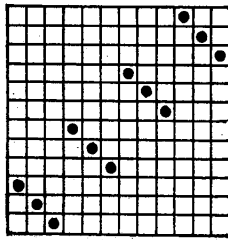
34



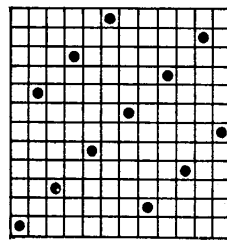
35



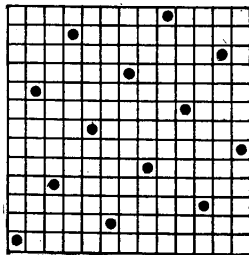
36



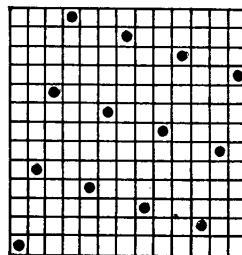
37



38



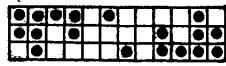
39



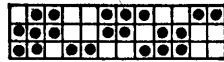
40

(Exercise continued on next page.)

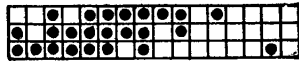
(J) Run out plans 41—46 until complete.



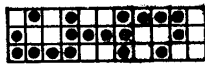
41



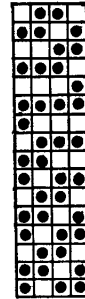
42



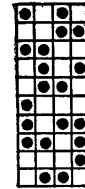
43



44

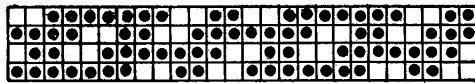


45

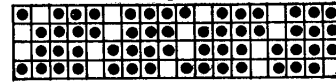


46

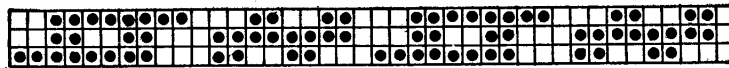
(K) Give one complete repeat of plans 47—53 and write order of weaving and move number for each.



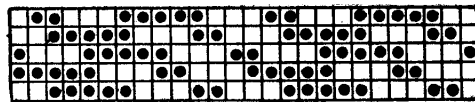
47



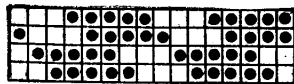
48



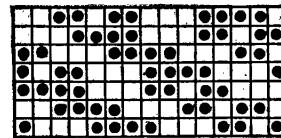
49



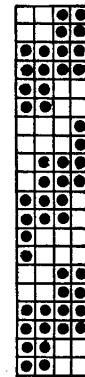
51



52



53



50

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.

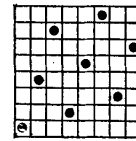
Sateen Tick Stripe. When the name "Sateen Tick" is used, the general impression is that of a line of goods or a fabric

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
	70	220

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;

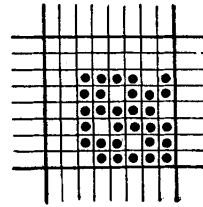


Fig. 123.

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

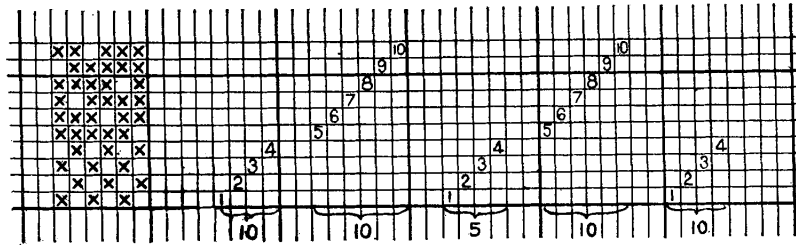


Fig. 124.

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
	<u>220 x 16</u>	
	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 × 16 patterns = 400 heddles	
On the 2nd harness	25 threads × 16 patterns = 400 heddles	
On the 3rd harness	25 threads × 16 patterns = 400 heddles	
On the 4th harness	25 threads × 16 patterns = 400 heddles	
On the 5th harness	20 threads × 16 patterns = 320 heddles	
On the 6th harness	20 threads × 16 patterns = 320 heddles	
On the 7th harness	20 threads × 16 patterns = 320 heddles	
On the 8th harness	20 threads × 16 patterns = 320 heddles	
On the 9th harness	20 threads × 16 patterns = 320 heddles	
On the 10th harness	20 threads × 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.

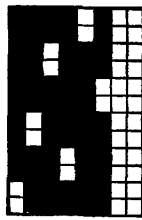


Fig. 126.

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

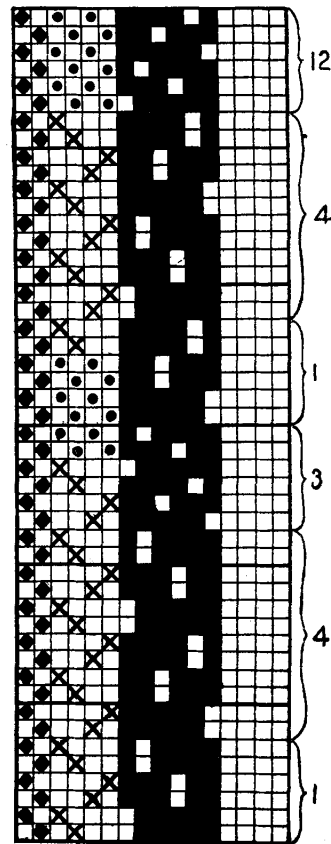


Fig. 127.

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 selvedge 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.

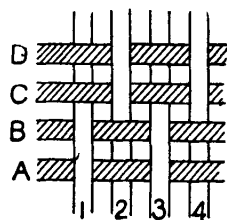


Fig. 128.

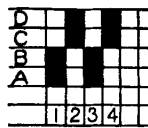


Fig. 129.

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



CASSIMERE LOOM WITH 92-INCH REED SPACE
Crompton & Knowles Loom Works

plain weave, with an additional pick made in the direction of the filling. This causes the warp to cover the filling. This effect is called a rib, and is made by the warp. These weaves are called warp-rib weaves, because the rib is formed by the warp, but the rib line runs across the piece or width of the fabric. In the filling-effect weaves, the rib lines run in the direction of the warp, but are formed by the filling. The threads 3 and 4 are the duplicates of 1 and 2. This weave repeats on 2 harnesses and 4 picks, Fig. 128 being the design for the enlarged section of the fabric.

The warp-rib weaves do not have the extended use which the filling ribs do. These are also an enlargement on the plain weave basis, but instead of being in the direction of the filling, the rib is

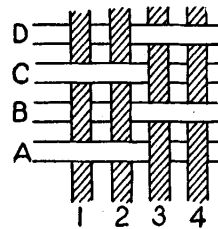


Fig. 130.

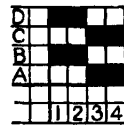


Fig. 131.

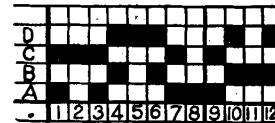


Fig. 132.

in the direction of the warp. Fig. 130 and Weave 131 illustrate the simplest filling-rib weaves that can be constructed. Fig. 130 is the enlarged section of the fabric, and Fig. 131 is the design for Fig. 130. The pick A is over the two threads 1 and 2 and under the two threads 3 and 4; the second pick, B, is the reverse of A, and the third and fourth picks, C and D, are the duplicates of A and B. The weave repeats on 4 warp threads and 2 picks. In the fabrics woven on this principle, the face rib is formed by the filling, and it covers the warp almost entirely. On account of this characteristic, these weaves are used largely in the manufacture of woolen and cotton union fabrics, that is, a cotton warp with woolen filling; but because of the slippery character of the cotton warp, and the filling crossing each bunch or set of threads in the same manner, it is found that in the fabric the filling will slip or pull on the warp and form open spaces. This defect can be remedied to some extent by using such a weave as is shown by Fig. 132. In this weave it will be

noticed that a warp thread is lowered on every rib or cord; this additional intersection holds the filling and keeps it from slipping on the warp.

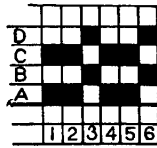


Fig. 133.

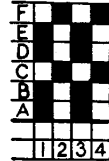


Fig. 134.

From the plain rib weaves the fancy and irregular rib weaves are made. These consist of the combination of two or more rib weaves of various widths in one design. Fig. 133 shows the design for a weave of this class, which repeats on 3 threads and 2 picks. Fig. 134 is the same idea designed for a warp rib.

EXERCISES FOR PRACTICE.

1. Make designs for warp-rib weaves to repeat on 2 harnesses and 6 picks, for 2 harnesses and 8 picks; also for 2 harnesses and 10 picks.

2. Make designs for filling-rib weaves to repeat on 6 threads and 2 picks; also 8 threads and 2 picks; also 10 threads and 2 picks.

3. Make designs for irregular rib weaves of this character, consisting of the combining of those weaves where the filling crosses 2 threads and 3 threads, 3 threads and 1 thread, 4 threads and 2 threads, and 4 threads and 1 thread.

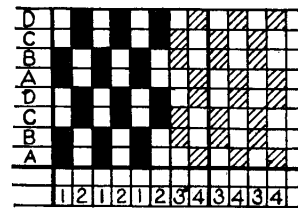


Fig. 135.

4. Make designs where the warp thread crosses the same number of picks as the warp threads in the above examples.

5. Make a diagram of each weave and a cut section of the first and second picks of each design.

WARP EFFECT, FIGURED RIB WEAVES.

The first step in making figured rib weaves is to break the rib line or to change it after a certain number of warp ends. The method of designing these weaves is shown in Fig. 135, where the rib line on the first 6 warp ends is the same, then by raising the intersection 1 pick, the rib line is broken from a straight

line across the fabric. On this break it also covers 6 ends, so that the weave repeats on 4 picks and warp ends. This weave can be varied considerably by using a different number of warp ends in the change of the rib line, such as using 12 ends for the first direction of rib line, and then a smaller number for the second direction.

Fig. 136 is the combination of the 4 up and 2 down rib weave, using 6 ends for each change of the rib line; this makes a broad and a narrow rib line, and is a very good fancy effect. It repeats on 12 ends and 6 picks. By using various rib weaves and changing the arrangement of the number of threads used for several widths, a great variety can be produced.

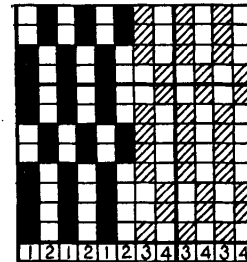


Fig. 136.

FILLING-EFFECT, FIGURED RIB WEAVES.

These weaves are designed on the same principle as the warp-effect rib weaves, except that the rib line runs in the direction of the warp instead of the filling. Fig. 137 shows the narrow and wide rib weaves combined, the rib line running for 6 picks, then

changing on the next 6. This will produce an alternating wide and narrow rib effect.

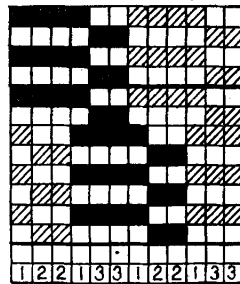


Fig. 137.

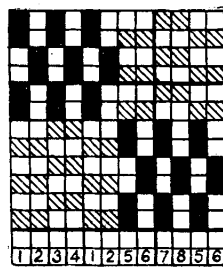


Fig. 138.

The filling effects, as in the warp effects, can be varied by using various widths of rib weaves and different numbers of picks for the various widths.

The next class of figured rib weaves combines the warp and filling effects in one weave. This is usually done in the shape of block effects, using the warp or filling effect for the ground, and the opposite of what is used for the groundwork of the pattern for the figure. Fig. 138 is the combination of the 2 up and 2 down, using the filling effect for 6 ends and 6 picks, and the

warp effect for 6 ends and 6 picks; this repeats on 12 ends and 12 picks.

8	F	F	W	F
8	F	F	F	W
8	F	W	F	F
8	W	F	F	F
	8	8	8	8

Fig. 139.

Fig. 139 is an idea for a weave of this character, each square representing 8 ends and 8 picks. Where W is marked, use warp-face and in those marked F filling-face rib weave.

EXERCISES FOR PRACTICE.

1. Make this weave (Fig. 139), which will require 32 ends and 32 picks; also make two other designs of this same class.
2. Make designs for three of the figured warp-effect rib and three of the figured filling-effect, marking number of ends used for each weave. Eight designs in all.

OBLIQUE RIB WEAVES.

These weaves are a combination of the warp and filling effect rib weaves, and are used principally in the manufacture of what are called bird's-eye effects. They produce a square pattern in the cloth, which fact will be readily observed from a careful study of the weaves.

To design these weaves first mark off on the design paper the repeat of the weave; that is, if it must be woven on 8 harnesses, mark a square containing 8 ends and 8 picks; subdivide this square into eight parts, as shown in

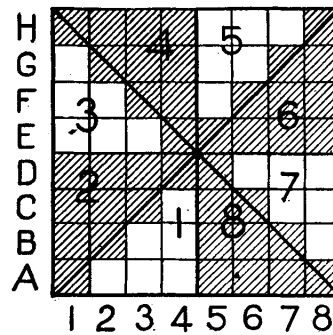


Fig. 140.

Fig.140; number each triangle in rotation 1, 2, 3, 4, 5, 6, 7, 8. To design an oblique rib weave, mark in each uneven numbered square the warp-effect rib weave (see Fig. 141), and in each even numbered square the filling-effect rib weave, which produces the completed oblique rib weave (Fig. 142). This procedure can be reversed; that is, the filling-effect rib can be designed in the uneven numbered triangles, and the warp-effect rib in the even numbered triangles, which will produce the finished weave (Fig. 143).

All weaves of this class are designed either commencing rib effects alternating with filling or the reverse.

These weaves are also combined with plain rib weaves for producing checks, usually using the oblique rib weave as the groundwork of the check, and the plain rib weave as the overlaid or check. A weave of this class is shown in Fig. 144, where the groundwork of check is the 8-harness oblique rib

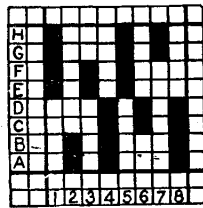


Fig. 141.

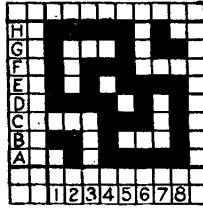


Fig. 142.

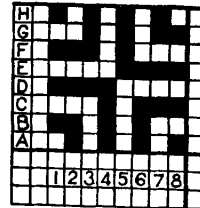


Fig. 143.

weave designed by commencing with the filling-effect rib in first triangle; the 4-harness rib filling effect for the warp overchecking, and warp effect for filling overchecking.

These combination weaves are simple, the only difficulty being experienced where the warp and filling effects of overchecking join. At this point care should be taken that the weaves come together, preserving as nearly as possible the effect of both. These weaves are principally used in the manufacture of piece dyed worsteds.

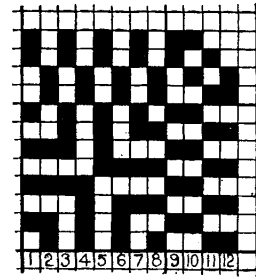


Fig. 144.

EXERCISES FOR PRACTICE.

1. Make designs for 6, 8, 10, 12, 14, 16 harness weaves of this class, using warp-effect rib in first triangle; also make 6, 8, 10, 12, 14, 16 harness weaves, using-filling effect rib in first triangle.

2. Design two weaves of this class, combining the 10 and 12 harness oblique weave with warp and filling effect rib weave.

BASKET WEAVES.

The common weaves of this class are simply an enlargement of the plain or cotton weaves, in that the intersections are 1 end up and 1 end down, and 1 pick up and 1 pick down. To enlarge on this requires that the number of ends and picks on the same intersection must be made larger. The plain weave consists of 1 end and 1 pick each way, and to enlarge on this arrangement the number of ends and picks must be increased. It

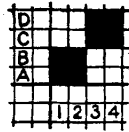


Fig. 145.

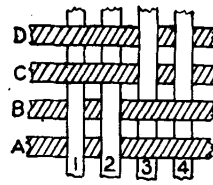


Fig. 146.

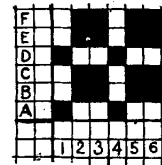


Fig. 147.

is obvious that the next change would be 2 ends and 2 picks each way. This produces the simplest basket weave that can be constructed, shown in Fig. 145, of which Fig. 146 is an enlarged section of a fabric woven on this weave. This basket is the 2 and 2.

Fancy basket weaves are constructed from the plain or common basket weaves. These are solely the combination of two or more weaves of the common basket, or a basket and the plain combined.

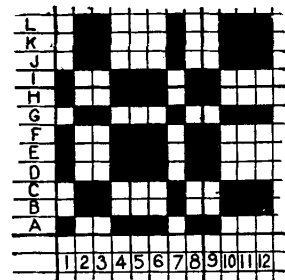


Fig. 148.

Fig. 147 is an illustration of these weaves. There is combined the plain and the two basket to form a weave which repeats on 3 ends and 3 picks. Fig. 148 shows the combination of a more complicated weave of this class.

It is the 1, 2 and 3 combined, and consists of three changes. It repeats on 12 ends and 12 picks. In designing these weaves always commence at the left-hand corner and run the weave across the paper to the upper right-hand square. Two repeats of the original weaves are necessary before a complete repeat of the weave

is secured. After designing these on paper, fill in the rest of the weave, always counting the changes the same both warp and filling way.

