

ELEMENTARY TEXTILE DESIGNING

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ELEMENTARY TEXTILE DESIGNING

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FUNDAMENTAL PRINCIPLES OF DESIGNING

INTRODUCTION

1. In the manufacture of textile fabrics, other than plain, standard goods, no branch of the business is more important than that of **designing**, nor does anything affect the desirability and selling qualities of a fabric more than the design. The material may be costly, the yarn perfect, and the weaving and finishing well executed, but if the design is not well conceived, or is not adapted to the purpose for which the cloth is intended, the fabric will be inferior. The designing of a textile fabric is an operation peculiar to itself and somewhat foreign to the general conception of the term designing, in that the actual construction of the fabric must be considered in order to obtain the desired effect, or design, on its face. In order that the best methods of manufacturing any class of goods may be intelligently understood, it is first of all essential to acquire a thorough knowledge of woven fabrics, since if the results obtained, or in other words the finished cloths, are not understood, it is unreasonable to suppose that the reasons for the processes through which the yarns pass before becoming cloth can be intelligently comprehended. The person who can take a small sample of cloth and reproduce it in the loom or who can originate a

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design of merit with only the necessary yarns and mechanisms with which to work, even if this work is not in his direct line, has a great advantage over a person who cannot. Designing may be said to be as old as weaving, since no cloth can be produced unless the manner in which the ends are drawn through the harnesses, the order of raising the harnesses, and the order of interlacing these ends with the filling are known.

Cloth analysis, or the process of finding the method of construction employed in a fabric, and designing, which strictly speaking, is the process of originating new fabrics, are studies that are closely allied, and the benefit derived from a close study of the structure of the various fabrics frequently met with cannot be overestimated.

WEAVE

2. Construction of Fabrics.—All woven fabrics are constructed of two series of yarns; namely, the *warp*, which is the system of parallel threads running lengthwise of the goods, and the *filling*, which is the system of parallel threads running across the cloth at right angles to the warp. A single thread of the warp is known as a *warp end*, or simply an *end*, and a single thread of the filling is known as a *pick*. By the weaving process the picks of the filling are interlaced with the ends of the warp so as to produce a woven fabric of a texture depending, to a great extent, on the method of interlacing.

3. Plain Weave.—The simplest method of interlacing the warp and filling is by that system known as *plain weave*. Fig. 1 is a diagrammatic view of a plain woven fabric, in which the threads shown in a vertical position are the warp ends, while those running from side to side are the picks of filling. If this diagram is examined closely, it will be noticed that one pick of filling is over all the odd-numbered ends of the warp and under all the even-numbered ends, while the next pick of filling interlaces with the warp ends in reverse order. This method of interlacing the warp and

filling is the simplest that can be devised, and is therefore called the **plain weave**.

It should be understood, however, that the interlacing of the warp and filling is not the same in all cloths; in fact, it is by changing the manner of this interlacing that different effects are formed.

4. **Design Paper.**—Since there are many methods of interlacing the warp and filling, some system must be employed to represent these methods, or *weaves*, on paper.

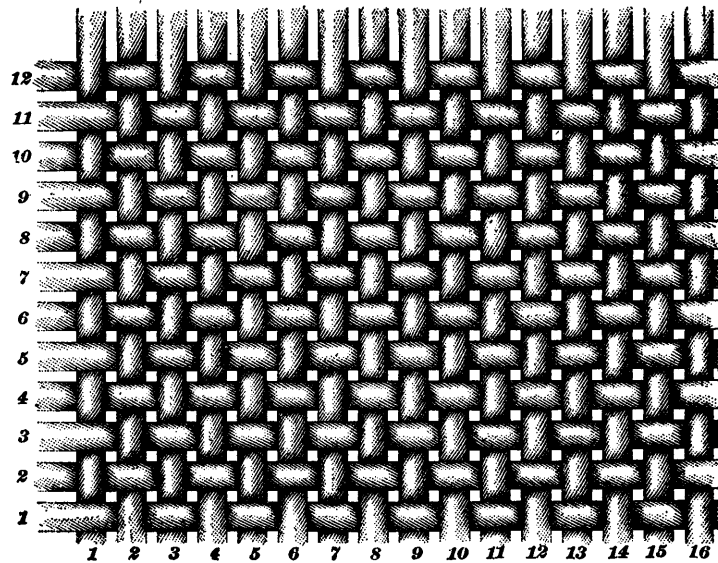


FIG. 1

The one universally used employs an especially ruled paper, shown in Fig. 2, known as **design paper**. It is made in several styles but the kind commonly used is shown at (a); the others are used in special cases. The common form of design paper is divided by heavy lines into blocks of eight rows of squares each way. Each vertical row of squares of the design paper represents a warp end, and each horizontal row, that is, those that run from side to side, represents a pick of filling. It should be thoroughly understood that it

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is not the lines but the rows of squares enclosed by these lines that represent the ends and picks; thus in Fig. 2 (a) there are 8 ends and 8 picks represented in each part marked

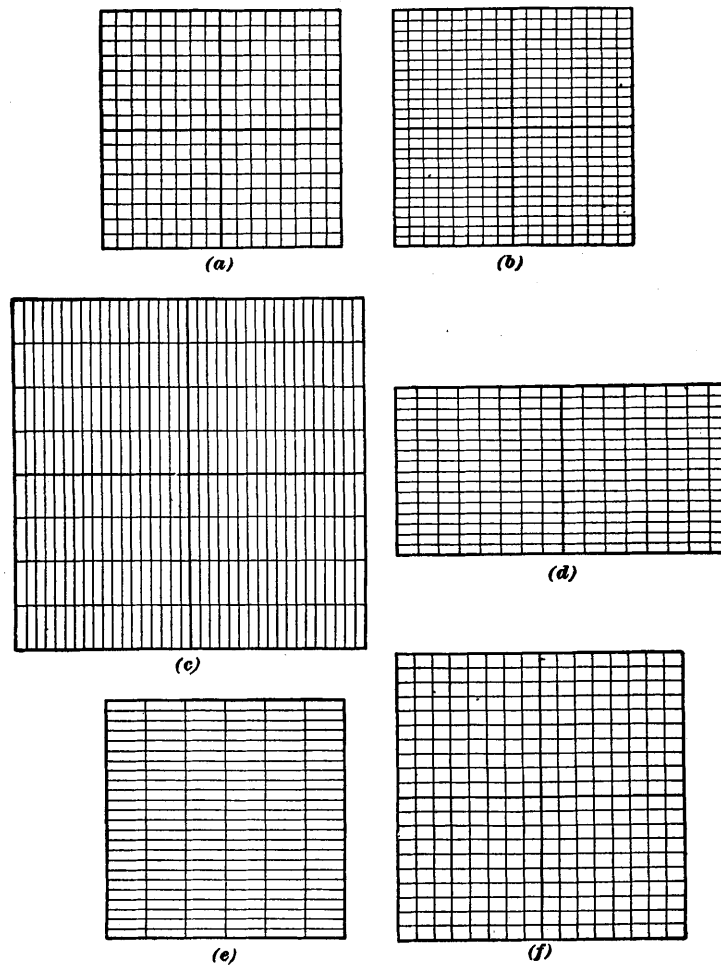


FIG. 2

off by the heavy lines. This is the method of designating different design paper; that is, by giving the number of ends and picks that are shown in the square marked off by the

