No. 5 1901

Construction of Weaves

A Text Book for Use in Textile Schools and for Designers, Overseers, Loom Fixers, Webdrawers and others.

By

Charles G. Petzold

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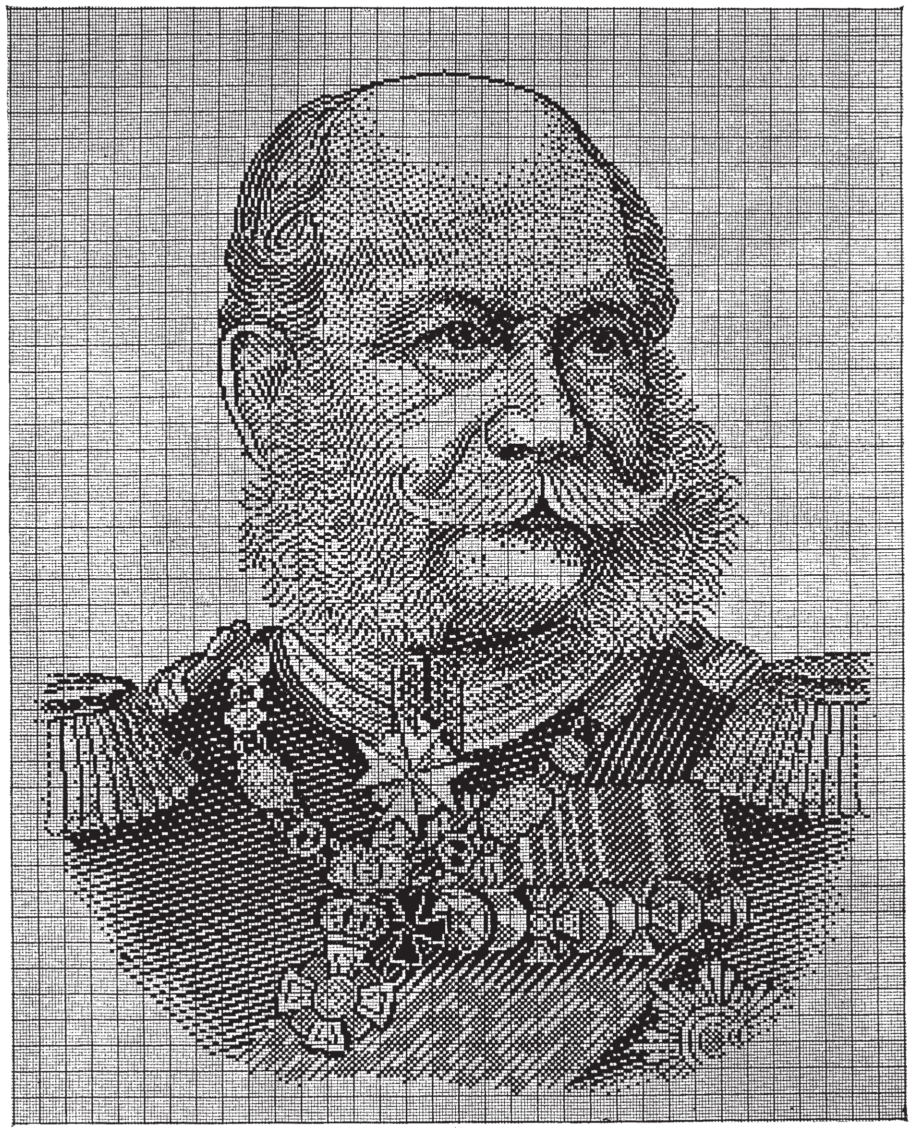
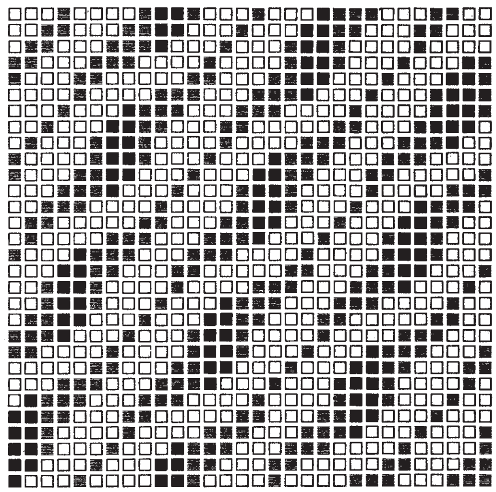


WILLIAM I, EMPEROR OF GERMANY.

DESIGNED AND WOVEN BY CHARLES G. PETZOLD, ARLINGTON MILLS, LAWRENCE, MASS.

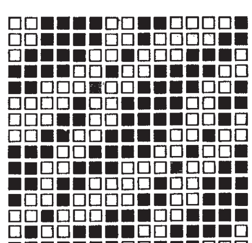
Figure 309 is based on 30 fields each way and divided into ten equal parts. For foundation we have selected the ten-harness sateen position. The design is worked out in the same manner as 307B and 308, and needs no further explanation.