EXERCISES FOR PRACTICE.

1. Make the designs for example 1, 3 and 3; example 2, 4 and 4; example 3, 5 and 5.
2. Combine the following in fancy basket weaves: example 4, 2-4; example 5, 1-4-2; example 6, 2-3-1-2-1; example 7, 1-1-2-2-3; example 8, 2-3-4.

CORKSCREW AND DOUBLE-TWILL WEAVES.

These weaves are chiefly used in the manufacture of worsted suitings and trouserings, and in some branches of silk manufacture. They are similar to oblique warp-effect rib weaves, in that they require a fine or close set, since the warp forms to a great extent the surface of both face and back of the cloth, the filling being merely embedded between alternate warp threads.

We shall now describe the construction of a few of these weaves, a close study of which will readily demonstrate the endless variety of new designs to be made in this manner.

With reference to the theory of constructing this class of weave, the true corkscrew is made from the regular twill weaves on an uneven number of harnesses, by using the regular 45-degree twill for a chain, and drawing the threads through the harnesses in the same order as the intersections would occur in any given sateen weave on that number of harnesses.

In order to provide for the equal overlapping at the juncture of the corkscrew twill, the warp section of the 45-degree twill must use one point in excess of the filling section or sinkers, thus:

$$\frac{3}{2} = 5 \text{ threads; } \frac{4}{3} = 7 \text{ threads; } \frac{5}{4} = 9 \text{ threads}$$

If the overlapping of floats at the juncture of the two twills is more than one point, the effect of this style of weave will be lost. This explains the reason why this method of drafting is impracticable on weaves of an even number of harnesses, as an even number cannot be divided into two unequal parts, one of which will exceed the other by one point only. The fewest

number of harnesses to make a corkscrew weave is the 5-harness $\frac{3}{2}$ 45-degree twill; the 13-harness being the largest corkscrew weave in practical use.

Fig. 149 is the 5-harness 45-degree twill.

Operation: Divide the number of harnesses into two parts, one of which will exceed the other by one point or unit; thus, 3

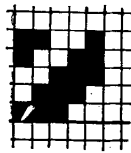


Fig. 149.

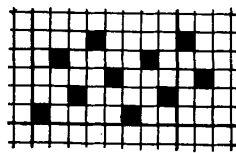


Fig. 150.

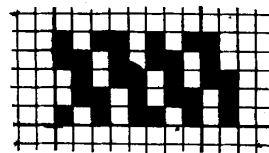


Fig. 151.

and 2 equal 5. The drawing-in draft to be made on the same principle as a sateen weave, always commencing with the first thread on first or front harness, using one of the numbers to count with as a move number, thus: first thread on first harness, second thread on fourth; that is, first and move 3,—this move will place the third thread on the second harness; second and move 3,—this move will place the fourth thread on the fifth harness; fifth and move 3,—this move will place the fifth thread on the third harness; third and move 3,—this move places the sixth thread on the first harness and determines one repeat of the weave.

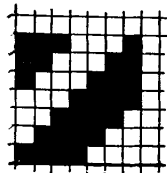


Fig. 152.

This draft shows a straight draw for 5 harnesses, consider-

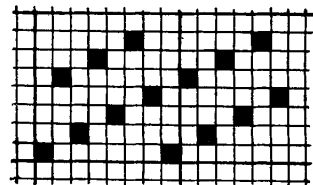


Fig. 153.

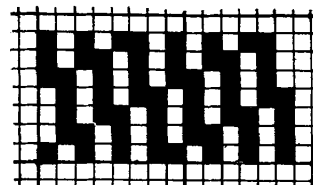


Fig. 154.

ing every other warp thread only, viz.: every uneven warp thread, 1, 3, 5, 7, 9, etc., etc., calling in turn respectively for the first,

second, third, fourth and fifth harnesses ; the even warp number 2 commences on the fourth harness ; considering again every other warp thread only ; viz., every even warp thread, numbers 2, 4, 6 and so on, calling in turn respectively for harnesses numbers 4, 5, 1, 2, 3. The draw or draft completed will read 1, 4, 2, 5, 3, 1, 4, 2, 5, 3. A study of Figs. 150 and 151 will explain. Explanation in detail :

- 1st thread on No. 1 harness, count off 3 places
- 2d thread on No. 4 harness, count off 3 places
- 3d thread on No. 2 harness, count off 3 places
- 4th thread on No. 5 harness, count off 3 places
- 5th thread on No. 3 harness, count off 3 places
- 6th thread on No. 1 harness, count off 3 places
- 7th thread on No. 4 harness, count off 3 places
- 8th thread on No. 2 harness, count off 3 places
- 9th thread on No. 5 harness, count off 3 places
- 10th thread on No. 3 harness, count off 3 places

Fig. 151 shows the corkscrew weave carried to its full extent. It will be noticed that in the first half of the draft, the first or odd thread commences the draw, whereas in the second part of the draft it is the sixth thread or even number that commences the draw. The draft must be extended to double the original weave to make one full repeat.

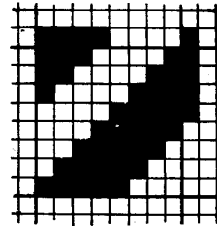


Fig. 155.

Fig. 152 is a 7-harness weave. Seven divided into two parts, one of which will exceed the other by one point only, 4 and 3 equal 7. $\frac{4}{3}$ 45-degree twill.

Fig. 153 represents the harness draft, and Fig. 154 is the extended design or corkscrew twill ; 4 is the move number.

Fig. 155 is a 9-harness weave. Nine divided into two parts, one of which will exceed the other by one point only, 5 and 4 equal 9. $\frac{5}{4}$ 45-degree twill, with 5 for the move number.

Fig. 166, harness draft. Fig. 157, extended design.

Uneven balanced weaves will always produce more perfect

corkscrew weaves than the even-sided twills, since it is only possible with the uneven-sided twills to balance the cut-off of the double twill. The direction of the twill will be reversed by using the lesser number.

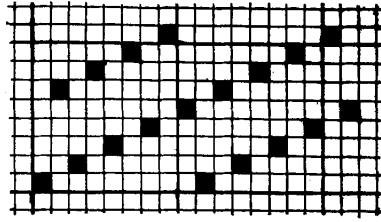


Fig. 156.

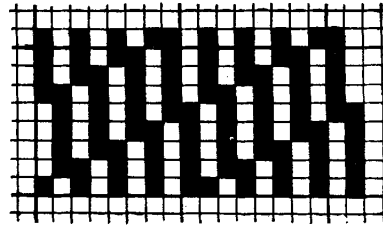


Fig. 157.

Corkscrew weaves on an even number of harnesses. No matter what even-harness 45-degree twill is used for the foundation for an even-harness corkscrew weave, the junction of the two twills will be faulty. There is not the equal cut-off as produced with weaves having an uneven number of harnesses for repeat; but sometimes a corkscrew weave on an even number of harnesses is required, especially with fancy effects, in which corkscrew weaves are used in combination with other weaves. For instance, a case may occur in which a corkscrew weave for an even repeat of harnesses is required to connect with a 6-harness twill. Fig. 158 is the $\frac{3}{3}$ 45-degree twill.

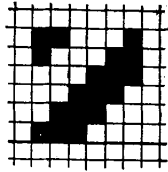


Fig. 158.

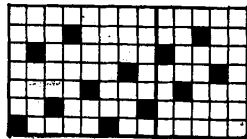


Fig. 159.

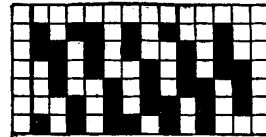


Fig. 160.

Fig. 159, drawing-in draft. Fig. 160, extended design.

It will be noticed that with this weave there is not the perfect junction when the two sections meet, as there is in the 5-harness weave, and this is always the case with an even-sided 45-degree twill.

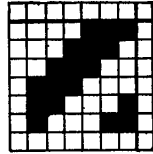


Fig. 161.

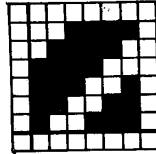


Fig. 162.

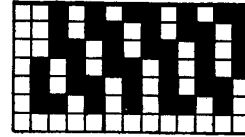


Fig. 163.

There is no true corkscrew weave on an even number of threads less than 12; and this weave is composed of two 6-harness twills, viz. : $\frac{3}{3}$ (Fig. 161) and $\frac{4}{2}$ (Fig. 162) twills. To obtain the even cut-off of the two twills, commence with the first thread of the $\frac{3}{3}$ twill and the fourth thread of the $\frac{4}{2}$ twill,

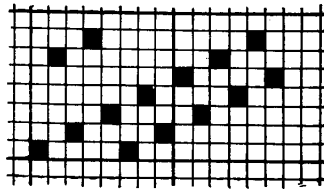


Fig. 164.

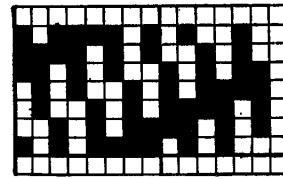


Fig. 165.

then take the threads alternately from each twill; thus, 1, 4, 2, 5, 3, 5, 4, 1, 5, 2, 6, 3 (Fig. 163); this weave repeats on 12 threads and 6 picks, having a balanced cut-off between the double twills, however, showing two slightly different sizes of twill effects,—that is, a 4-float alternating with a 3-float.

Again, such corkscrew weaves do not permit of a reduction of harnesses, which is a serious defect. The above example cannot be reduced to less than 12, whereas the uneven-number corkscrew weave can be reduced to the number of the original 45-degree twill.

When corkscrew weaves are made from weaves exceeding 9 threads and picks, the interlacing of warp and filling is very loose, so that the fabric is not merchantable, as the warp will slip on the filling. To remedy this without changing the face of the fabric, the warp floats upon the back must be reduced by adding one or more points of interlacing.

Take an 11-harness 45-degree $\frac{6}{5}$ twill. To change this twill so that it will bind firmly, the five sinkers which go to the back must be made to interlace $\frac{1}{2}$; this changes the 45-degree twill to interlace $\frac{6}{2} \frac{1}{2} = 11$ harness.

Figs. 164 and 165 illustrate the 7-harness weave constructed the wrong way. Compare these Figs., 164 and 165 with 153 and 154.

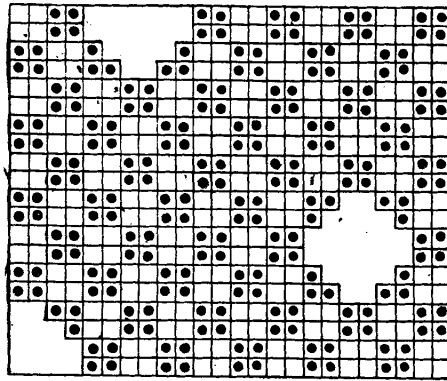


Fig. 27.

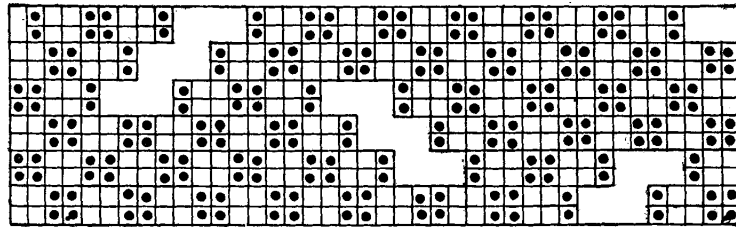
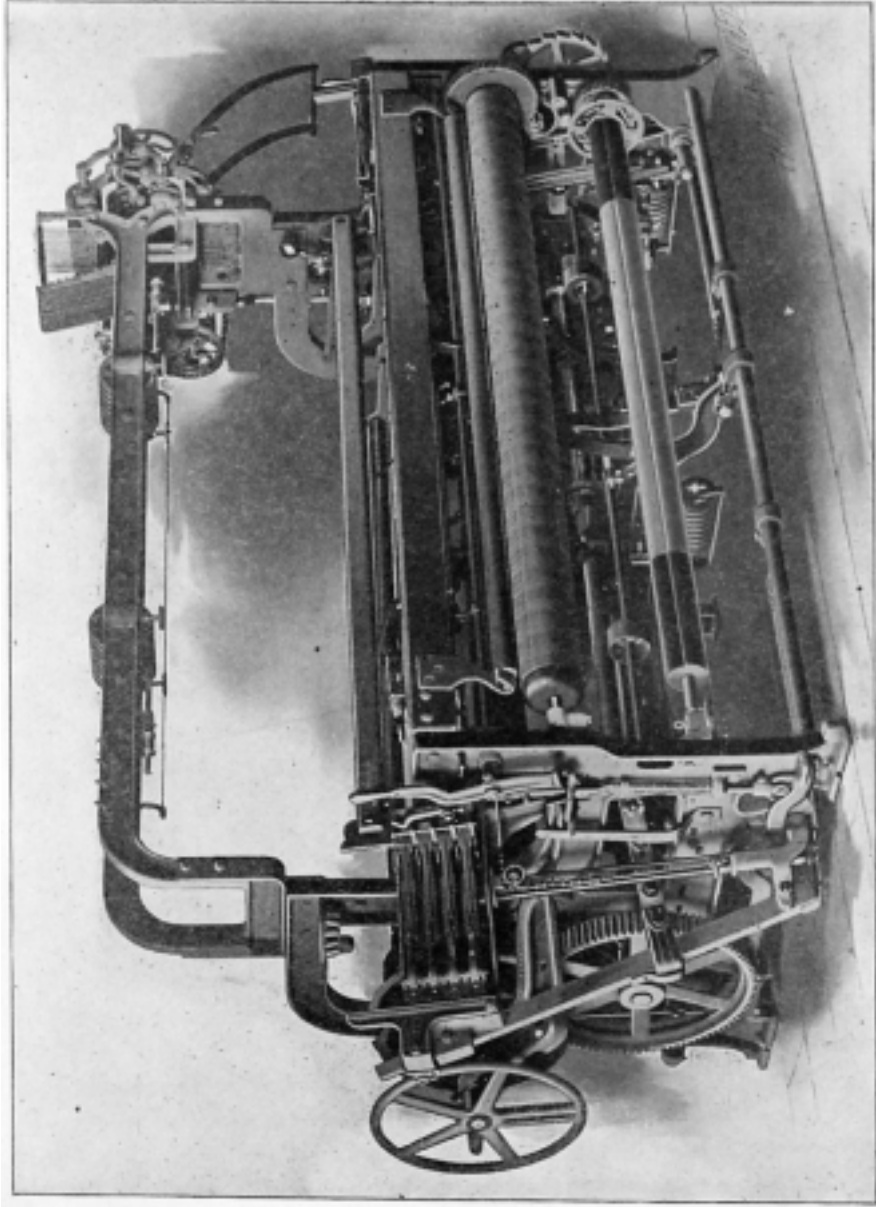


Fig. 28.



KNOWLES HEAVY GEM LOOM FOR DRESS GOODS
Crompton & Knowles Loom Works

TEXTILE DESIGN.

PART III.

CLOTHS BACKED WITH FILLING.

This branch of weaving has not had a very extensive use in the cotton trade, but in the woolen and worsted industries it has a very wide application.

The term, single cloth, is generally applied to a fabric that is interwoven with one set of threads for the warp and one set of picks for the filling. This may be a cloth in which the weave will allow the warp and filling to be equally divided between the face and under surface of the fabric, or such cloths as sateens and doeskins where the warp or filling predominates on the face.

A fabric which has an extra layer of threads woven on the under surface or back of the cloth, and which is distinct from the face, is called a backed cloth. These extra threads may be in the direction of the warp, or they may be in the direction of the filling.

Backed fabrics of this description are not what is understood as double cloths. There is as much difference between a backed cloth and a true double cloth as there is between a single cloth and a cloth backed with either warp or filling.

To retain the fine surface and appearance of a light-weight pattern on the face of a fabric, and at the same time to increase the weight or bulk of the fabric, a lining or back must be interwoven on the under surface of the cloth. This back can be interwoven either in the direction of the filling or warp.

Double cloths are composed of two distinct sets of threads, both in the warp and filling. They are two separate cloths, interwoven at various intervals to form one compact fabric.

Sometimes one fabric is superior to the other in quality; in such cases the fine fabric is called the face and the inferior fabric is called the back; or it may be that the two cloths are of the

same quality and material, but of different colors, one cloth forming the outer garment, while the other cloth forms the lining. The face of one cloth may be of a very fine surface and of one color; the lining of such a cloth can be composed of a fancy weave, and the pattern and coloring of several bright and radical colors.

There are three methods of backing a fabric :

First, by having one warp, with two fillings ; one filling for face and the other for back.