heavy lines. In speaking of design paper the number of ends represented is always given first, followed by the number of picks represented. Thus (*a*) is called 8×8 design paper; (*b*) is 8×12 ; (*c*) is 18×4 ; (*d*) is 8×16 ; (*e*) is 6×24 ; and (*f*) is 8×10 .

METHOD OF INDICATING A WEAVE ON DESIGN PAPER

5. The interlacing of the warp and filling, or the weave, is indicated by marking or filling in certain squares of the design paper while others are left blank. When a square is marked, it indicates that the warp end represented by that vertical row of squares is lifted at that point and that the pick of filling represented by the horizontal row of squares is underneath the warp end; for instance, if the square on the first end and first pick is marked, it indicates that the first end is raised over the first pick. When a square is left blank, it indicates that the warp end represented by that vertical row of squares is lowered at that point and that the pick of filling represented by that horizontal row of squares is over the warp end; for instance, if the square on the first end and first pick is left blank it indicates that the first end is lowered under the first pick. The fact that marked squares always mean warp up and blank squares filling up, should be firmly fixed in mind.

The warp ends are drawn through harnesses, so that when a harness is raised the warp ends drawn through it are raised and lifted over the filling; whereas, when a harness is lowered the warp ends drawn through it are depressed under the filling. Consequently, whenever a square on the design paper is filled in, it shows that the harness through which that end is drawn is lifted; and, on the other hand, when a square is left blank, it shows that the harness through which that warp end is drawn is lowered.

6. The representation on design paper of the interlacing of the warp and filling is known as the weave. Fig. 3 is a diagrammatic view of a cloth woven with the plain weave and also illustrates the method of representing the weave on design paper. Dealing first with (*a*) and (*b*) only, (*a*) shows

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the way the ends and picks of the cloth are interlaced, while (b) shows the weave.

It must constantly be borne in mind that each vertical row of squares represents a warp end, while each horizontal row represents a pick of filling. The lines drawn from (a) to (b) show which warp end each vertical row of squares

represents; the ends are numbered 1, 2, 3, 4, 5, and 6 at the bottom.

By following the ends from (a) to (b), it will be seen that when they are up, as shown in (a), the corresponding squares in (b) are filled in, and on the other hand when the ends are down, the cor-

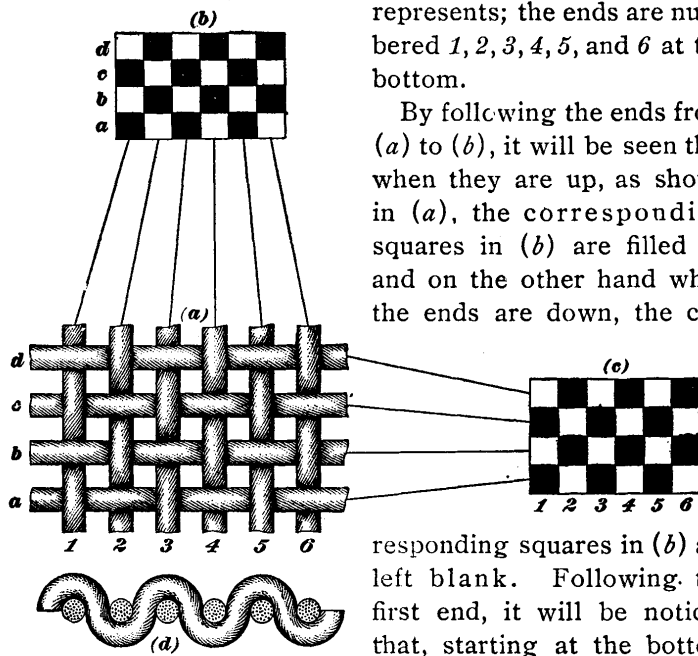


FIG. 3

responding squares in (b) are left blank. Following the first end, it will be noticed that, starting at the bottom of (a), this end is over the

first pick *a*; therefore, the first square at the bottom of the row of squares representing this end, as shown in (b), is filled in. Continuing with this same end, it will be seen that it is under the next pick *b*; therefore, in (b) the next square above the one previously marked will be left blank. Still continuing with this end, it will be seen that it is over the next pick *c*; therefore, the next square above in (b) is filled in. The end now passes under the next pick *d* in (a) and is shown by leaving the corresponding square in (b) blank. Following the next end 2 in the same manner, it will be seen that it is under the pick *a*, over *b*, under *c*, and over *d*. If the

vertical row of squares, in (*b*), that represents this end is now examined, it will be seen that wherever this end is up, the square is filled in, and wherever it is down, the square is left blank. Thus, the weave is shown in (*b*), and if each end is examined in the same manner it will be seen that the interlacing of each end in (*a*) is correctly shown in (*b*).

It should be noticed that when the interlacings of the warp ends are shown in this manner, the interlacings of the filling must necessarily also be shown, since when a square is filled in it not only shows that the warp end is up at that point but also indicates that the filling at that point is under the warp; and when a square is left blank it not only shows that the warp end is down at that point but also that the filling is over the warp end. Therefore, when the ends have been shown on design paper, the picks also have been shown, and consequently (*b*) shows where the filling is up and where down in the same manner as it shows where the warp is up and where down. That this is so may be seen by referring to (*c*), which is exactly the same as (*b*) except that in this case the lines are drawn from the picks in (*a*) to the rows of squares in (*c*) that represent the respective picks. If the picks are followed from (*a*) to (*c*) in the same manner as the ends were followed from (*a*) to (*b*), it will be seen that (*c*) shows the interlacings of the picks. Therefore, since (*b*) is the same as (*c*), either will show the weave of the cloth equally well.

In Fig. 3, (*d*) is a method of showing the interlacing of one pick of filling with the warp and represents the manner in which either of the picks *b* and *d* interlaces with the warp ends, the curved line showing the pick of filling and the circles, sections of the warp ends. As shown, the pick is over the first and under the second warp end, etc.

7. Another very important point to be noticed in this connection is that every other end is alike and every other pick is alike. By examining Fig. 3 (*a*) it will be seen that the first, third, and fifth ends are alike and also that the ends marked *2*, *4*, and *6* are similar to each other, while the picks marked *a*

and *c* are alike as also *b* and *d*. From this it will be seen that in the case of a plain weave it requires only 2 ends and 2 picks to show the manner in which all the ends and picks interlace. Or, in other words, 2 ends and 2 picks show one

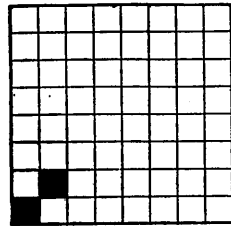


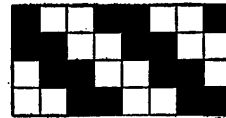
FIG. 4

repeat of the weave, all the other ends and picks being simply repetitions of these 2 ends and 2 picks. Fig. 4 shows one repeat of the plain weave represented on design paper.

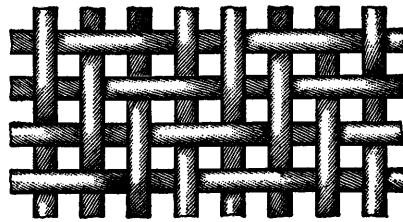
All weaves repeat on a certain number of ends and picks. It need not necessarily be two ends and two picks, nor is it necessary for the ends to repeat on

the same number as the picks, but each must repeat at some time. To illustrate this point further Fig. 5 is given; (a)

shows a weave on design paper; (b) shows the manner in which the ends and picks interlace; and (c) shows one of the picks interlacing with the warp ends. If each end in (b) is compared with the representation of the corresponding end in (a), it will be seen that (a) is the weave of (b). When speaking of the first end of a weave, the one at the extreme left is always intended, while the first pick is the one at the bottom; the first end and first pick are



(a)



(b)



(c)

FIG. 5

represented in all cases by the square in the lower left-hand corner. Referring to (a), notice carefully the interlacings of each end. It will be seen that the first, second, third, and

fourth are all different, but that the fifth is like the first, the sixth is like the second, the seventh is like the third, and the eighth is like the fourth. If more ends were shown they would repeat in the same manner; therefore, it will be seen that this weave is complete on 4 ends and that at (*a*) and (*b*) two repeats are shown. If more picks were shown the fifth pick would be like the first, and so on; therefore, the weave is complete on 4 picks. Consequently, one repeat of this weave occupies 4 ends and 4 picks. With every weave, the number of ends and picks that constitutes a repeat should be carefully determined.

HARNES DRAFT

8. Every end in the warp that interlaces with the filling differently from the others must be drawn through a separate harness in the loom, but every end in the warp that works in a manner similar to some other end may be drawn through the same harness as that other end, provided that it is drawn in its regular order. Thus in the case of the plain weave, if every even-numbered end is drawn through one harness and every odd-numbered end is drawn through another harness and these two harnesses are made to rise and fall alternately, or first one and then the other is lifted, and a pick of filling passed through each opening, cloth similar to that shown in Fig. 1 will be formed.

The method, or order, of drawing each end of a weave through the loom harnesses is usually indicated on design paper by means of a draft, generally called the **harness draft**, but frequently designated as the **drawing-in draft**. This is best indicated with figures, but may be shown by means of crosses, dots, etc. In Fig. 6, (*a*) shows the plain weave extended on 8 ends, while (*b*) shows the harness draft—that is, through which harness each end is drawn. The number over each end in the weave (*a*) indicates the number of the warp end. It will be seen that the first end is drawn through the first harness, as shown in the harness draft (*b*), while the second end, as it interlaces with the filling differently from the first, must be drawn through a separate harness, or

the second, as shown; the third end in the weave works like the first and therefore can be drawn through the same harness

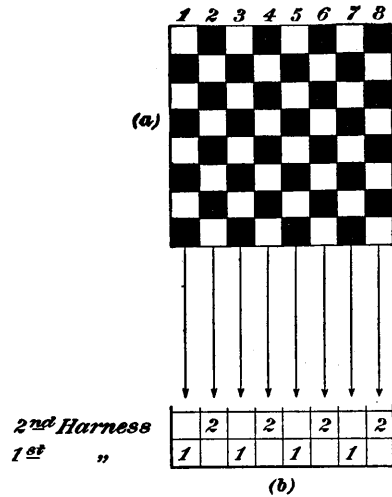


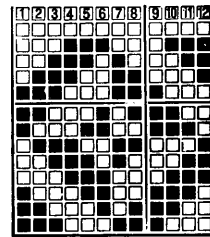
FIG. 6

as the first end; the fourth end works like the second and is consequently drawn through the same harness as the second. Thus it will be seen that the first end is drawn through the first harness and the next through the second, and that throughout the weave and the warp every alternate end is drawn through the same harness. The harness draft is simply a draft showing the person who draws in the warp ends through which har-

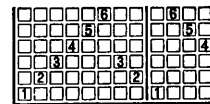
ness each end of the warp is to be drawn, being so constructed that ends having the same interlacings are drawn on the same harness. Harness drafts are generally constructed for only one repeat of the weave, since all other ends are drawn in similarly to the ends in that repeat. Consequently, in making out the harness draft for the plain weave only the first two ends need be shown; therefore, the first two ends in the harness draft, Fig. 6 (b), show the manner of drawing in all the ends of the warp.

9. The derivation of the harness draft for the plain weave, although a typical example of the method employed with all weaves, is comparatively simple; hence,

to illustrate further this method another example is given in Fig. 7, where (a) shows a weave and (b) shows the harness



(a)



(b)

FIG. 7

draft. By noticing the weave it will be seen that the first 6 ends interlace with the filling differently; therefore, they must all be drawn through separate harnesses. This is done in the harness draft (*b*), which shows the first end drawn through the first harness, the second end drawn through the second harness, the third end drawn through the third harness, and so on up to the sixth end, which is drawn through the sixth harness. The seventh end of the weave is like the third and can therefore be drawn through the same harness. One point to be noted is that in making out a harness draft each row of squares running across the paper represents a harness. Therefore, when making out a harness draft, as each end is indicated, the number showing through which harness it is to be drawn must be placed in the horizontal row of squares representing that harness. Thus in this case, the number 3, which shows that the seventh end is drawn through the third harness, is placed in a square that will represent the seventh end and also the third harness, as shown. Continuing with the ends in the weave, it will be seen that the eighth end is exactly like the second; therefore, it can be drawn through the same harness as the second end, or the second harness, as shown. The ninth end is exactly like the first end; therefore, it is drawn through the same harness as the first end, which is the first harness. The tenth end is like the sixth, the eleventh like the fifth, and the twelfth like the fourth; therefore, the tenth end is drawn through the same harness as the sixth end, which is the sixth harness, the eleventh end through the fifth harness, and the twelfth end through the fourth harness, as shown in the harness draft.