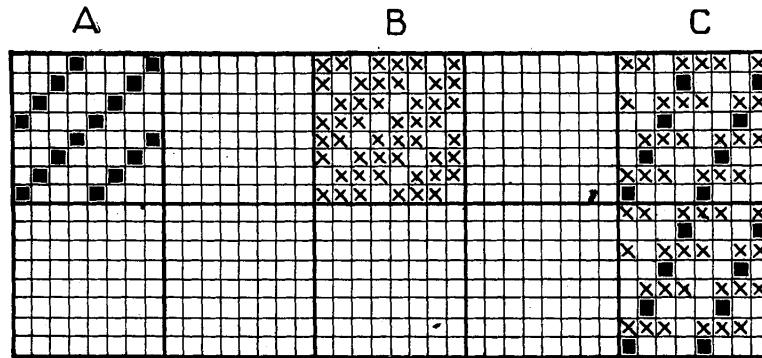
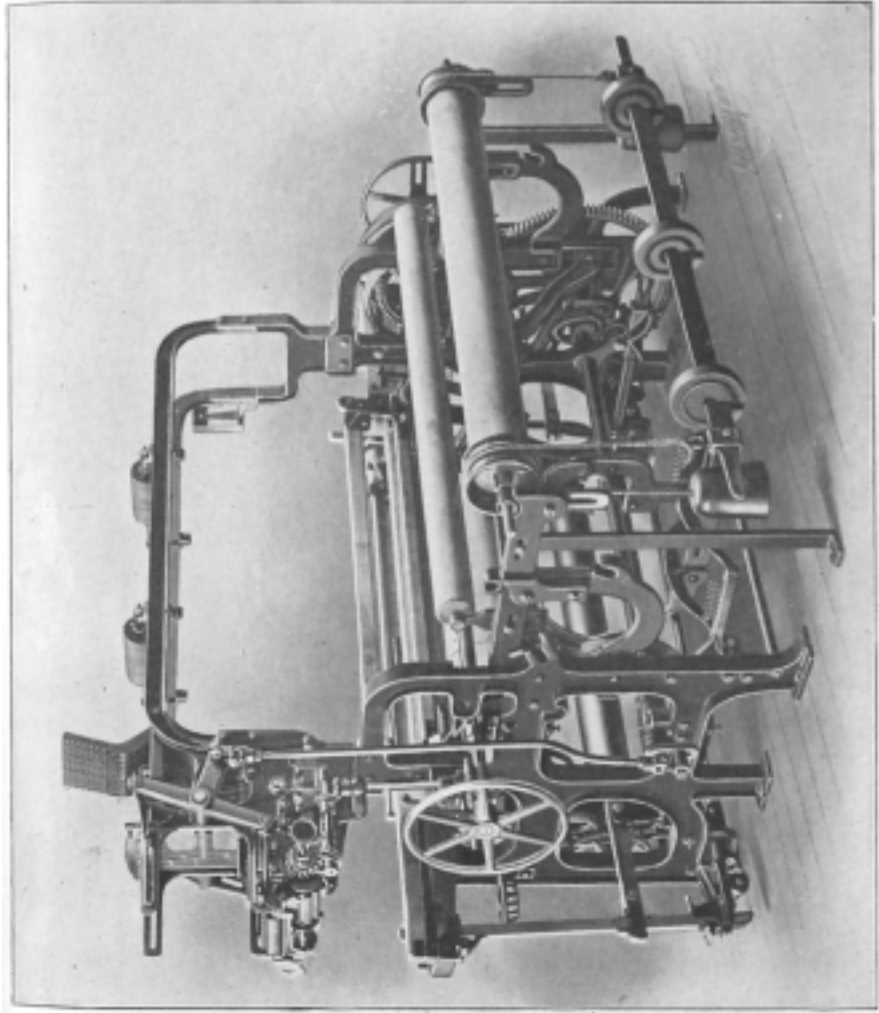


Fig. 166.

Second, by having one filling and two sets of warp threads ; one set for the face, the other set for back.

Third, by having two distinct sets of warp and filling, interwoven so as to make two different fabrics, bound together at certain intervals.

Those backed with filling are usually low or medium grades of cloth. This system is probably the best for such fabrics, as it allows the warp threads to be set close together, and also allows the manufacturer to use heavier yarn in the filling at the back of the cloth. But this system of backing does not allow the back to assimilate with the face, as all the yarn at the back is in the direction of the filling. Cloths backed in the direction of the warp can be made to correspond with the face of the fabric, especially in stripe effects. Some of the finest of worsted cloths backed on this system are as neatly colored on the back as on the face of the fabric.



DOBBY SILK LOOM FOR TAFFETAS AND OTHER BROAD SILKS
Crompton & Knowles Loom Works

Fabrics backed with two sets of filling threads and one set of warp threads may be divided into two classes: first, those with one pick of face and one pick of back; second, with two picks of face and one pick of back.

In designing a fabric on any one of these systems it is very essential that the point or position where the face warp interweaves with a backing pick, or *vice versa*, should be very carefully placed.

Fig. 166. A is the face of the cloth, B is the back, C represents the two cloths combined. Take note of every detail. A is a filling flush, 4-harness twill, while the back is a warp twill on 4 harness. Study where these two weaves can be joined together, so that the point of intersection or binding will not show on the face.

When binding a flush weave, the point of intersection should always be at the place where the thread has just been down in one pick and will be down at the next pick (see Fig. 166, C). It will be noticed that the face filling floats over three warp threads, and in the center of these at the backing pick is where the two weaves are amalgamated. This, the point of intersection, is covered by the filling on each side of the back pick, so that when the cloth is completed the warp is entirely covered, and the two surfaces presented, which may be of two indifferent colors, show only the filling. In this make of cloth the backing filling must not be much heavier than the face yarn. Otherwise the face yarn cannot cover the intersecting or binding points of the backing pick.

In order to have an even face on cloths backed with filling it is necessary to have the same number of picks on the face as on the back; that is, if in a given sample of single cloth there are 30 picks per inch, the backed cloth would require 60 picks per inch, as, for instance, a cloth composed of the 4-harness cassimere twill for face weave, and the 4-harness crow weave for back.

Fig. 167 shows a most satisfactory binding for coarse and medium set goods. It will be noticed that the backing pick floats under three warp threads and interweaves at the fourth thread. Notice also the point of intersection or tie. The first pick of face, 3d and 4th thread down. The first pick of back, 4th thread

down or stitch. The 2d pick of face, 4th and 5th threads down. Thus, the first backing pick in Fig. 167, C, takes down the fourth thread, which has been depressed by the first face pick and

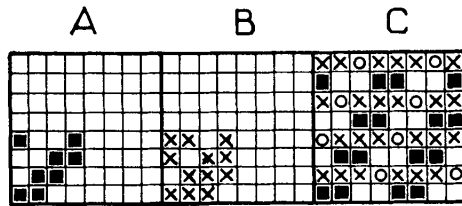


Fig. 167.

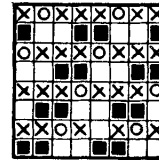


Fig. 168.

also followed by being depressed at the second face pick. Thus the flushing on each side of the back pick by the first and second face picks conceals the stitching point or binding.

Fig. 168 represents a cloth composed of the same two weaves as those at Fig. 167, but the point which unites the back to the

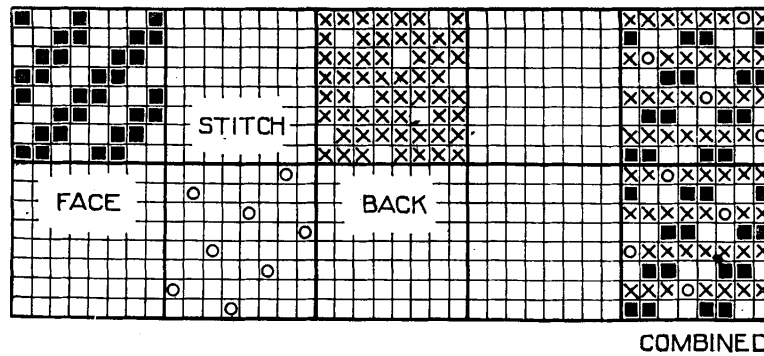


Fig. 169.

face is not in a position where it can be covered on both sides by a filling flush.

Fig. 169 is the very best way in which a filling back can be woven to a cassimere twill weave. The backing is an 8-harness sateen weave. It will be observed again here that the points of intersection on the face are depressed previous to, and after the intersection of, the backing pick. The 8-harness sateen back produces a soft and full texture.

Backed cloths in the proportion of two picks of face and one pick of back. There is one important fact with this system; that is, that the backing pick cannot be bound as satisfactorily as in the one-and-one system. Fig. 170 shows that only every alternate thread is interwoven with the back. To have a thoroughly even balanced cloth, every thread should have the same amount of binding, otherwise the thread that has the greater number of interlacings must necessarily "take up" the quickest in weaving; therefore, in making an uneven fabric, to have each thread take up equally, the warp should be dressed on two beams.

There are cloths woven on this principle which have only one beam, but the fabric is not satisfactory, especially when the backing filling is much heavier than the face filling. After a certain length of cloth has been woven, the threads with which the backing has been interlaced most frequently will work tight and cause streaky places to appear in the cloth.

It must be thoroughly understood that whenever the structure of the design will admit of the arrangement of backing ties, these should always be preceded and followed by flushes of face filling. This is the secret of good binding.

In making figured designs, the same principles will apply. Fig. 171 is a checker-board pattern, the weave of which cuts at every eight threads and pick. Therefore, as the design stands, two face picks then one of back, it would be impossible to arrange it in such a way as to have the filling flush on each side of the binding point if the first and sixth picks were not coupled together.

Fig. 172 shows the wrong way, and Fig. 173 illustrates the correct method to arrange such weaves.

Fig. 174 represents a figure warp-surface weave. It is a design which illustrates the irregular system of binding; this figure is bound at two points on the filling pick and only one on the warp thread.

There is one other class of goods that has had a considerable

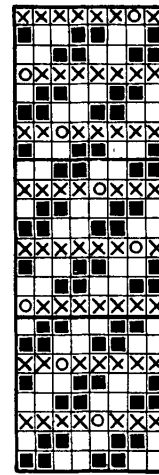


Fig. 170.

sale, and the designing principles of which are very similar to those just referred to; cotton warp, worsted or woolen face, woolen back. The weave is generally a filling flush, as represented in Fig. 175.

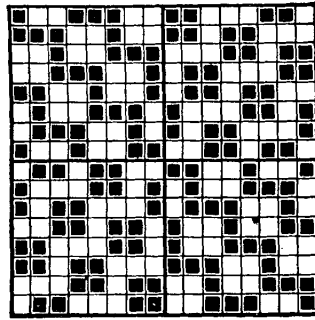


Fig. 171.

The chief object in this class of work is to hide the cotton warp, so that the face represents a perfect and smooth worsted or woolen surface. As the weave is made of long filling flushes, it is not a very difficult matter to find a suitable place to join the back and face to the cotton warp.

Fig. 176 represents a class of goods which is made in direct opposition to the previous example. The cloth is made from worsted warp.

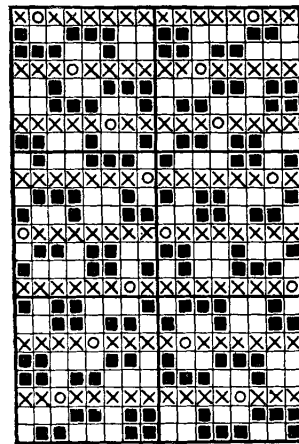


Fig. 172.

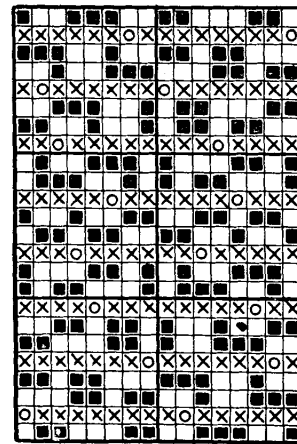


Fig. 173.

Cotton filling and woolen back. These designs are more difficult to bind than the preceding examples, as there are no filling flushes. The binding is done with the warp threads, on the reverse principle to the filling flush. When binding with a warp thread, the thread previous to the binding and the thread after the binding must be elevated, so that the point of interlacing is between two warp flushes. This character of fabric must have the warp threads set compactly in the loom.

CLOTHS BACKED WITH WARP.

This type of fabric can be backed by two methods: by the one-and-one principle and also by the two-and-one system. The example Fig. 177 illustrates a cloth backed with filling and requiring only five harnesses to weave the design, but the cloth when backed with warp requires an extra set of harnesses, and generally requires twice the number of harnesses as there are threads in the face weave. For instance, with the four-harness cassimere twill and the eight-harness sateen for the back, twelve harnesses are required to complete the full draft. Four harnesses for the face and eight for back equals twelve. The arrangement upon paper for the design is exactly the reverse of the fabric backed with filling.

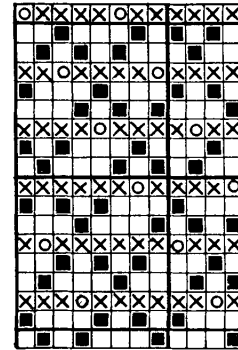


Fig. 175.

Fig. 177 represents a cloth backed with filling, while Fig. 178 illustrates a fabric backed with warp. On careful examination it

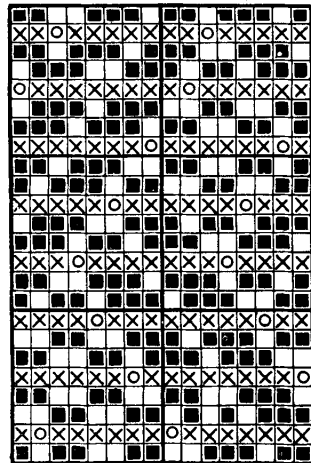


Fig. 174.

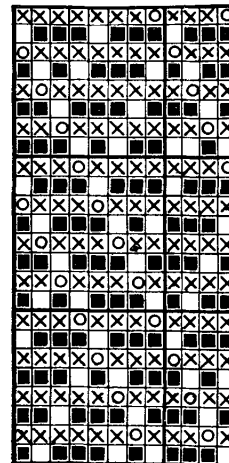


Fig. 176.

will be found that the risers and sinkers on each design are nearly the same; therefore the explanations that have been given for the one fabric will hold good for the other fabric. There is, however,

one advantage to be gained by using an extra warp; on each side of the fabric an entirely different design can be made, and as it takes extra harnesses to weave a warp back, the designer can utilize them to vary the figure. There is not much diversity applied to the under surface. This is usually of a sateen character, but the face weaves have every variety of design. The point of tie is as important in this type of cloth as in the previous one; the binding should fall in such positions as have face warp threads elevated on both sides, exactly as flushes of face-filling are necessary to effect the successful binding when backing with

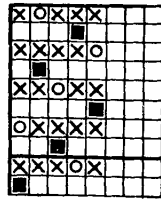


Fig. 177.

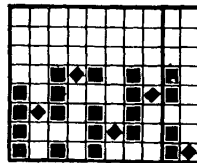


Fig. 178.

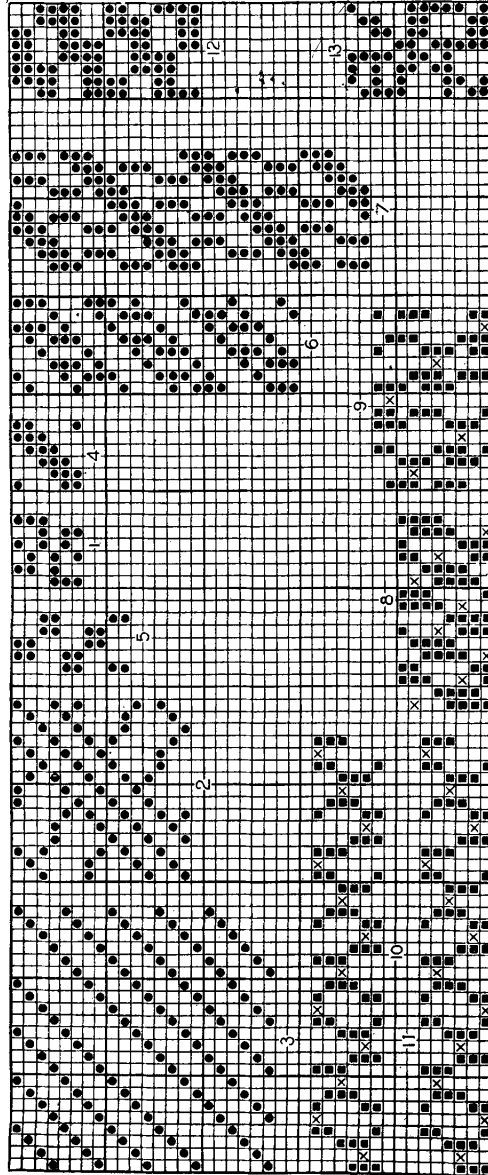
filling. Flushes of face warp are as essential to cover the ties when backing with warp as are filling flushes when backing with filling. The order of laying out this class of fabric is on the one-and-one principle.

To arrange the threads on the two-and-one system, would necessitate the use of a heavier yarn for the back, and even then would produce a rather open texture on the under-surface. The yarns used for warp backs are, as a rule, about the same size of thickness as those used for the face fabric; the yarn is set close in the reed, and the warp contains a large number of threads per inch in proportion to their counts or sizes.

EXERCISES FOR PRACTICE.

1. Back plans 1 and 2 with weft 3 picks face to 2 picks back; plans 3, 4 and 5, 2 picks face to 2 picks back.
2. Back plans 6 and 7 with weft, 3 picks face to 1 pick back.
3. Point out any defect in plans 8 and 9 and give connected plans.
4. Plans 10 and 11 show two methods of backing the same weave with warp 2 and 1. Which do you consider the better of the two and why?
5. Back plan 12 with warp, 2 ends face to 1 end back so that there may be one pick only in each shed.

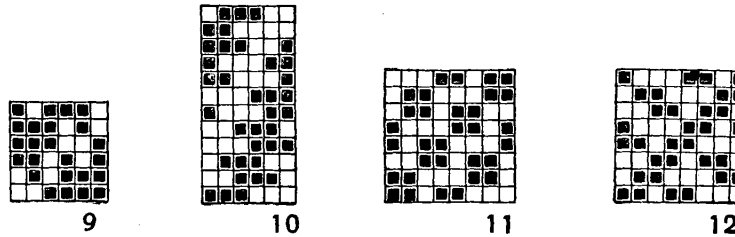
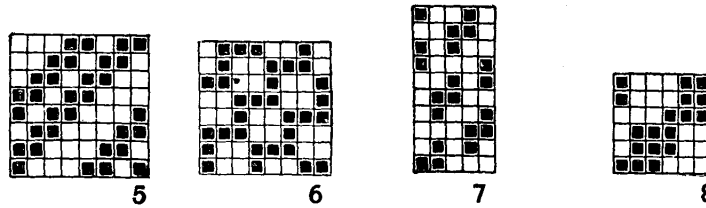
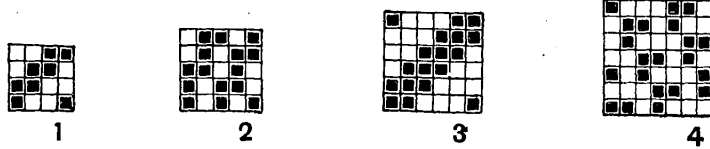
6. Would the face weave in plan 13 be affected in any way by the stitching of the backing weft?

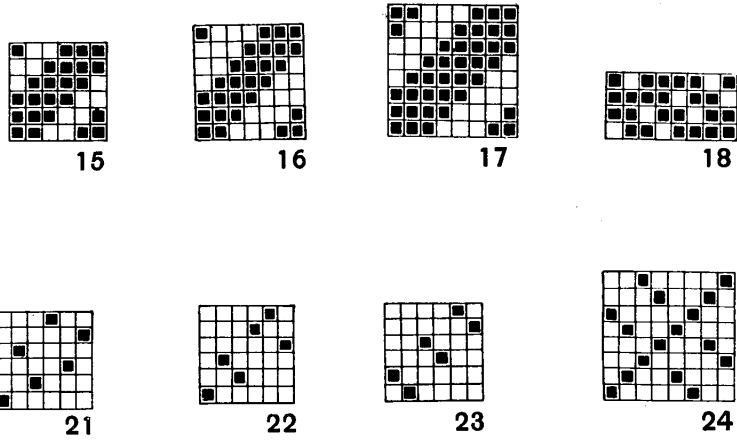


Give the reason for your answer and make a plan of this weave stitched correctly.

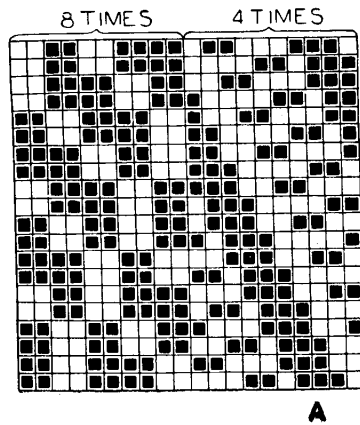
EXERCISES FOR PRACTICE.

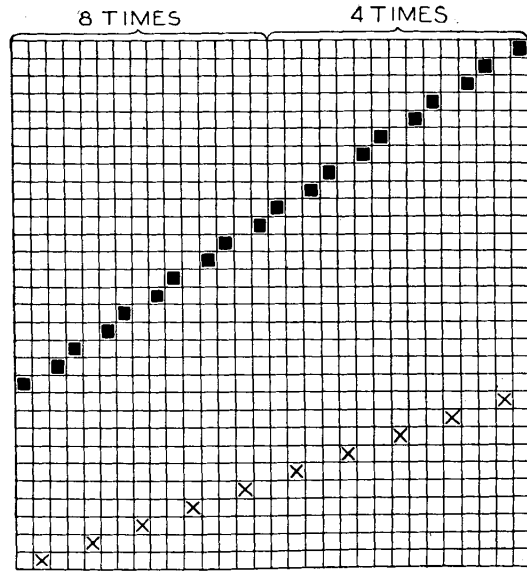
1. Back with warp 1 face to 1 back, plans 1-6, stitching firmly.
2. Back with weft 1 face to 1 back, plans 7-12, stitching once in the repeat.
3. Back with warp 1 face and 1 back, plans 13-18, stitching so that the back will be like the face.
4. Back with weft 1 face to 1 back, plans 19-24, stitching so that the back will be like the face.



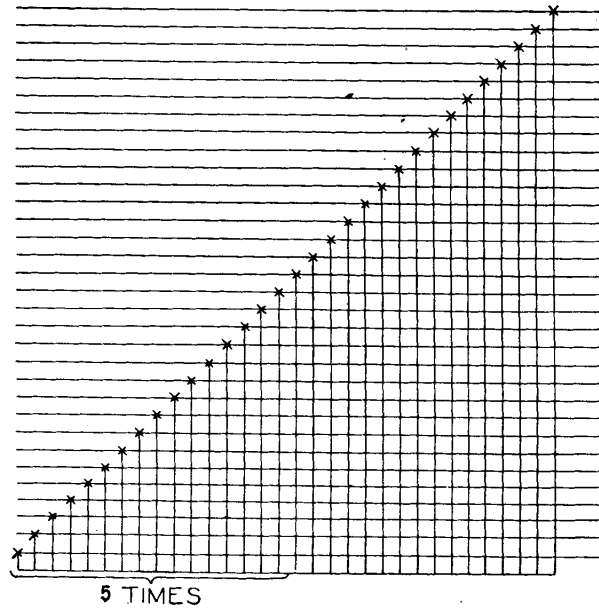


5. Back plan A with warp, 2 ends face to 1 end back, and give peg plan to weave it with draft B.
6. Back plans C D and E with warp, 3 ends face to 2 ends back.
7. Back plan F with warp, 2 ends face to 1 end back, so that there may be one pick only in each shed.
8. Give draft and peg plan to weave design G with a warp back, 1 end of face to 1 end of back.

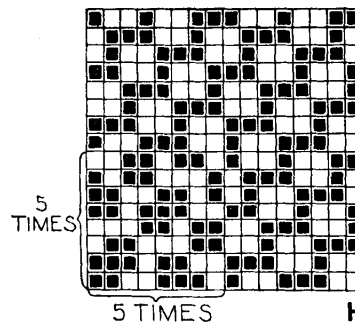
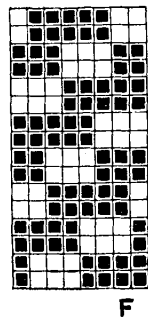
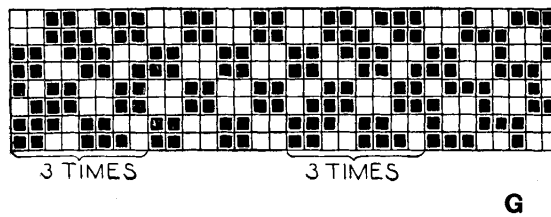
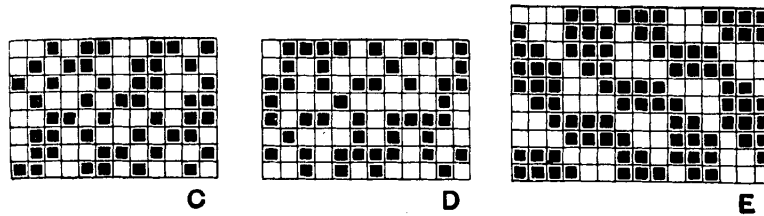




B



J

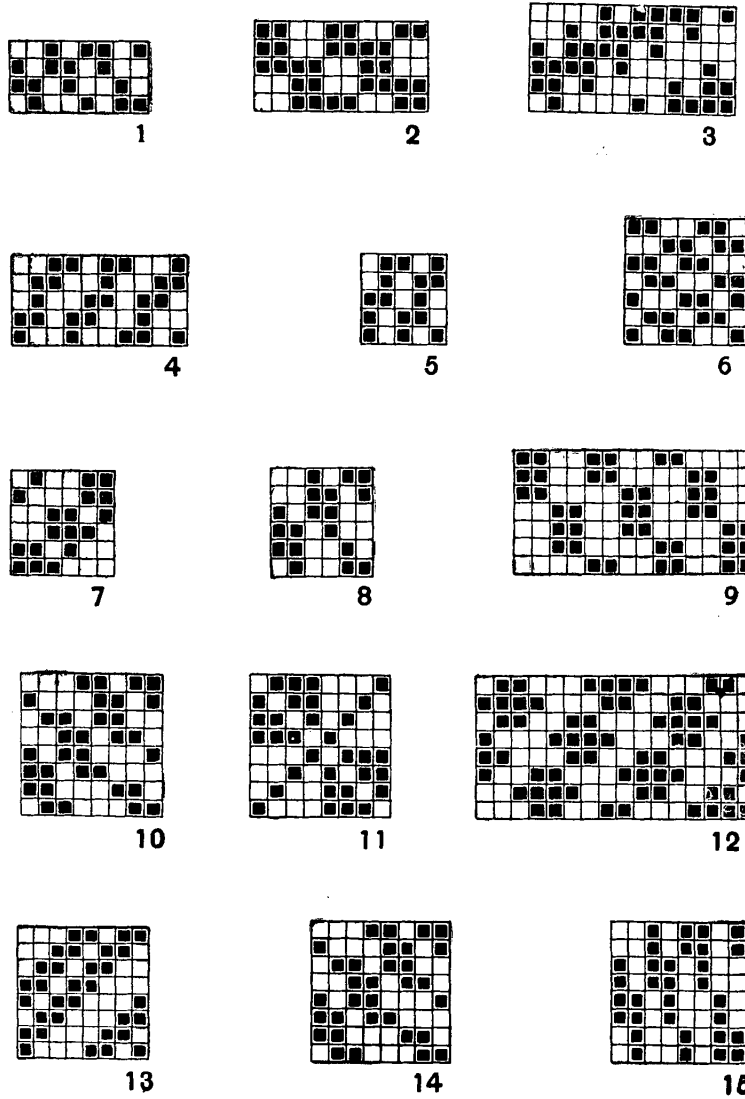


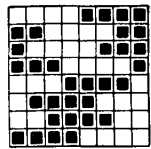
9. Back plan H with warp end and end and give peg plan to weave your design with draft J.

EXERCISES FOR PRACTICE.

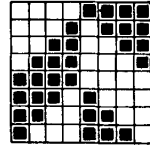
1. Back plans 1-6 with warp 2 face to 1 back, stitching each backing end once in a repeat of the face weave.
2. Back plans 7-12 with warp 2 face to 1 back, stitching twice in a repeat.

3. Back plans 13–18 with weft 2 face to 1 back, stitching twice in a repeat.
4. Back plans 19–24 with warp end and end.
5. Back plans 25–30 with warp end and end, stitching so that the back will be like the face.
6. Back plans 31–33 with weft, 1 face to 1 back.

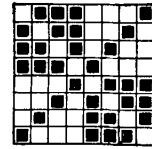




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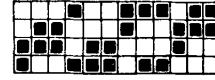
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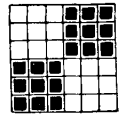
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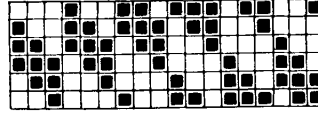
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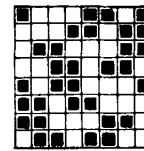
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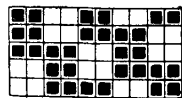
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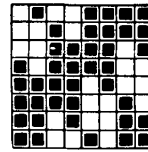
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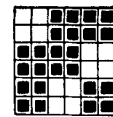
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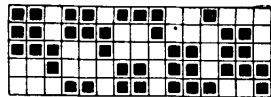
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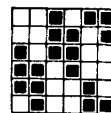
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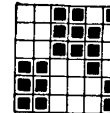
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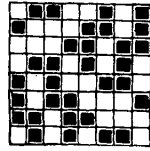
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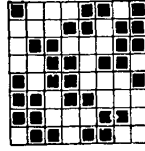
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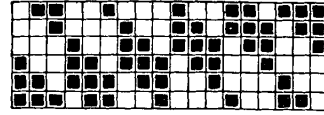
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EXERCISES FOR PRACTICE.

PAGE 125.

1. Put a warp back on plans 1-36, binding with a firm stitch. 1 end face to 1 end back.
2. As No. 1, but 2 face to 1 back.
3. Put a weft back on plans 1-36, binding with a loose stitch. 1 pick face to 1 pick back.
4. As No. 3, but 2 picks face to 1 pick back.

EXERCISES FOR PRACTICE.

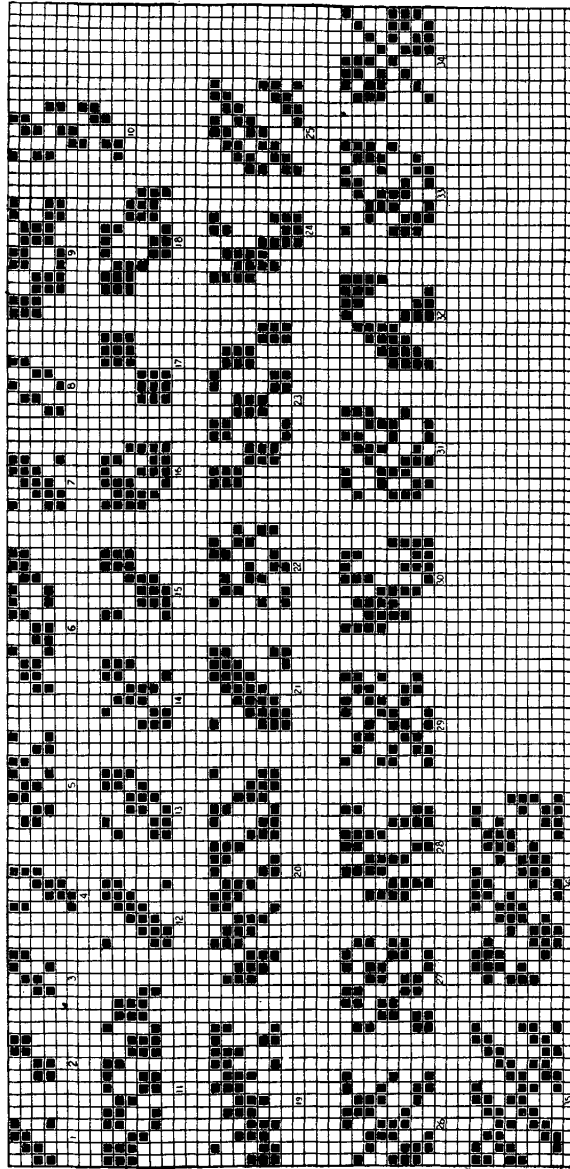
PAGE 126.

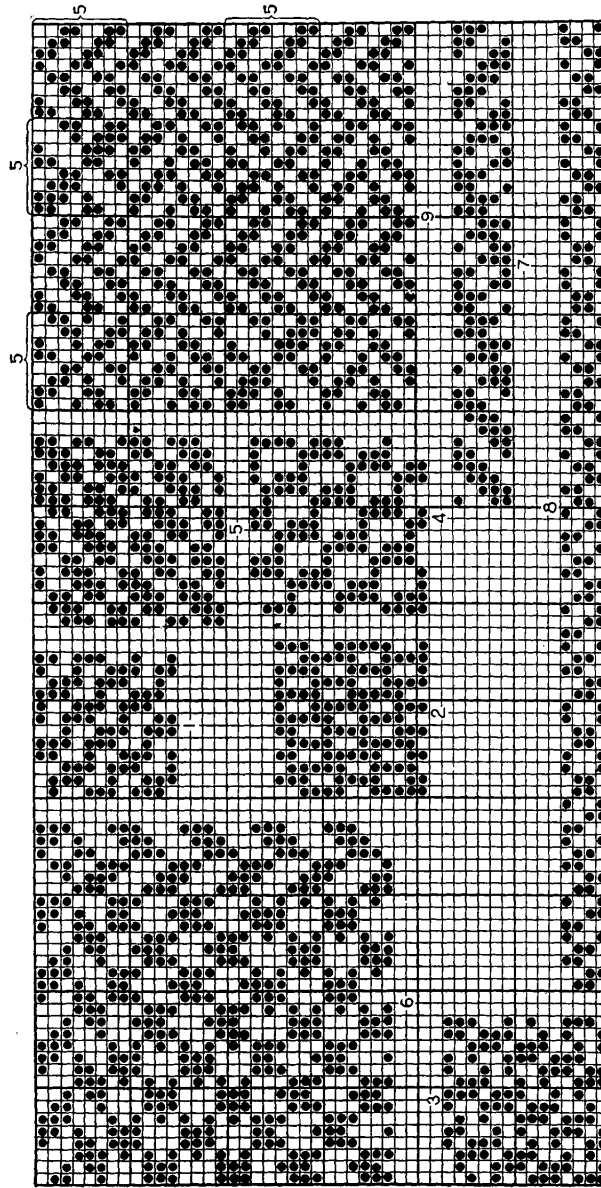
1. Back plans 1-5 with warp, end and end, and with weft 2 picks face to 1 pick back.
2. Back plans 6 and 7 with warp end and end, stitching firmly, and give draft and peg plan for your answer.
3. Back plans 8 and 9 with warp end and end, stitching loosely, and give draft and peg plan for your answer.