CHAIN DRAFT

10. After the harness draft has been made to show the method of drawing in the warp ends, a plan must be made to show how, or in what order, the harnesses must be lifted so that the ends drawn through them will interlace with the filling according to the desired weave, or in other words a plan showing which harnesses are to be raised and which lowered

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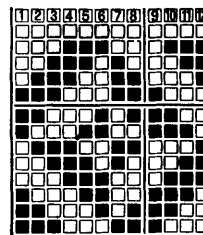
on each pick. This plan is known as the **chain draft** and is obtained from the weave and harness draft as follows: Referring to Fig. 6, it will be seen that the first end has been drawn through the first harness and that all the ends working like the first end have been drawn through that harness; so that if the first harness is raised and lowered in the order indicated by the first end of the weave, all the ends drawn through that harness will be raised and lowered in the same manner and will therefore interlace with the filling in the same way. The second end has been drawn through the second harness and also all the ends that work in a manner similar to the second; consequently, if the second harness is raised and lowered in the same order as that indicated by the second end of the weave, all the ends drawn through that harness will interlace with the filling in a similar manner.

The marks and blanks on the first end of the weave, as shown in (a), Fig. 6, indicate the manner in which that end is to be raised or lowered; consequently, by raising the harness through which that end is drawn, or the first harness, in the same manner as the first end is raised, all the ends drawn through that harness will be raised and lowered in their proper order. The marks and blanks on the second end of the weave indicate the manner in which that end must be raised and lowered; consequently, by raising the harness through which that end is drawn, or the second harness, in the same manner as the second end is raised, all the ends drawn through that harness will be raised and lowered in their proper order. This includes all the ends in the warp that work differently, and consequently two harnesses are all that are necessary to produce this weave.

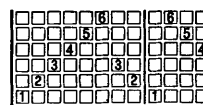
The manner of lifting and lowering the harnesses, or in other words the chain draft, is indicated on design paper by means of blank and filled-in squares, each filled-in square indicating that a harness is raised, while each blank square shows that a harness is lowered. To make a chain draft from the weave and harness draft, commence with the first end and copy the interlacings of each end in one repeat of the weave that is drawn in through a separate harness as indicated by

the harness draft, placing these interlacings of the ends in the same relative position that the harnesses through which they are drawn occupy.

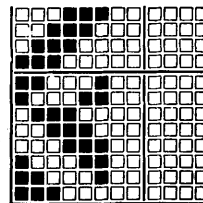
Fig. 4 shows one repeat of the weave shown by the diagram Fig. 1, and since the first end is drawn through the first harness, the interlacings of the first end must be copied to show the manner in which this harness should be raised and lowered. The second end is drawn through the second harness; therefore, to show the workings of this harness the interlacings of this end, as shown in Fig. 4, must be copied. When this has been done it will be noticed that the chain draft is similar to the weave as shown in Fig. 4; therefore, this figure can be used to indicate the chain draft as well as to show the weave.



(a)



(b)



(c)

FIG. 8

11. To illustrate further the method of obtaining the chain draft from the weave and harness draft, a chain draft is made for the weave and harness draft shown in Fig. 7. In Fig. 8, (a) represents one repeat of the weave; (b) shows the harness, or drawing-in, draft; and (c) shows the chain draft. The significance of the rows of squares in each figure should be carefully noted. In (a), each vertical row of squares represents one end; each row of squares across the design paper, one pick; and each filled square, an end raised over a pick. In (b), each vertical row of squares represents one end, the same as in (a), but each row of squares across the design paper represents one harness, and each number the harness through which that particular end is drawn. In (c), each vertical row of squares represents the working of one harness, or in other words the order of raising and lowering the harness, while each row across the design paper represents one pick, or

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one bar of the chain that is placed on the loom to govern the operation of the harnesses.

To make a chain draft from a weave it is simply necessary to copy the interlacings of those ends that are drawn on separate harnesses. Therefore, in order to ascertain the number of ends that any chain draft will require it is only necessary to find the number of harnesses that the drawing-in draft occupies. By referring to Fig. 8 (*b*), it will be seen that 6 harnesses are used, and thus only six vertical rows of squares, representing the 6 ends of the weave that have different interlacings, will be required for the chain draft. In copying the interlacings of those ends that are drawn on separate harnesses, since the first end is drawn through the first harness, the first harness shown in (*c*) is marked the same as the first end shown in (*a*). The second end is drawn through the second harness, and consequently the second harness shown in (*c*) is marked the same as the second end shown in (*a*). This method is continued with the first 6 ends, all of which are drawn through separate harnesses. The seventh end of the weave is drawn through the third harness, but since the working of this harness has already been set down, it must not be marked again. The same can be said of the rest of the ends, all of which work in a manner similar to some one of the first 6 ends. Therefore, the chain draft is complete as shown in (*c*).

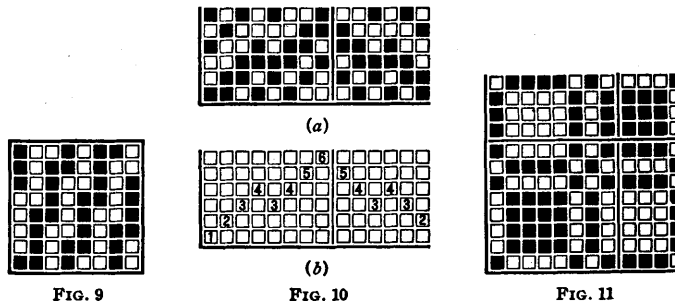
12. The expression **chain draft** is derived from the harness chain used on a woolen or worsted loom, which consists of bars on which rollers, or *risers*, and washers, or *sinkers*, are placed, each bar selecting the harnesses to be raised for 1 pick. With most woolen and worsted looms a roller raises the harness and a sinker causes it to be lowered; thus, wherever a mark is placed in a square of the chain draft, a riser is placed on the harness chain, which will cause that harness to be raised, and wherever a blank square is left in the chain draft, a sinker is placed on the harness chain, which will cause that harness to remain down. The construction of some woolen and worsted looms is such that

the reverse of this statement is true (namely, a roller on the harness chain lowers the harness, while a washer causes it to be raised), so that a mark on the chain draft indicates a washer on the harness chain and a blank square a roller.