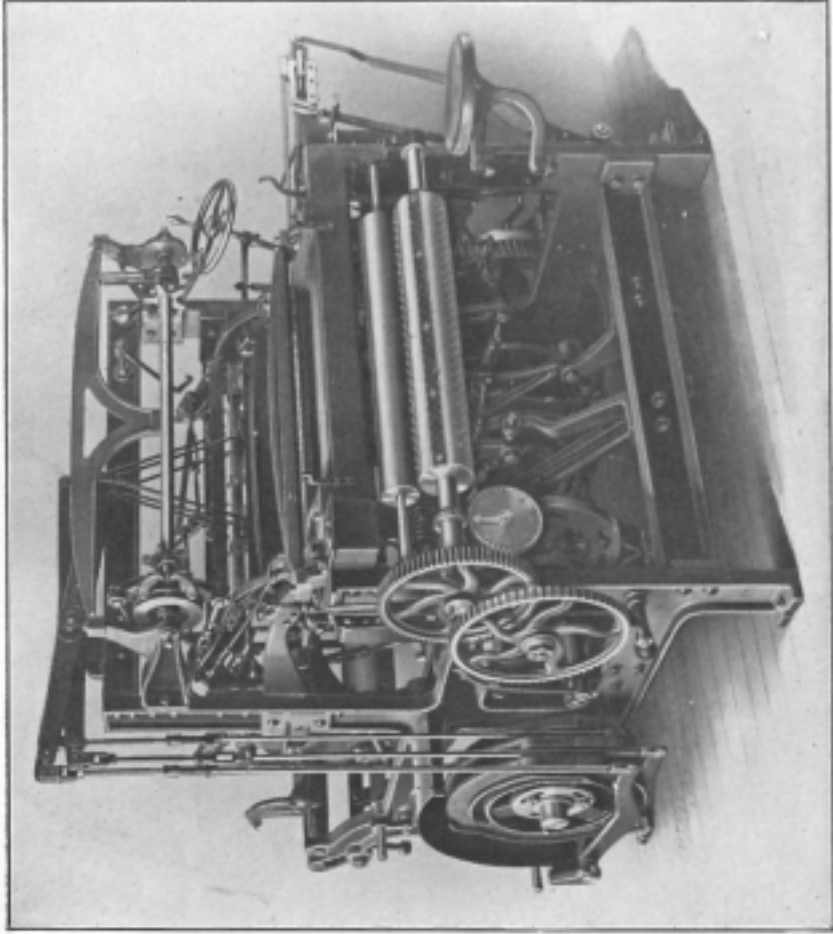
EXERCISES FOR PRACTICE.

PAGE 127.

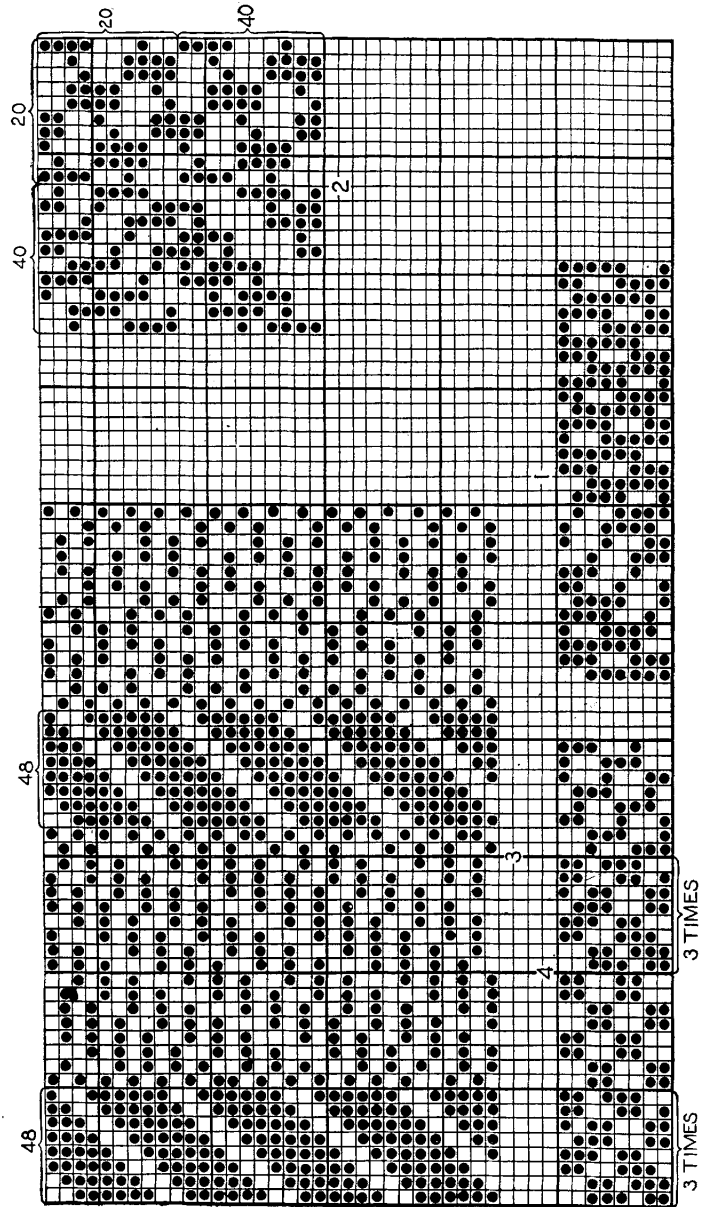
1. Complete design 1, of which 8 picks are given, and back with weft 2 face to 1 back.
2. Back plan 2 with warp, 2 face to 1 back, and give draft and peg plan.
3. Back plan 3 with warp, 2 face to 1 back.
4. Give draft and peg plan to weave design 4 with a warp back. 1 end of face to 1 end of back.

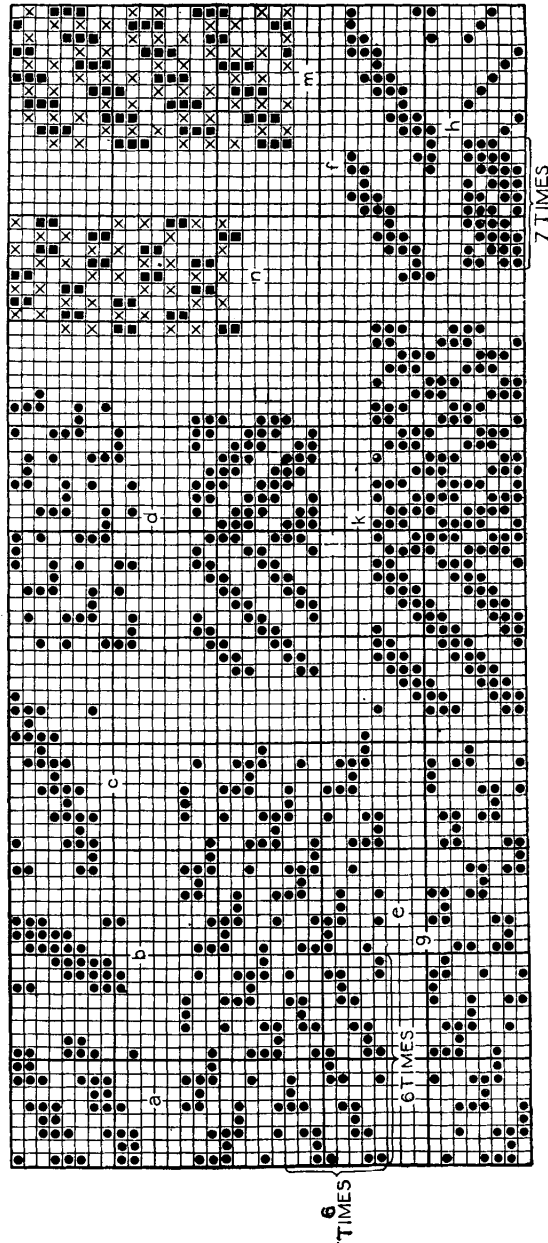






KNOWLES AXMINSTER CARPET LOOM
Crompton & Knowles Loom Works





EXERCISES FOR PRACTICE.

PAGE 128.

1. Make a design for a single cloth to weave on one beam and appear like plans a, b, c and d, in the same set.
2. Make a design with single weave to imitate the warp-backed design, e.
3. Make designs with single weaves to imitate designs f and g, then back your designs with weft 2 picks face to 1 pick back, so as to hide the backing weft as much as possible.
4. Back designs h and k with warp, 2 face to 1 back, then make single cloth designs to imitate them, giving suitable setting and counts of yarn for each.
5. Back design 1 with warp, 2 face to 1 back, then make a single cloth design to imitate your backed design and to weave on 30 shafts or less.
6. Make designs for backed cloths to give the nearest effect to plans m and n.

DOUBLE CLOTH.

The next step is to make two separate and distinct fabrics employing two warps and two fillings. Cloths of this kind may be made with either both sides alike, or totally different; that is, each of the separate cloths may be of the same pattern and made from the same yarns and the same quantity of yarn in each, or one cloth may be much finer than the other, and of totally different pattern.

Double cloths are merely two separate and distinct single fabrics woven on the same loom at the same time, but during the weaving process, so bound together as to appear like one fabric. The two fabrics may be identical in appearance and make-up, or one may be a coarse fabric and the other a fine one with the weaves and color arrangement differing radically without interfering with each other. Designs for such fabrics are made on design paper just the same as for single cloths, but the threads and picks on the design paper are divided into two sets, one for face threads and picks, and the other for back threads and picks. A good practice to adopt for distinguishing one set from the other is to shade the threads and picks to be used for the back cloth, in their proper arrangement, with a light wash of color or by fine lines. Different

proportions of face and back may be used, as one thread of face to one of back, two threads of face to one of back, two threads of face to two threads of back, three threads of face to one of back, or any other arrangement which may suit any particular design. Whatever the system adopted, it is customary to start the design with one thread of face. In the case of two of face and one of back arrangement, the order would be one face, one back and one face, repeated to the full extent of the design.

Suppose, for instance, that it is required to make a double cloth, each fabric to be a simple four-harness cassimere twill, as shown in Fig. 179. The warp threads would follow in the harnesses alternately, one of face and one of back, and the filling threads would appear in the same manner. Seeing that alternate

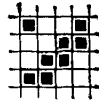


Fig. 179.

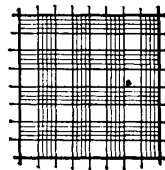


Fig. 180.

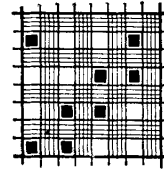


Fig. 181.

threads on this paper represent two different cloths, the student should run a faint wash of color, or shade with fine lines, over one of the sets of threads, so that when putting the design on paper there will be little liability to confusion (see Fig. 180). Now proceed to put the face weave upon one of the systems of threads, as shown by squares in Fig. 181; then put the back weave on the other system of threads, as shown in Fig. 182 by the oblique crosses, remembering all the time that the shading put upon one set of threads possesses no significance but to guide him. If divested of the shaded lines and color, the weave will now have the appearance of a simple eight-harness twill, as shown in Fig. 183, and if woven as given here would produce a simple twill and not a double cloth. Then something more must be done. When the face filling is being put in, all the back warp must be left down for the shuttle to pass over, and when the back filling is put in, the face warp threads must be lifted for the shuttle to pass under. This is quite easy of accomplishment. Simply add to Fig. 182 the marks which

will raise the face warp when the back pick is going in, as shown in Fig. 184 by the circular marks.

One thing must be made perfectly clear at this point: the crosses or marks cannot be subject to any variation; they must be put on the back pick and upon every face thread. There will be some apparent interference with this when binding or stitching the two cloths together, but in the meantime the rule must be held to be absolute. Now suppose the matter is carried a step further, and the twill is to be used for the face cloth only and the back be made plain, as in Fig. 185. This arrangement of design is quite simple and easy. Each weave is put on paper upon its own threads only, and then the marks are inserted to cause each filling to interweave with its own warp only.

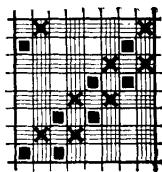


Fig. 182.

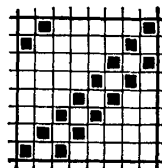


Fig. 183.

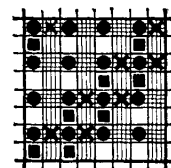


Fig. 184.

Attention must be directed to the probabilities in dealing with such a design as this. Here the threads of the two cloths are alternate, but their weaves are different. It requires little ingenuity to point out, and but little knowledge on the part of the student to understand, that if one cloth be woven twill and the other plain, and the yarns of the two are the same, one cloth must be much finer than the other. So that if any fabric is woven to this design and each cloth is intended to be equal in structure, as regards the relationship of yarn to weave, then that of the twilled cloth must be thicker in proportion than the plain cloth, and that proportion will be governed by the order of intersection. It is not often that this is done. Generally, in cloths of this kind, the two are of the same weave and quality, and consequently there is little trouble on that account. They may, of course, be of any pattern, such as that in Fig. 186, which consists of two six-harness twills, or they may be of fancy weaves.

Generally speaking, this kind of double cloth is made when it

is desired to have both sides of the fabric of the same texture, but perhaps of different colors. They are seldom made use of except in simple patterns, such as twills of the simplest kinds. Fancy designs, so far as the interweaving is concerned, are seldom used, the variety of patterns desired being generally produced in colors, which may be in stripes, checks or over-plaids.

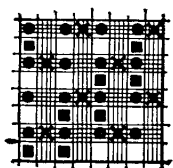


Fig. 185.

Attention must now be directed to double cloths in which fancy designs and weaves are required, the backing, as in most double-filling fabrics, being for the purpose of giving bulk and weight to the fabric. The conditions of arrangement are somewhat similar to those of cloth backed with filling, but there are two warps, and of course both have to be taken into account. Take, for example, the pattern given in Fig. 187, which consists of the four-harness cassimere twill for face and the two-harness plain cotton weave for back; there are two threads of face to one thread of back, the face weave being shown in Fig. 188 and the back weave in Fig. 189. As will be noticed, the same practice is followed out as in the one-and-one system. The face weave is first put upon its own series of threads, and then the back weave is dealt with in like manner; when both weaves are completed the rising marks are put on the back pick and upon the face threads, to cause a separation of the two cloths.

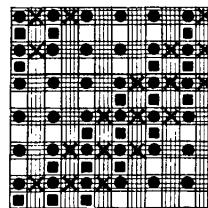


Fig. 186.

Now, to carry this out to a greater length, make a six-harness twill face and a plain back, as shown in Fig. 190, with face weave in Fig. 191. In this case, if the pattern is only carried out once, there would be but three threads of backing, and as a plain cloth is not complete upon three threads, the whole must be carried out to double the length, so that twelve threads of face and six of back must be employed. In such a case as Fig. 192, there would be no necessity for a repeat of the weave; as the face pattern in Fig. 193 occupies eight threads, four threads would be required for back, and consequently the whole would be complete on twelve threads.

It will be well to keep the practical application and the

arrangement side by side. For instance, the question of drafting will come forward, because in many cases the face pattern will be a very elaborate one and the back may be perfectly plain, or a simple twill, and consequently does not require many harnesses to

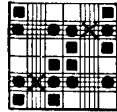


Fig. 187.



Fig. 188.



Fig. 189.

weave it. In the design, Fig. 187, there would be no reduction, because the face weave occupying four threads and the back weave two threads, there would of necessity be six harnesses required, but the matter of arranging the harnesses must be considered; that is, the arrangement

of the draft must have particular attention, not only so as to know how the threads will be drawn through the harnesses, but also to determine the actual positions of the face threads and the back threads. Draw the face threads on the four front harnesses and the back on the two back harnesses, as in the draw in Fig. 194 and chain in Fig. 195; then reduce Fig. 190

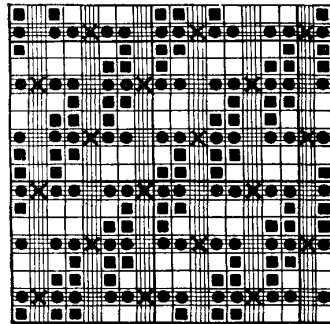


Fig. 190.

to the smallest possible number of harnesses, as in the draw in Fig. 196 and chain in Fig. 197; next reduce Fig. 192 to its lowest number of harnesses, as in the draw at Fig. 198 and chain in Fig. 199.

Binding. So far, the designs give two entirely separate fabrics, and to complete the double fabric it is necessary to bind the two together. To accomplish this binding, which is also termed stitching, tacking, etc., either one of two systems may be adopted. The two cloths may be bound together by lifting a back thread over a face pick at certain intervals, or by sinking a face thread under a back pick at certain intervals, one system being

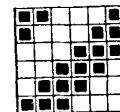


Fig. 191.

exactly the reverse of the other. Several considerations must be taken into account at this time, however, for if these binding points are selected indiscriminately a faulty piece of cloth is sure to result.