The term **pegging plan** is also often used for chain draft, because the pattern chain commonly used on a cotton dobby loom consists of wooden bars into which pegs are inserted. When a square is marked on the chain draft, a peg is inserted in the bar and the harness is raised; when the square is blank, the bar has no peg and the harness remains down.

EXAMPLES FOR PRACTICE

1. Give the drawing-in draft for Fig. 9.
2. Give the chain draft for Fig. 9 to correspond with the drawing-in draft shown in answer to question 1.



3. Fig. 10 (a) and (b) shows a weave and drawing-in draft; give the chain draft to correspond with the drawing-in draft.
4. Give the drawing-in draft for the weave shown in Fig. 11, placing all ends that work alike on the same harness.
5. Give the chain draft for Fig. 11 to correspond with the drawing-in draft shown in answer to question 4.

THE EFFECT OF THE WEAVE

13. The weave, harness draft, and chain draft have thus far been explained in connection with specific cases, but these subjects will now be dealt with in a more general way. The weave may be said to influence the build of the fabric; for instance, if the interlacings of the different ends are not equally balanced, that is, if all the ends in one repeat of the weave do not interlace about the same number of times, it will be impossible to obtain a regular and uniform cloth. Fig. 12 shows a weave that will serve to illustrate this point.

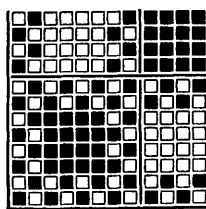


FIG. 12

By examining this weave it will be noticed that the first, second, seventh, and eighth ends make twelve interlacings, while the remaining ends make only four interlacings in one repeat of the weave. A warp end is said to interlace, or to make one interlacing, each time that it passes through the cloth from the face to the back or from the back to the face; that is, an interlacing is made each time that the warp end is raised over, or depressed under, one or more picks. In the same way a pick is said to make an interlacing each time that it passes over or under one or more warp ends. Those ends and picks that make the greater number of interlacings will naturally be woven tighter than those that make fewer interlacings; therefore, with such a weave as is shown in Fig. 12 it is not possible to produce a level cloth. This weave is known as a *honeycomb*, and a level cloth is not desired but rather one with a honeycombed effect.

The number of interlacings in a weave affects the length of warp required to weave a given length of cloth. For example, if cloths having the same number of picks per inch and the same counts of yarn were woven with the weaves shown in Figs. 3 and 5, the cloth made with the weave in Fig. 3 would require a longer warp than that woven with the weave shown in Fig. 5, if the same number of yards of each cloth were desired. This may be demonstrated by taking a

piece of thread and interlacing it two or three times between the fingers of one hand, having the thread pass over one finger, under the next, over the next, and so on, noting the length of thread that is taken up, and afterwards passing the thread back and forth again the same number of times but having it pass over two fingers and under two fingers, when the difference in the lengths required in the two operations may be noticed. It will be found that the length of the thread increases with the interlacings. It is exactly the same principle that necessitates a longer warp when there are more interlacings of the ends and picks. The interlacings also affect the number of ends and picks that can be placed in 1 inch of the cloth; the general rule being that the greater the number of interlacings, the smaller is the number of ends or picks that can be crowded together.

The weave also affects the appearance of the cloth, since it is possible to produce a great many patterns in woven fabrics by simply changing the method of interlacing the warp and filling, no variety of colors or yarns being needed. Again, a weave may be used in a figured design that will influence the development of the details of the pattern; for instance, it may be desired to have a certain effect or to bring certain colors to the face of the cloth in some parts of the design.

STANDARD TYPES OF HARNESS DRAFTS

14. Straight Drafts.—The simplest method of drawing the warp ends through the harnesses is that employed with the plain weave. As previously explained, in this weave there are only 2 ends in one repeat of the weave and they are drawn through 2 harnesses, first an end through one harness and then the next end through the other harness, and so on. This method of drawing in the warp ends is a standard method and is known as the *straight draft*. A **straight draft** is not confined to 2 harnesses, but may be defined as a draft in which the ends are drawn through the harnesses in regular order from front to back. To illustrate this, suppose that a weave occupied 10 harnesses instead of 2 harnesses and that the

ends were drawn straight from the front harness to the back harness. Then the first end would be drawn through the first harness, the second end through the second harness, the third end through the third harness, and so on, ending with the tenth end, which would be drawn through the tenth harness. The draft would then commence another repeat with the first harness again, and the next, or eleventh, end would be drawn through that harness, the twelfth end would be drawn through the second harness, and so on. The harness draft is repeated in this manner until all the ends in the warp have been drawn in. It will be noted here that when the

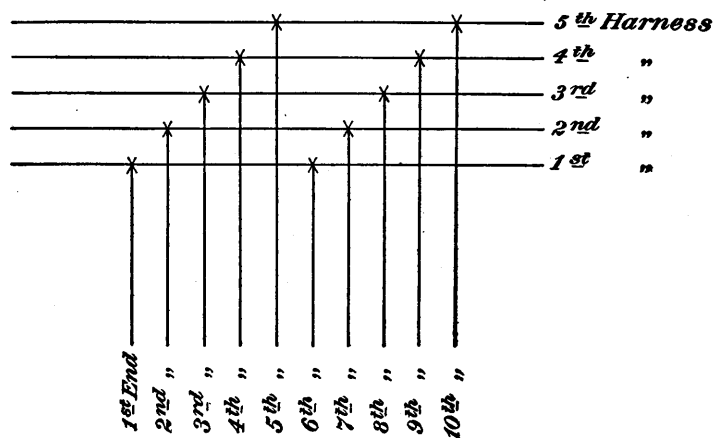


FIG. 13

warp is actually being drawn through the harnesses it is more convenient to read the drawing-in draft in reverse order, that is, from right to left, commencing on the right of the harnesses and drawing from back to front; however, this will not affect the result in the least.

Fig. 13 shows two repeats of a straight drawing-in draft on 5 harnesses and also illustrates another method of representing the harness draft, the lines running across the page representing the harnesses, the vertical lines indicating the warp ends, and the crosses showing through which harness each warp end is drawn. In Fig. 13, the first end is drawn

through the first harness, the second end through the second harness, and so on up to the fifth end, which is drawn through the fifth harness, whereupon the draft commences to repeat, that is, the next end, which is the sixth, is drawn through the first harness, the seventh end is drawn through the second harness, and continues in this manner up to the tenth end, which is drawn through the fifth harness. Here the harness draft commences to repeat again and the next end, which is the eleventh, if it were shown, would be drawn through the first harness.

15. Point Drafts.—Another method of drawing in warps that is used quite extensively is known as the *center*, or *point*, *draft*. In **regular point drafts**, the ends are drawn from the front to the back harness and then the order of drawing in is reversed; that is, after drawing in the end in the back harness the next end, instead of being drawn on the front harness as in the straight draft, is drawn through the next to the back harness and the

ends then drawn in regularly from back to front. Fig. 14 is an illustration of a regular point draft on 8 harnesses in which the first end is drawn through the first harness, the second end through the second harness, and so on up to the eighth end, which is drawn through the eighth harness. The next, or ninth end, instead of being drawn through the first harness, as in a straight draft, is drawn through the next to the back, or the seventh, harness and the ends then drawn in from back to front, or in reverse order, the fourteenth end being drawn in through the second harness. The draft commences to repeat here.

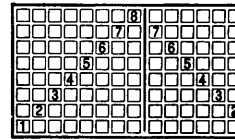


FIG. 14

With a point draft it should be carefully noted that the last end of the repeat should always be drawn through the second harness, that is, if the draft is commenced on the first harness, and that the drawing-in draft should never commence and end with the same harness. It should also be noticed that a regular point draft is always complete on a

number of ends that is two less than twice the number of harnesses employed. Thus, in Fig. 14, the draft occupies 8 harnesses, and one repeat is complete on 14 ends, which is according to the rule, as follows: $2 \times 8 = 16$; $16 - 2 = 14$, the number of ends on which one repeat of the draft is complete.

Another type of point draft, illustrated in Fig. 15, is known as the **irregular point draft**. In these drafts the ends are drawn through the harnesses straight for a certain number of times and then reversed as in a regular point draft; thus in Fig. 15,

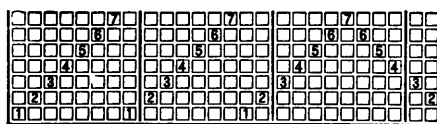


FIG. 15

for example, the ends are drawn in straight on 7 harnesses three times and then reversed. It will be noticed that the last end of the repeat is drawn through the second harness, as previously explained. Still another type of irregular point draft is illustrated in Fig. 16. The method adopted in this case is that of drawing the ends straight for a certain number of harnesses and then reversing, but only running the ends

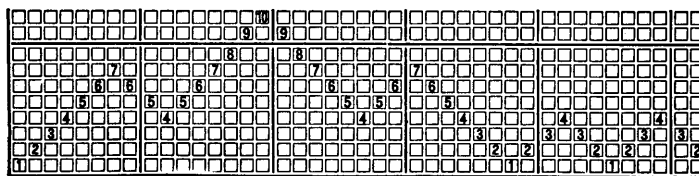


FIG. 16

for a few harnesses, when they are again run straight and again reversed, etc. It will be noticed that a repeat of the draft occupies 10 harnesses and 42 ends, and also that the last end of the repeat is drawn through the second harness.

16. Angled Drafts.—In the method of drawing in the warp ends known as the **angled draft** they are drawn straight for a certain number of harnesses and then reversed, but instead of the reversing starting with the next to the back harness as in the point draft, it is started on an intermediate

harness, generally half way between the first and last harnesses, but depending somewhat on the chain draft that is to be used. Fig. 17 shows an angled draft on 8 harnesses in which the first 8 ends are drawn straight and the method of drawing in then reversed, but instead of commencing with the seventh harness and drawing the ninth end through that harness as in a regular point draft, the ninth end is drawn through the fourth harness, the tenth end through the third harness, and so on until an end has been drawn through each harness, which completes one repeat of the draft.



FIG. 17

17. Skip Drafts.—The skip draft may be considered as a straight draft drawn in sections with one or more harnesses skipped between the sections. Fig. 18 shows a skip draft on 4 harnesses in which the first section of 4 ends is drawn in straight; then 1 harness is skipped and the next section of 4 ends drawn straight, then another harness skipped and the next section drawn in straight, and so on. Thus it will



FIG. 18

be noticed that the fourth end is drawn in on the fourth harness, but the fifth instead of being drawn in on the first harness as in the straight draft, is drawn in on the second harness. In the same way the eighth end is drawn in on the first harness, but the ninth, instead of being drawn in on the second, is drawn in on the third, and so on. It will be noticed that this draft repeats on 16 ends, since if it were continued the seventeenth end would be drawn in on the first harness, as the fourth would be skipped. Thus the seventeenth end would be the first end of the next repeat of the draft. In the draft shown in Fig. 18 only 1 harness is skipped between the sections, but it is perfectly feasible to skip any desired number

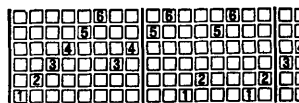


FIG. 19

In Fig. 19 a skip draft on 6 harnesses is shown in which 2 harnesses are skipped between the sections. In this draft the first 6 ends are drawn in straight, but the seventh end skips 2 harnesses and starts on the third, while the thirteenth end, instead of being drawn in straight, skips 2 harnesses and begins on the fifth. In this draft there are really three sections and the draft repeats on 18 ends, since the nineteenth end, if shown, would start on the first harness, the fifth and sixth being skipped.

18. Satin Drafts.—Satin drafts are really adaptations of the skip-draft principle in which harnesses are skipped between the ends instead of between sections of ends. Thus in the 5-harness satin draft shown in Fig. 20, the first end is drawn in on the first harness; the second end is drawn in on the third harness, skipping the second harness; the third end is drawn in on the fifth harness, skipping the fourth harness; the fourth end is drawn in on the second harness, skipping the first harness;



FIG. 20

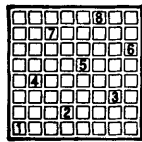


FIG. 21

and the fifth is drawn in on the fourth harness, skipping the third harness. In this satin draft only 1 harness is skipped between the ends, but in the 8-end satin draft shown in Fig. 21, 2 harnesses are skipped between the ends; thus, the first end is drawn in on the first harness; the second end on the fourth harness, skipping the second and third harnesses; the third end on the seventh harness, skipping the fifth and sixth harnesses; the fourth end on the second harness, skipping the eighth and first harnesses; and so on. It will be noticed that satin drafts repeat in the same manner as the skip drafts; thus in Fig. 20 the sixth end would be drawn in on the first harness, the fifth harness being skipped between the fifth and sixth ends, and in Fig. 21 the ninth end would be drawn in on the first harness, skipping the seventh and eighth harnesses between the eighth and ninth ends.