To bind correctly by lifting a back thread over a face pick, it should be lifted between two risers of face and either between two risers or next to a riser of back on the back thread. It is usually possible to lift between two back risers, but when a plain weave is used for the back, it is lifted next to a riser as the thread is not lifted over two consecutive picks. If, when binding in this manner, the back thread is lifted over a face pick at a point where

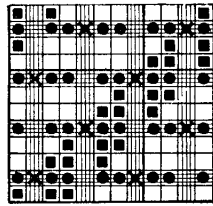


Fig. 192.

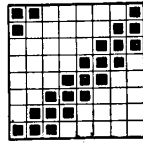


Fig. 193.

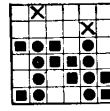


Fig. 194.

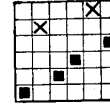


Fig. 195.

a sinker of face weave would come on either or both sides, the thread lifted would float over the face filling which is on the surface at this point and consequently the back warp thread would be brought to the face at this point, and if, as is often the case, the two cloths were of different color, the result would be a plainly discernible imperfection.

By lifting the back warp thread between two face threads which are lifted, the two face threads come into close contact and cover the back thread completely. It is necessary to lift the back thread between two risers or next to a riser, because, if the back thread were weaving on the under surface of the back cloth and carried directly through to the face of the cloth, it would carry the face pick through to the back in such a manner as to make it show on the back, causing a similar imperfection on the back to that which was caused on the face. The second system of binding being just the reverse of the first, the point selected for the binding should be just the reverse in every particular for similar reasons to those just given for the first system.

The binding points in a design are generally arranged in some definite order, such as a twill or sateen, so as to distribute them evenly throughout the cloth, but this order must suit the other requirements named. Taking now the design in Fig. 184, which requires only the binding to complete it: suppose it is to be bound by the first system, the binding points to be distributed

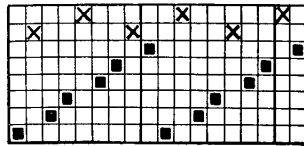


Fig. 196.

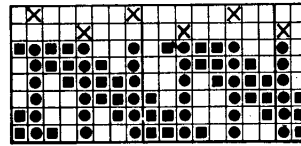


Fig. 197.

in the order of a $\frac{1}{3}$ four-harness twill. By the rule, the first point must come where a face pick crosses a back thread between two risers of face and between two risers or next to a riser of back. The only point on the first face pick answering these requirements is where the first face pick crosses the first back thread, as indicated by the diamond-shaped mark in Fig. 200. Letting this mark indicate a riser, it shows the back thread lifted over a face pick, thus binding together the two cloths. Following out the binding points in the order as decided upon, the next point will come where

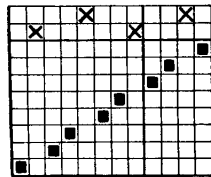


Fig. 198.

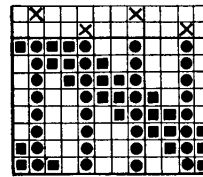


Fig. 199.

the second pick crosses the second back thread, this point coming in consecutive order, and answering all the requirements. By indicating all the binding points in their order as the first have been indicated, the design will appear as in Fig. 200; and if a fabric were woven with this design, it would be a double cloth with cassimere twill face and back, and bound together by interweaving the face-filling with the back warp in the order of the $\frac{1}{3}$ twill. This binding would be very close and firm, and in most cases it is

desirable that the binding should be distributed at greater intervals, as further examples will show. Fig. 201 is a cut section of the first two picks of Fig. 184, and Fig. 202 is a cut section of the first two picks of Fig. 200, showing the binding, and Fig. 203 is a diagram of the complete weave.

For a further illustration of binding, suppose a cloth is desired with the same face and back weaves as were used in the previous example; but this fabric is to be bound by the second system, with the binding points arranged in the order of an eight-harness sateen. As the binding is to be done with the face threads, and eight threads are required for the face, with the design arranged in the proportion of one thread of face to one of back, there would necessarily be eight threads required for back, giving sixteen threads and picks required for a full repeat of the design.

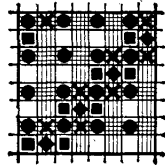


Fig. 200.

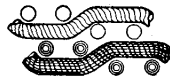


Fig. 201.



Fig. 202.

Rule.— To find the dimensions of a ply or multiple fabric, find the least common multiple of the number of threads required for each of the single weaves to be employed, including the binding motive, and multiply by the number of threads in one repeat of the ply dressing; i. e., if the cloth is arranged one of face and one of back and one of face, multiply by three, etc. A double cloth arranged in the proportion of one thread of face to one of back is called a one-and-one double cloth, or a double cloth arranged on the one-and-one system; and a double cloth arranged in the proportion of two threads of face to one of back is called a two-and-one double cloth, or a double cloth arranged on the two-and-one system.

Having found sixteen threads by sixteen picks to be the dimensions of the design given, shade off the design paper and place upon it the face and back weaves and the face lifters on the

back picks, each of the two weaves being carried out twice in each direction, as in Fig. 204. To select the first binding point, the requirements are to sink a face thread under a back pick between two sinkers on the back pick and between two sinkers or next to a sinker on the face thread. On the first back pick two such points may be found, the first on the fourth face thread and the second on the eighth face thread, both of which are equally good. Taking the point where the first back pick crosses the face thread as the first binding point, the face thread is found to be lifted by the system of lifting all of the face threads on the back picks; in this case the thread must not be lifted, but must be

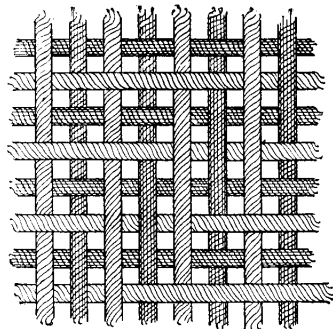


Fig. 203.

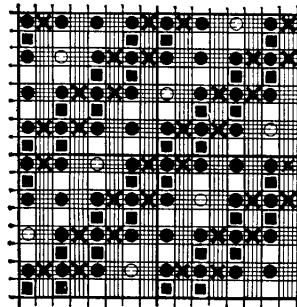


Fig. 204.

sunk under the back pick to effect the binding. This being the case, the mark indicating a lifter must be removed, and the space left vacant showing the thread to be sunk, but for convenience in showing the binding arrangement, the point is indicated by a circle, as in the design.

Now as an eight-harness sateen is to be used for a binding motive, and as either five or three may be used as move number to produce an eight-harness sateen, it must be decided which number will give the proper arrangement to suit the other requirements. Using three as a move number, and counting off from the first point already selected, the next binding point would come where the fourth back pick crosses the fifth face thread, and as this point is surrounded by risers of both face and back weaves, it is obviously incorrect for this system of binding. Then using five instead of three as a move number, the next point would

come where the sixth back pick crosses the fifth face thread, and as this point is a good one in all respects five may be accepted as a move number for the sateen, as it will distribute the binding points in correct positions all over the design, as shown by circles in Fig. 204. Fig. 185 should be bound with the same motive as Fig. 184; Fig. 186 may be bound in a similar manner to Fig. 184, using instead of the one up and three down binding motive, the one up and five down, commencing at a similar point; Fig. 187 could not be suitably bound without a further extension, as there are only two back threads; Fig. 190 could be bound with the same motive as Fig. 186; and Fig. 192 with the same motive as Fig. 184. Any changes made in the design by inserting or removing risers for binding purposes will, of course, necessitate a corresponding change in the drawing-in draft and chain.

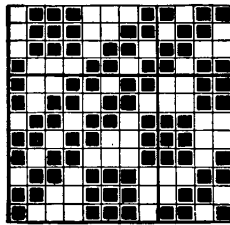


Fig. 205.

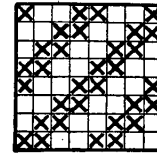


Fig. 206.

It will be noticed that the last three examples are arranged in the proportion of two threads of face to one of back. With designs arranged in this manner, the first system of binding is always preferable because the addition of binding points would be likely to so complicate the face weave as to necessitate the use of more harnesses.

With the design arranged one of face and one of back, there would be no choice of binding systems, except in a case where the face weave were a fancy one with a plain or simple twill back. Then the binding should be done by the second system, as it would not increase the number of harnesses required, because the face weave would probably occupy a greater number of harnesses than the back. Suppose for example the face weave is an eight-harness fancy twill and is to be backed by a four-harness twill, the binding motive to be an eight-harness sateen. If the binding

were done by the first system, it would require eight back threads to repeat the binding, and as the back weave would repeat on four, it would prevent any reduction of the number of harnesses for the back weave. If the binding were done by the second system, as the face is composed of eight face threads, the binding would not increase; the number of harnesses would then be reduced to four.

As a further illustration of weaves and binding, suppose that Fig. 205 is to form the face fabric, and that there must be a back cloth woven upon it, and also suppose that the cassimere twill in Fig. 206 is the back weave, and that there are two threads and picks of face to one each of back. What would be the relations of the two weaves to each other? The face pattern occupies twelve threads and the back weave occupies only four threads, consequently, there being two of face to one of back, when the face pattern is complete there would be six threads, or one repeat and a half of the back weave, so that to make the whole complete the face must be repeated and the back continued until there are twenty-four of the face and twelve of the back, as shown in Fig. 207. When this is done, it must be evident that the relations of the two weaves must be different in the first half and the second half respectively.

Now suppose that in the design given in Fig. 207, a binding point were found as indicated on the second face pick and first back thread; the corresponding point in one repetition would not bear the same relation to the face and back respectively, as is shown on the seventh back thread and second face pick, by the hollow diamond. The correct arrangement is shown fully carried out in the design, but not in the chain and draft. It will be seen that at the point of binding when the back filling is over one of the threads of its own cloth, and the next pick of the face following immediately upon it is passing under the same thread, there is a great probability of one showing through to the surface of the other.

In binding two cloths together, there must be some attention paid to the distribution of the bindings, exactly as there is when backing with warp or filling only, and this may materially affect the number of harnesses employed. If the binding is to be done by the second system, then in all probability there would be no

necessity to increase the number of harnesses employed, because at the point of binding any one of the harnesses carrying the warp thread selected for binding could be left down at the desired point for the back filling to pass over, and the distribution could be arranged according to the character of the design ; if, however, the first system is used, then for the purpose of obtaining the desired distribution there must be more backing harnesses employed.

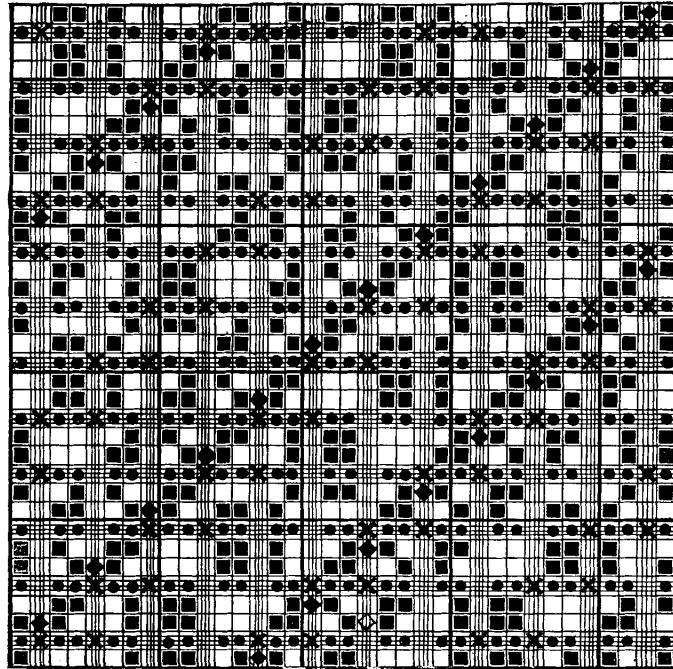


Fig. 207.

Look for example in Fig. 207, the draft of which is given in Fig. 208 and the chain in Fig. 209 ; there are four back harnesses only. There could be no proper distribution of a reasonable character if the binding were done on the back warp threads, therefore there must be an extension. Take for example Fig. 210, which is the same face design with a plain back, with the draft in Fig. 211 and the chain in Fig. 212 ; here it would be absolutely impossible to bind the two cloths together in anything like a reasonable manner with the face filling passing under a backing

warp, because there are only two backing harnesses used, and therefore it could only be on alternate threads. The practical

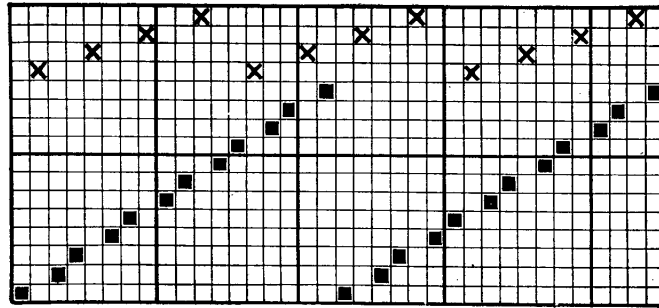


Fig. 208.

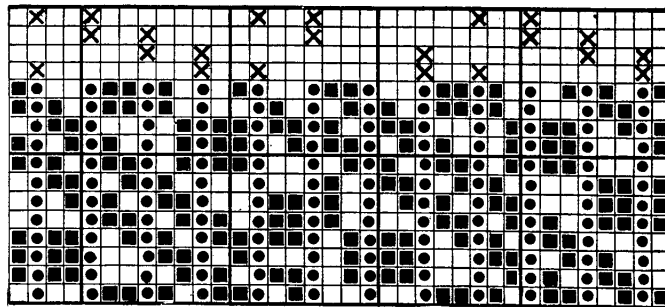


Fig. 209.

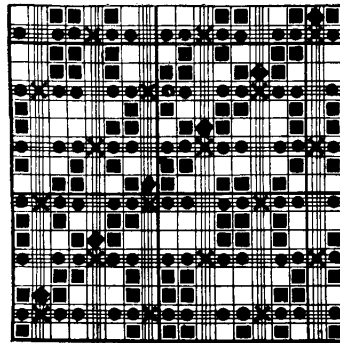


Fig. 210.

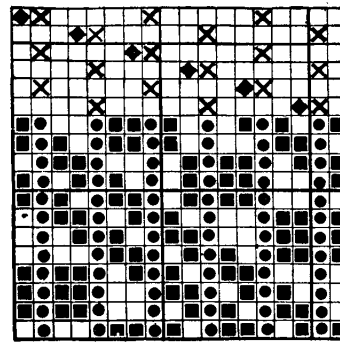


Fig. 211.

course in this case would be to increase the number of backing

harnesses, so that the distribution could take place in accordance with the requirements of the pattern.

To bind this design a $\frac{1}{5}$ motive should be used, starting on the first back thread and second face pick. The complete chain, including the binding, is shown in Fig. 211 and the draw in Fig. 212.

TO LAY OUT A DOUBLE-CLOTH DESIGN.

First: Obtain complete dimensions and mark off.

Second: Shade the back threads and picks with light blue.

Third: Place the face weaves on the face threads and picks with black.

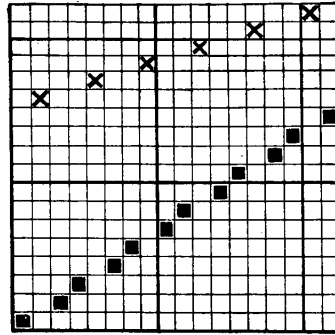


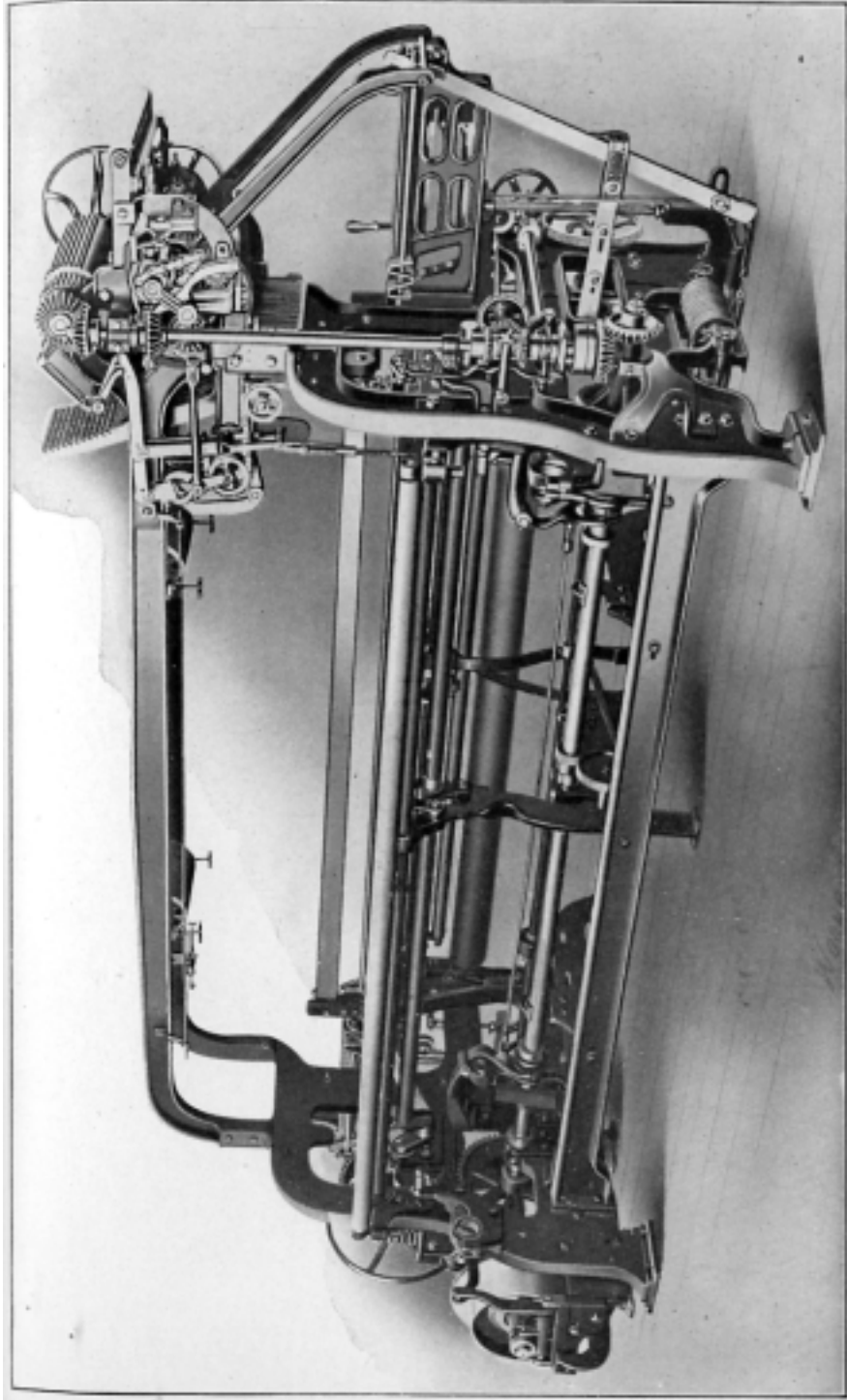
Fig. 212.