19. Section Drafts.—A section draft may consist of any one or more of the foregoing styles of drafts arranged so

as to be repeated in sections throughout the width of the cloth. Thus Fig. 22 shows a section draft on 12 harnesses, and as indicated by the brackets the method of drawing in the first section of 4 ends is to be repeated three times, and the method of drawing in the second and third sections of 4 ends is to be repeated the same number of times. Thus, it will be seen that this is really a short method of indicating a comparatively large draft, since if this draft were extended fully as indicated, it would occupy 36 ends, as shown in Fig. 23. This section draft is simply an amalgamation of straight drafts in sections, but it is not necessary to use

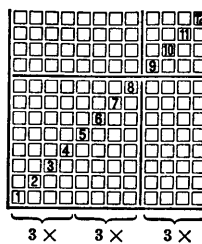


FIG. 22

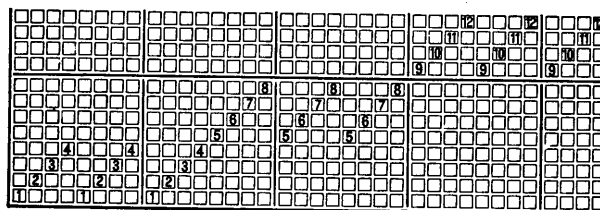


FIG. 23

straight drafts, since angled, skip, or satin drafts may be extended in sections in the same manner.

EFFECTS OF THE HARNESS AND CHAIN DRAFTS

20. That different drawing-in drafts will give widely different results in the cloth, even if the same chain draft is used, is readily apparent. The effect that will be produced in a cloth by any harness and chain draft may be easily ascertained by simply copying the interlacings of each end of the chain draft in the order indicated by the harness draft. The effect is practically the weave, and consequently finding the effect when the harness and chain drafts are given is simply the reverse of finding the harness and chain drafts when the weave is given.

To illustrate this, suppose that Fig. 24 is a chain draft for a weave and that the ends are drawn in straight on 8 harnesses; then the effect in the cloth will be exactly like the chain draft, since the first end will work like the first harness of the chain draft, and consequently the interlacings of that end will correspond to the rising and falling of that harness. Since the second end works like the second harness and so on throughout the draft, the effect will be exactly like the chain draft. When a straight harness draft is used, the chain draft is always exactly like the weave; and on the other hand, the effect, or weave, produced by any chain draft with a straight harness draft is always like the chain draft. Suppose that the same chain draft, Fig. 24, is used, but that the harness draft in Fig. 14 is used in place of the straight draft, and it is desired to find the effect that will be produced in the

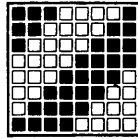


FIG. 24

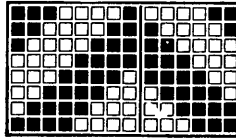


FIG. 25

cloth. As previously stated, the manner in which the harnesses rise and fall, as shown in the chain draft, will give the manner in which the ends drawn through those harnesses interlace with the filling; therefore, if it is desired to learn how a certain end interweaves, it is simply necessary to copy the order of lifting and lowering the harness through which that end is drawn, and since the harness draft shows through which harness any end is drawn, while the chain draft shows when each harness is up and when down, it is possible from these two drafts to tell exactly how each end interweaves. Proceeding in this manner, in order to find the effect produced with Fig. 24 as a chain draft and Fig. 14 as a harness draft, since the first end is drawn through the first harness it will rise and fall with that harness, and consequently the lifting of the first harness as shown in the chain draft represents the manner in which the first end interweaves and is therefore copied for the first end of the effect, as shown in Fig. 25. The second end is drawn through the second harness and the lifting and lowering of

this harness is therefore copied in order to show the interweaving of this end, and so on up to and including the eighth end; but the ninth end is drawn through the seventh harness, and therefore to show the interweaving of this end it is necessary to copy the order of lifting and lowering that harness as shown in the chain draft. Continuing in this manner until the interlacings of all the ends shown in the harness draft have been copied from the chain draft, the effect shown in Fig. 25 is obtained.

21. For another example suppose that the same chain draft is used with the harness draft shown in Fig. 17 and that it is desired to find the effect that will be produced. Fig. 26 shows the effect, and it is hardly necessary to go into any detailed explanation of the manner in which this is obtained

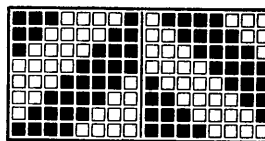


FIG. 26

except to call attention to the ninth end. By noticing the harness draft, Fig. 17, it will be seen that the ninth end is drawn through the fourth harness; therefore, in representing this end in the effect it is necessary to copy the lifting and lowering of the fourth harness as shown in the chain draft. By noticing the effect, Fig. 26, it will be seen that the working of the ninth end is similar to the working of the fourth harness as shown in the chain draft, Fig. 24. The working of the tenth end is similar to the working of the third harness,



FIG. 27

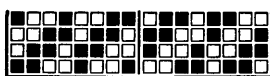


FIG. 28

since it is drawn through that harness; the working of the eleventh end is similar to the working of the second harness, since the eleventh end is drawn through that harness; and, in short, by examining the ends as shown in the effect, Fig. 26, it will be seen that they all work in a manner similar to the harnesses through which they are drawn.

For another example suppose that it is desired to find the weave produced by the skip draft shown in Fig. 18 with the

chain draft shown in Fig. 27. The first section of 4 ends is drawn in straight; therefore, these ends will be the same as the chain draft; then, according to the drawing-in draft, the fifth end is like the second, the sixth is like the third, the seventh is like the fourth, the eighth is like the first, the ninth

is like the third, and so on, as shown by the completed weave in Fig. 28.

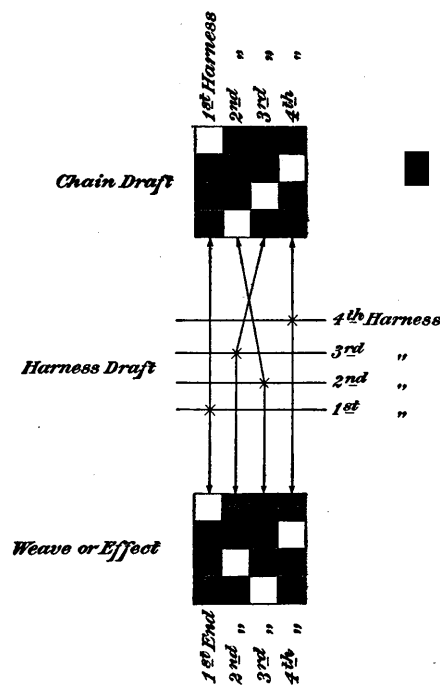


FIG. 29

A final example of the relation between the harness draft, the chain draft, and the effect is shown in Fig. 29. In this figure, the first end, as shown in the harness draft, is drawn through the first harness; therefore, the first end in the weave will be like the first harness in the chain draft. The second end is drawn through the third harness; therefore, the second end in the weave will be like the third harness in the chain draft. The third

end is drawn through the second harness; therefore, the third end in the weave will be like the second harness in the chain draft. The fourth end is drawn through the fourth harness; therefore, the fourth end in the weave will be like the fourth harness in the chain draft.