Fourth: Place the back weaves on the back threads and picks with red.

Fifth: Raise all the face threads on the back picks with green.

Sixth: Stitch by lifting a back thread between two risers of face and next to a riser of back, indicating with yellow; or

Seventh: Stitch by sinking a face thread between two sinkers of back, indicating with a circle.



REAR HARNESS-END VIEW OF HEAVY WORSTED LOOM
Crompton-Thayer Loom Co.

EXERCISES FOR PRACTICE.

PLATE A.

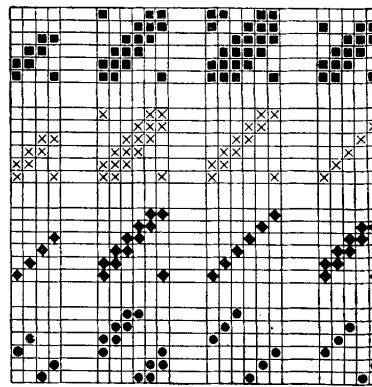
1. Stitch plans 1–5 for double cloths, using both warp and weft for this purpose.
2. Complete plans 6–9 for double cloths, using both backing warp and weft for stitching.
3. Make 4 plans for double cloths from the following particulars:

Plan of Face Weave.

Plan of Back Weave.

Plan of Back Warp stitch.

Plan of Back Weft stitch.



4. Make plans for double cloths with 1 end and pick of face to 1 end and pick of back, using both backing warp and weft for stitching; with plan 10 for face and plan 11 for back; plan 12 for face and plan 12 for back; plan 13 for face and plan 14 for back.

PLATE B.

5. Complete plans 1–4 for double cloths, using both backing warp and weft for stitching.
6. Complete plans 5–8 for double cloths, using the backing warp for stitching.
7. Make plans for double cloths 2 face to 1 back in warp and weft, with plain backs, and weaves 9, 10 and 11 for face.
8. Make plans for double cloths 2 face to 1 back warp and weft, with twill backs, and weaves 12, 13 and 14 for face.
9. Point out any defect in plan 15, and give corrected plan.
10. Analyze plans 16 and 17, and give face and back weaves, stitching and separating plans.

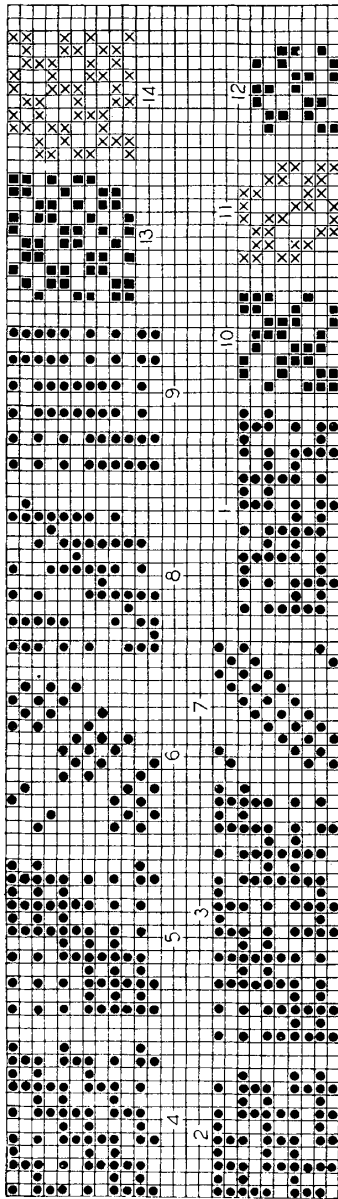


PLATE A.

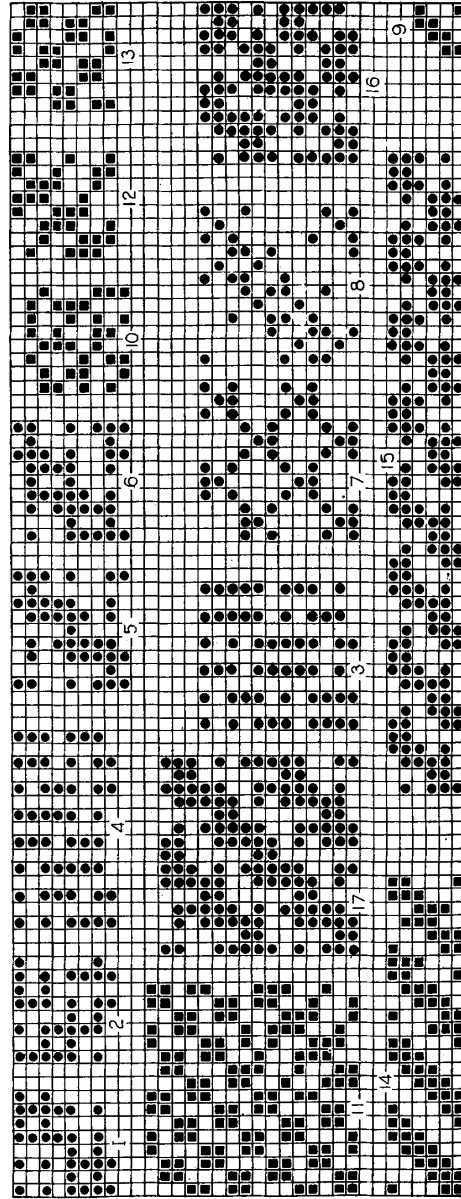
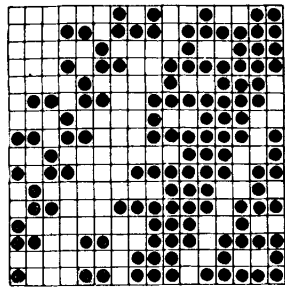


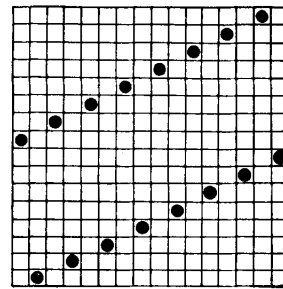
PLATE B.

EXERCISES FOR PRACTICE.

1. Plan A is a peg plan for draft B; work out the design that would be produced, analyze it and describe its construction.
2. Give designs for double cloths, 1 and 1 warp and weft with (1) plan C for face and back, (2) plan D for face and back, also give peg plans to weave them with draft B.

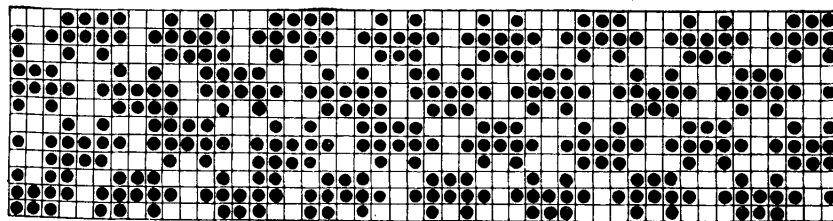


A



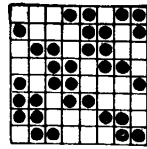
B

3. Make draft and peg plan to weave design E, backing healds to be in front, and give two peg plans for original designs to be woven in the same draft.

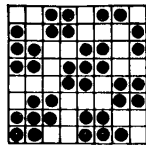


E

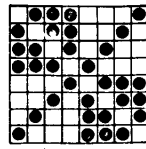
4. Put a plain back on plans F, G, H, 2 ends and picks of face to 1 end and pick of back; give peg plans to weave all in same draft.
5. Make plans for double cloths with weaves K, L, M for face and same for back, 1 end and pick of face to 1 end and pick of back, and make a diagram showing section between 2d and 3d picks of plan M.



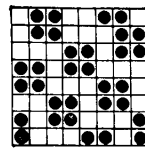
C



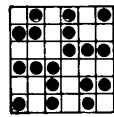
D



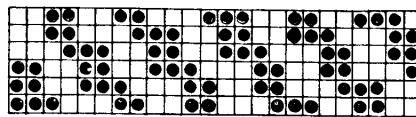
K



L



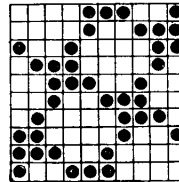
F



G



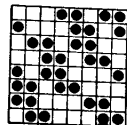
M



H

EXERCISES FOR PRACTICE.

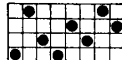
1. Make plans for double cloths with plans A, B, C for face and D for back in each case; 1 end face to 1 end back, and 2 picks face to 1 pick back.



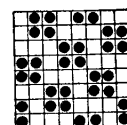
A



B



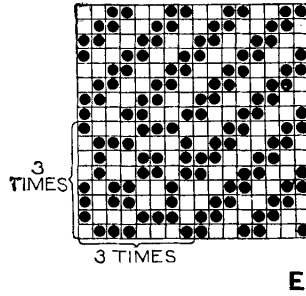
C



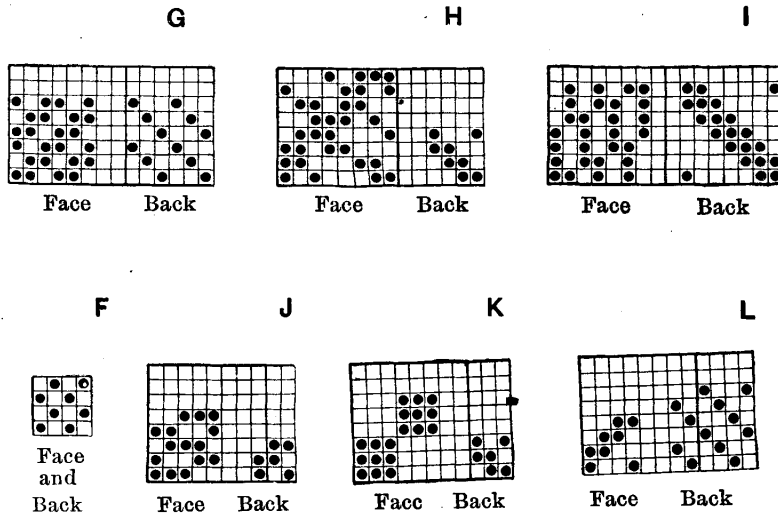
D

2. Make a double cloth with design E for face and a wadded satin back.

3. Give design, draft and peg plan for a double cloth, 2 face to 1 back, with original check plan for face, and a back which will hide the backing weft as much as possible.



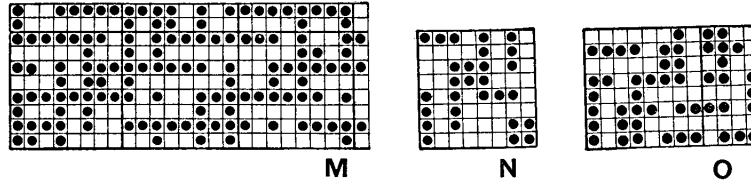
4. Make designs for double cloths A to G with the following weaves: 1 thread face to 1 thread back, warp and weft, using extra warp for stitching.



5. Rearrange the double cloth designs F and G with 2 ends and picks of face to 1 end and pick of back, the stitching warp to have the same number of ends as the backing warp.

6. Analyze plan H, showing on point paper the face and back weaves, stitching plan, etc.

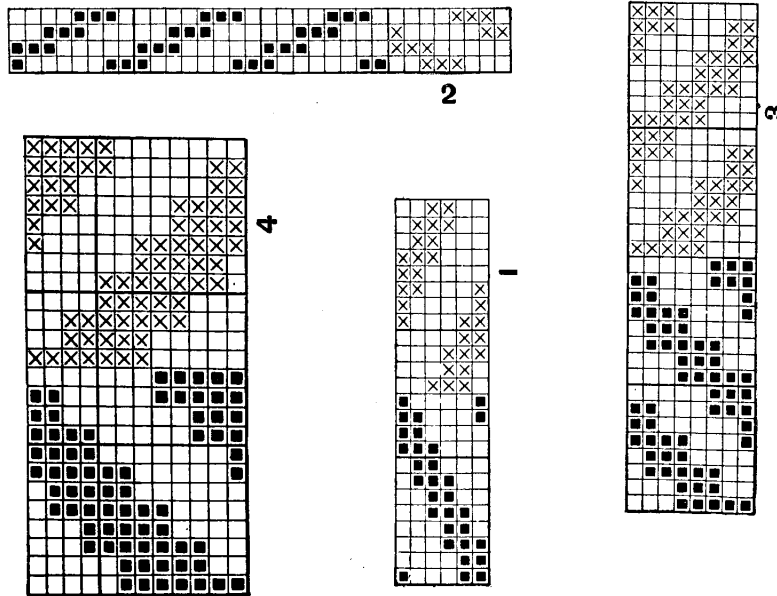
7. Point out any defect in the plans K and L for double cloths, and give the correct plan in each case.



8. Make a 2 and 2 twill double cloth stitching by means of an extra stitching pick.

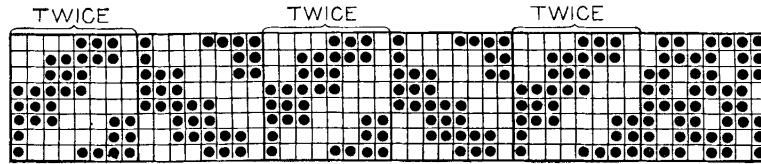
EXERCISES FOR PRACTICE.

1. Supply 2 single weaves for each of the accompanying designs, 1, 2, 3 and 4 to weave with the same set and in place of the portions in crosses (X).



2. Give color figure produced from design 5, with the following warping and wefting :

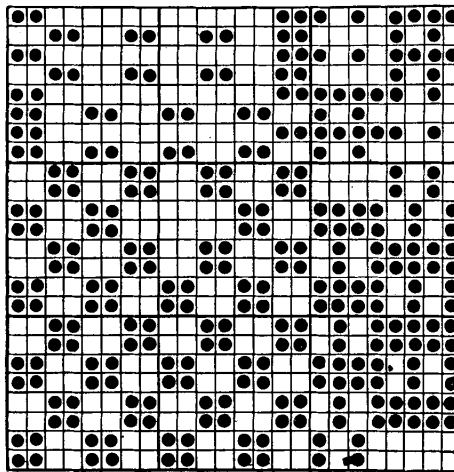
$$\begin{array}{l} \text{Warp No. 1 Color} \quad - \quad .11 \quad .11 \} \\ \text{Warp No. 2 Ground} \quad - \quad \underbrace{213, 222}_{8 \text{ times}} \} = 72 \end{array} \quad \begin{array}{l} \text{Weft No. 1 Color} \quad - \quad 11 \} \\ \text{Weft No. 2 Ground} \quad - \quad 321 \} = 8 \end{array}$$



5

3. With a similar design, make an original color figure.
4. Color design 6, thus showing the effect produced in a cloth woven as follows :

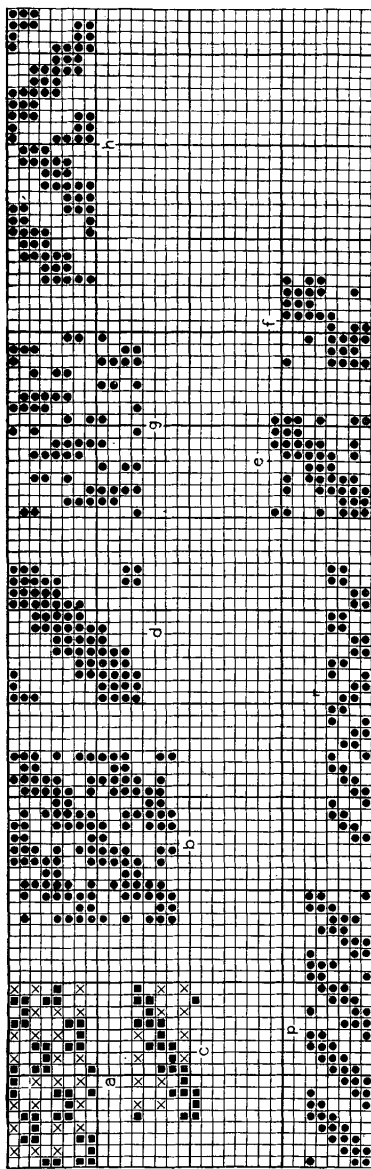
$$\text{Warp and Weft} \left\{ \begin{array}{l} \text{No. 1 Ground} \quad \frac{3}{36} \text{ White} \quad - \quad 17111 \} \\ \text{No. 2 Color} \quad \frac{1}{16} \text{ Light Blue} \quad - \quad 11111 \} = 24$$



6

EXERCISES FOR PRACTICE.