22. From these explanations, it will be seen that by simply altering the harness draft several effects in the cloth can easily be obtained from one chain draft. On the other hand, it will readily be understood that it is possible to

obtain different effects with the same harness draft by simply changing the chain draft, since if the harnesses are made to rise and fall differently it will of necessity cause the ends drawn through these harnesses also to rise and fall differently, thus changing the manner of interweaving the ends and consequently changing the weave. It should, however, be carefully noted that the chain draft and harness draft must always occupy exactly the same number of harnesses.

POINTS TO BE CONSIDERED WHEN CONSTRUCTING HARNESS DRAFTS

23. As has already been shown, when two or more ends in one repeat of a weave have the same interlacings it is possible to draw such ends through the same harness, but it is not always advisable to do so. It would be possible, if the loom would operate the necessary number of harnesses, to draw each end in one repeat of a weave through a separate harness, or in other words to use a straight draft for every weave, in which case one repeat of the weave would always be the chain draft; but owing to the large number of ends occupied by a single repeat of some weaves, it is not always practicable to do so, and consequently it becomes necessary to draw all or some of the ends working alike through the same harness. However, this is a matter in which a person must use his judgment to a large extent, constantly remembering that the nearer the method of drawing in can be brought to a straight draft, the better it will be for the weaving in every way.

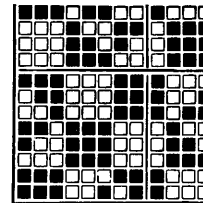


FIG. 30

As an illustration, suppose that the weave shown in Fig. 30 was to be used and that it was desired to make the harness draft. By carefully noting the weave it will be seen that the ninth end works like the third and can therefore be drawn through the same harness as the third end, which is the third harness, and also that the tenth end works like the fourth end

and can therefore be drawn through the harness with the fourth end; thus, the harness draft could be made out as Fig. 31 (a), and woven with 10 harnesses, but it will be

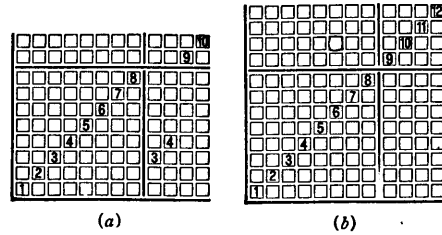


FIG. 31

noticed that by so doing a break is made in the drawing-in draft, which makes it more difficult to draw in the warp and also more difficult for the weaver to draw in any ends

that might break out during weaving. A better plan, therefore, is to draw the ends in straight on 12 harnesses, as shown in Fig. 31 (b).

24. In order that a better understanding of this subject may be obtained, suppose that it is desired to draft the weave shown in Fig. 32 in the most practical manner. Examining this weave, it will be seen that the first 3 ends are entirely different; therefore, the first end will be drawn through the first harness, the second end through the second harness, and the third end through the third harness. Next it will be seen that the fourth end is like the second and therefore can be drawn through the harness with the second end; also that the fifth, sixth, seventh, and eighth ends interlace in a manner similar to the first, second, third, and fourth, respectively, and therefore can be drawn in the harnesses in the same manner as the first four; and so on up to and including

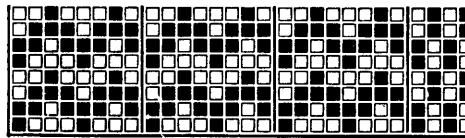


FIG. 32

the twenty-fourth end. It will be noticed that the twenty-fifth end works like the ends drawn through the first harness, while the twenty-sixth works like those drawn through the third harness; therefore, these ends are drawn

through the first and third harnesses, respectively. The twenty-seventh end is similar to the twenty-fifth, and the twenty-eighth is like the twenty-sixth. If the ends are drawn in this manner, the harness draft will be like Fig. 33 and the chain draft like Fig. 34.

As previously stated, however, a harness draft should be made out in such a manner that the design can be woven as easily as possible. It will readily be understood that by placing all the ends on 3 harnesses they are more crowded on one or more of the harnesses



FIG. 33



FIG. 34

than if they were placed on more harnesses. Again, increasing the number of ends in the harnesses always adds to the difficulty the weaver has in drawing in the broken ends, and especially so if the warp contains a large number of ends per inch. Another consideration when drafting is to have as nearly as possible the same number of ends on each harness, for then there will be a uniform strain on the harness motion of the loom; while on the other hand, if some harnesses contain more ends than others, heavy and light lifts are forced on the loom mechanism at different times, and a jerky movement of the loom is generally the result.

By noticing Fig. 33, it will be seen that in one repeat of the drawing-in draft 8 ends are drawn through the first and third harnesses, while 12 ends are drawn through the second harness. As a result of this method it would necessarily take more power to lift the second harness than the first or third. In order to remedy this,



FIG. 35

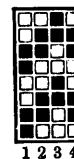


FIG. 36

suppose that instead of drawing the ends as shown in Fig. 33, the first end is drawn through the first harness, the second end through the second harness, the third end through the third harness, the fourth end through the fourth harness, and that this order is repeated until the twenty-fifth end is

30 ELEMENTARY TEXTILE DESIGNING

reached, which is drawn through the first harness, while the twenty-sixth end is drawn through the third harness, the twenty-seventh through the first, and the twenty-eighth through the third. The harness draft for the ends when drawn in this manner is shown in Fig. 35, while Fig. 36 shows the chain draft for this harness draft. It will readily be understood that such an order of drawing in the ends is preferable to that shown in Fig. 33, since the draft is easier for the weaver and drawing-in girl, as well as for the loom.

EXAMPLES FOR PRACTICE

1. Fill 8×8 small squares of design paper with the plain weave and show the harness and chain drafts that would be used if the cloth were to be woven on 4 harnesses with a straight drawing-in draft.

2. A plain cloth is to be woven on 4 harnesses with the first end drawn through the first harness, the second end through the third harness, the third end through the second harness, and the fourth end through the fourth harness; show the chain draft.



FIG. 37 3. Show the effect that would be produced in the cloth by using a regular point draft with Fig. 37 for the chain draft.

4. (a) Show an irregular point draft on 12 harnesses; (b) show the effect that would be produced, using Fig. 7 (a) for a chain draft.