1. Make plans to imitate plans a, b, c, in a weft-backed cloth.



2. Make plans to imitate plans d, e, f, g, in a single cloth.

3. Give backed or double cloths of which plans h, k, l, m, n, are imitations.

4. Back plans p and r with warp 1 and 1, and make single cloth weaves to imitate them in the same settings.

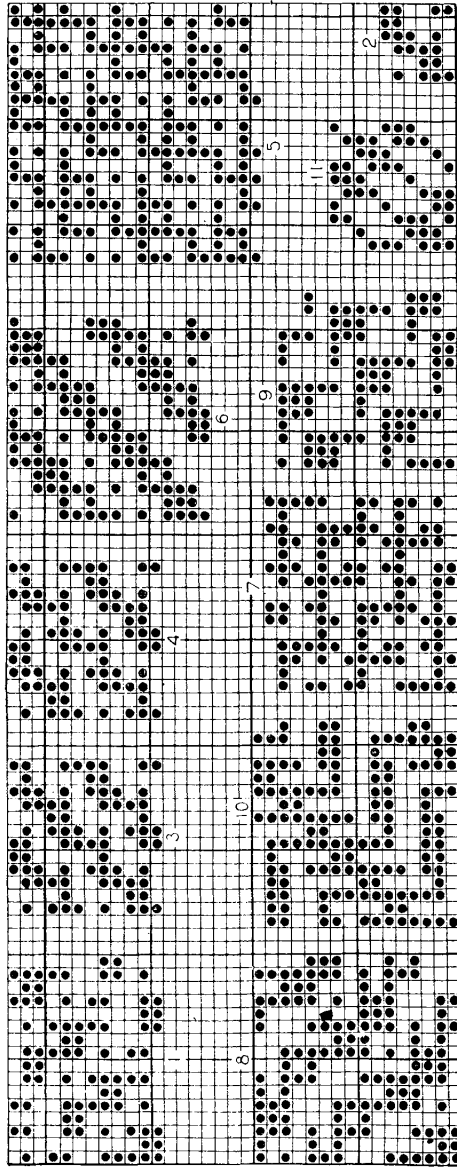
5. Point out any defects in the designs 1 to 7 for double cloths, and correct.

6. Make plans for a double reversible 6 and 6 twill and 8 and 8 twill, stitched as lightly as possible.

7. Analyze the accompanying plans 8 and 9 for double cloths, giving face and back weaves and stitching plans.

8. Describe the construction of design 10 and analyze it, giving separate plans of each component part.

9. In analyzing a double cloth the face weave is found to be plan 11, and the back weave plain; make peg plan to weave the cloth with a draft separating the back and face healds.



THREE-PLY OR TRIPLE CLOTHS.

Having treated with double cloths, the next fabric to be considered is three-ply or triple cloth. Triple cloths are fabrics having three distinct sets of warp and filling, constructed in a similar manner to double cloths. There are three different fabrics, called the face, middle and back, bound together at certain intervals so as to form one complete fabric. The binding is done by the principles as employed in binding double cloths, and, in fact, any of the principles used in the construction of double cloths apply equally well to the construction of all multiple fabrics. There is ordinarily an equal proportion of face, middle and back employed, i. e., one thread of face, one thread of middle and one thread of back, with the filling in the same order.

Yarns differing greatly in size may not be used for the different fabrics of a three-ply cloth unless the weaves employed are such as will permit of a variation in the diameter of the yarn. For instance, if a plain weave is being used for one fabric, and it is desired to increase the fabric in weight and yet retain the same number of threads per inch, coarser yarn could be used, but the weave would have to be changed to one with longer floats and fewer intersections, so as to accommodate the increased diameter of the yarn. Of course the same number of threads per inch must be retained so as to correspond with the other two fabrics.

The opposite will hold true about changing the weaves, as any radical difference in the weaves used would result in a difference in texture, i. e., making it either closer or more open, according as to whether the change would be made from a long float weave to one with shorter floats, and a greater number of intersections. For this reason either a finer or a coarser yarn would be required to make up for such a difference, unless the number of threads per inch could be changed.

In these triple cloths the weaves generally used are the plain weave, simple twills and basket weaves combined in various ways. Different effects in such cloths are usually produced by the coloring, which may vary extensively in different cloths, and sometimes differs entirely on the two surfaces of the same fabric.

The face and back fabrics are often of a very similar quality,

with an inferior class of material for the middle fabric. In fine-surface lighter weight goods of high quality the middle cloth would probably be of fine worsted warp with a medium woolen filling, but with the cheaper class of goods, where a good surface is also required with a somewhat greater weight, a cotton or cheap woolen middle warp would be employed, with a coarse and cheap woolen filling.

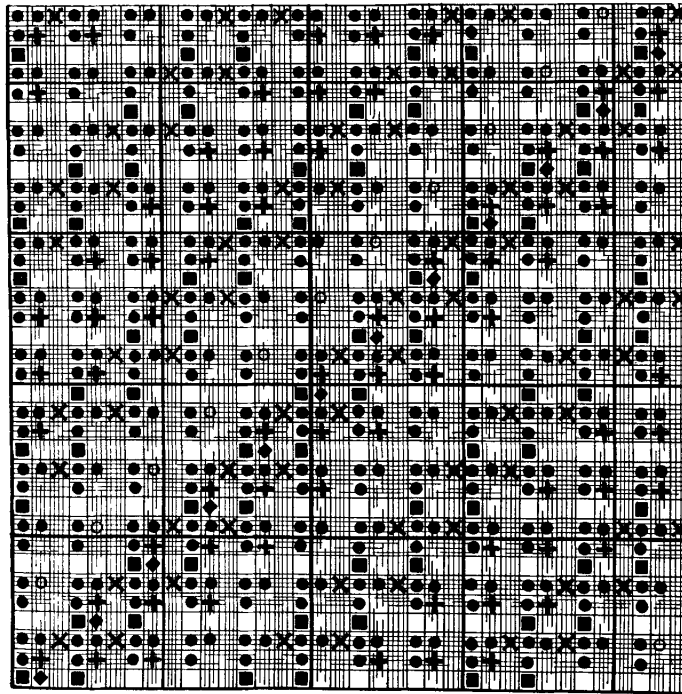
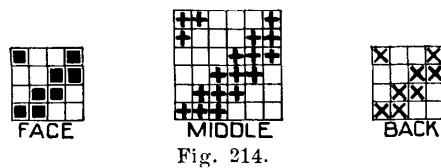


Fig. 213.

Now suppose it is desired to make a three-ply cloth with face and back of an equal quality, with a coarser middle cloth. For the face and back the cassimere twill weave $\frac{2}{2}$ may be used, and for the middle cloth the $\frac{3}{3}$ six-harness twill may be employed so as to permit the use of coarser yarn. It may also be the twelve-harness twill $\frac{1}{11}$. Knowing the weaves to be

employed, together with the binding motive, the dimensions of the complete design may now be ascertained.

The least common multiple of 4, the face and back weaves, 6, the middle weave, and 12, the binding motive, is 12, and as it is a three-ply cloth, multiplying by 3 will give 36 threads and picks, the dimensions of the complete design. Having found the dimensions required, the design paper may be shaded to indicate the different sets of threads and picks, as was done with double cloths; but, as in this case there are three different sets of threads, two different kinds of shading must be used, one for middle and one for back, the face being left unshaded. For the middle a light wash of yellow may be used, and for the back a light wash of blue; or the middle may be shaded with broken fine



lines, and the back with unbroken fine lines, as shown in Fig. 213. By the use of either of these methods confusion is avoided.

Next place the different weaves on the shaded paper, indicating the face weave with full squares, the middle weave with straight crosses and the back weave with oblique crosses, as shown in Fig. 214. This being done, the weaves for the different fabrics are all indicated, but nothing has been done to separate the three fabrics, i. e., to prevent the filling intended for one cloth interweaving with the other warps. When the face filling is being interwoven, the middle and back warps must be left down, and as these warps have not been raised on the face pick, no change is necessary on that pick. When the middle pick is being interwoven, the face warp must all be lifted and the back warp must all be left down, so on this pick the face warp is lifted, as shown by the round marks in Fig. 213. When the back pick is being inserted, both the face and middle warps must be lifted out of the way of the back filling, and this is done as indicated by the round marks on the back pick in Fig. 213. Now all the weaves are indicated, and the lifters which separate the three cloths are also indicated, the binding only being necessary to complete the design, because the design without the binding would produce three distinctly separate cloths not joined together at any point.

The best results in binding three-ply cloths are obtained by using a combination of the two methods employed for double cloths in such a manner as to bring all the binding on the middle threads. This is accomplished by lifting a middle thread over a face pick at a suitable point, thus binding the face and middle cloths together, and by binding the middle and back together, by sinking a middle thread under a back pick at a suitable point. The rules given for selecting binding points hold good with three-ply, the same as with double cloths. Occasionally a three-ply fabric is bound directly through from face to back, or *vice versa*, but unless this is made necessary by some particular reason, it should not be done. Now to bind the design above : first bind

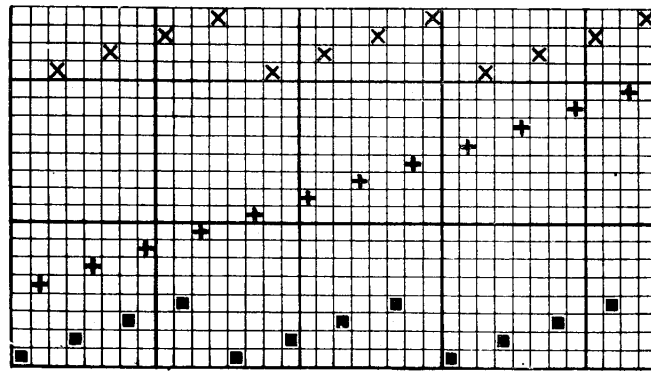


Fig. 215.

the face and middle together by lifting a middle thread over a face pick. Referring to the design, it will be seen that on the first face pick there is but one point which answers the requirements necessary to produce a perfect binding. This point is where the first face pick crosses the first middle thread, and it will be noticed that the face thread on each side of this point is lifted, and also the middle thread is lifted over the middle pick preceding and the middle pick following this point, thus making it a perfect binding point in every way. This may be taken as the first point, and as the face and middle weaves are regular twills, the binding motive also being a regular twill, the consecutive binding points will come at positions governed by the same conditions,

i. e., at the point where the second face pick crosses the third middle thread, etc. These points are indicated by the diamond-shaped marks in Fig. 213, making the binding of the face and middle complete. To complete the design, it is only necessary to bind the middle and back fabrics together by sinking a middle thread under a back pick. As all the middle threads have been lifted over the back picks by the circular marks in the same design, it is necessary to remove one of these marks wherever the binding makes it necessary, or such point may be indicated with a circle, this circle to indicate a sinker. This binding point must come where the back filling crosses the middle warp, with a sinker of back on each side and a sinker of middle both on the preceding middle pick and on the middle pick following.

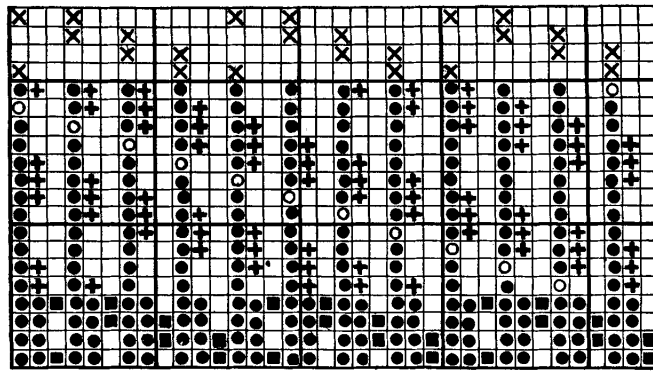


Fig. 216.

Referring to the design, it will be seen that there is but one point answering this description on the first back pick, and that is where it crosses the last middle thread. This point has a sinker of back on each side of it, and a sinker of middle preceding and following it, answering fully the required conditions. Taking this point as the first, indicate it with a circle, as shown, and following out the binding points in consecutive order the next comes where the second back pick crosses the first middle thread, etc., continuing until all the points are indicated by these circles. The design is now fully completed, the three different weaves being indicated, also the face lifters on the middle picks, and the

face and middle lifters on the back picks, the three fabrics thus being bound together.

The drawing-in draft for the above design is given at Fig. 215, with the chain-draft at Fig. 216, and a cut section of the first three picks at Fig. 217. Fig. 218 is a design composed of the same three foundation weaves as before, and is like Fig. 213 in every way but the binding. In this case the binding is done by lifting a middle thread over a face pick to bind the middle and face together, and by lifting a back thread over a middle pick. The binding motive is a twelve-harness twill $\frac{1}{11}$ and the

binding is indicated in the design by the diamond-shaped marks, Fig. 218. The threads are numbered underneath the design in the order of the drawing-in draft, and as this design would require twenty-eight harnesses as compared with twenty for the previous example, it shows clearly the advantage of doing all the

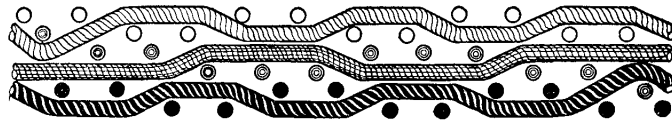


Fig. 217.

binding with the middle warp as in Fig. 213. The difference of eight harnesses is often the difference between a design which may be practicably woven and one which may not, and in this case may be truly said to be so.

In many mills cloths are woven which have two fillings interwoven with three warps, the middle warp being employed only for the purpose of binding the face and back fabric together. This warp, which is called the stitching or binding warp, would, in the finer class of goods, probably be made of fine worsted, and in the cheaper class of goods be made of cotton.

The advantage of using this middle warp is that a double-face cloth using such a warp is usually of a much softer and fuller texture than a double cloth in which the two fabrics are bound directly together, and there is less danger of the colors of one cloth showing through the face of the other. The superior texture of a cloth made with a binding warp is due to the shrink-

age of the wool in the face and back fabrics during the fulling process, which affects the worsted very little, or the cotton not at all, thus causing the worsted or cotton warp to kink enough to allow the face and back fabrics to separate slightly, and in this way cause the extra softness, where in the ordinary double cloth the two fabrics would be firmly felted together.

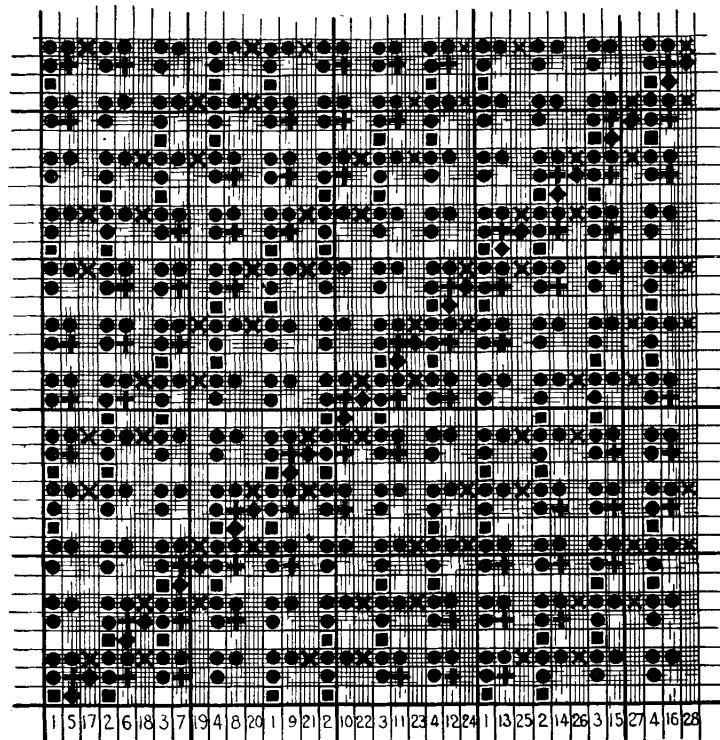


Fig. 218.

A design for this kind of fabric is given at Fig. 219, where the face and back weaves are both the four-harness cassimere twill $\frac{2}{2}$ bound together by first lifting the middle thread over a face pick, and then sinking it under a back pick at such points as meet the proper requirements, at other points it merely floating between the face and back fabrics.

The binding motive is an eight-harness sateen, as indicated by the diamond-shaped marks where the binding threads are lifted