309

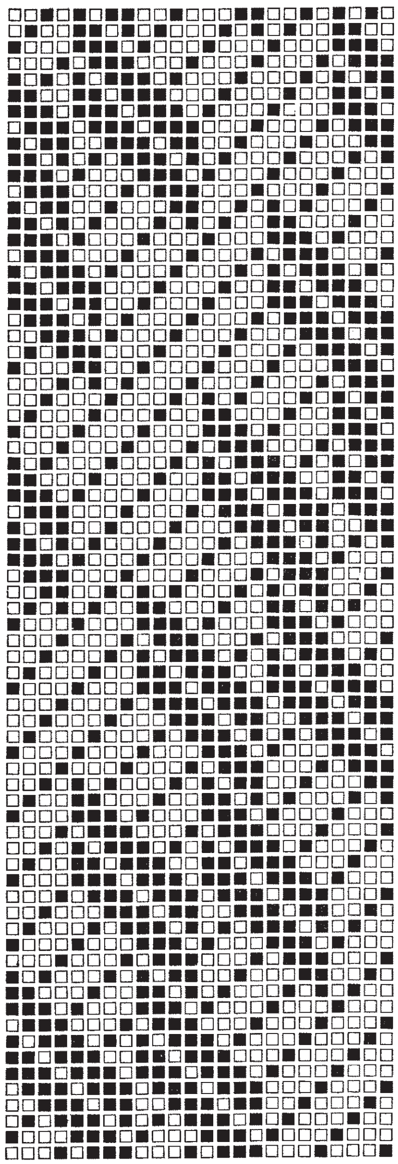


Broken twills, obtained from sateen positions, sometimes require too many harnesses, and ways and means have been found to imitate these weaves on less harness numbers. For example we take figure 310. In figure 310 we use the same twill piece as we have obtained in figure 309, which extends over 15 ends. We now make a cross section of fifteen fields each way and divide into three equal parts. The first twill part we begin on the first pick and end. The second twill part we begin on the eleventh pick and sixth end. The third twill part we begin on the sixth pick and eleventh end, and the result is practically the same as we have in figure 309, but has been produced with only half the harness number.

310



311



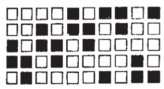
Another example is illustrated with figure 311. Instead of single twill parts we have used twill parts in pairs. The width for this design is 24 ends. The heighth of the design is 72 picks. To ascertain why we need 72 picks, we find the difference in picks of each pair of twill parts, which is 12; then find the difference of ends in each pair of twill parts, which is 4. A difference of four ends is combined with a difference of 12 picks. Four is contained in twenty-four six times—therefore $6 \times 12 = 72$ picks.

Figures 312 to 321 inclusive illustrate another series of broken twills. In these weaves all the twill parts are running in opposite directions. Figure 312 is based on five-harness $\frac{2}{\ }\big|\frac{\ }{3}$ twill, the difference in picks is one for each twill part. $5 \div 1 = 5$ twill parts.

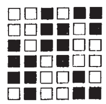
Figure 313 is based on six-harness $\frac{3}{\ }\big|\frac{\ }{3}$ twill; the difference in picks is two for each twill part. $6 \div 2 = 3$ twill parts.

Figure 314 is constructed from six-harness $\frac{3}{\ }\big|\frac{\ }{3}$ twill. The difference in picks is one for each twill part. $6 \div 1 = 6$ twill parts.

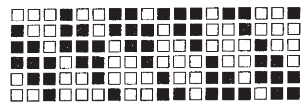
312



313



314



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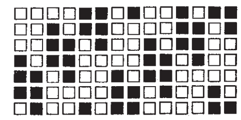

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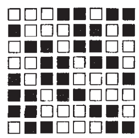

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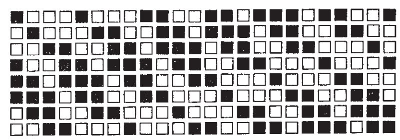
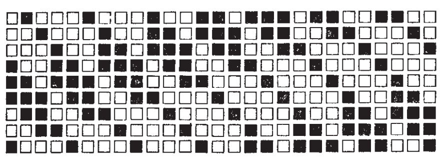


318



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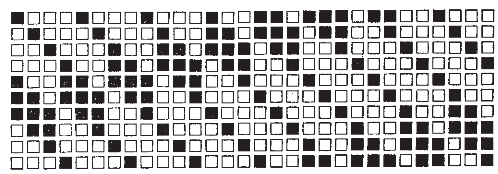

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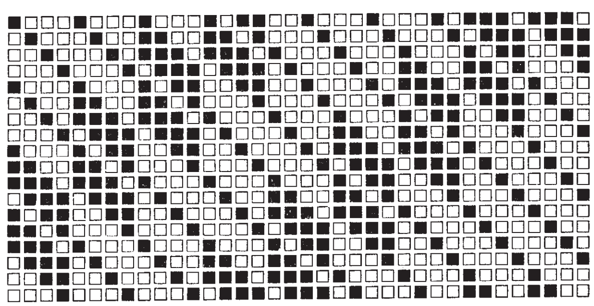


321

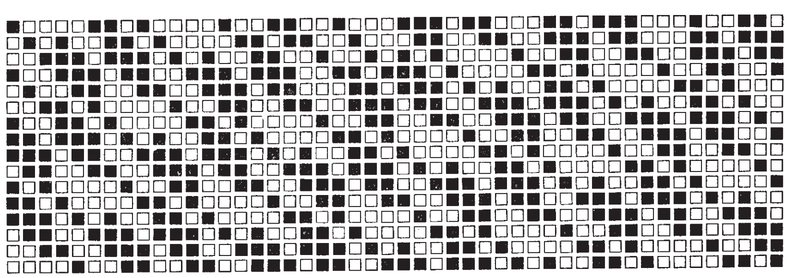
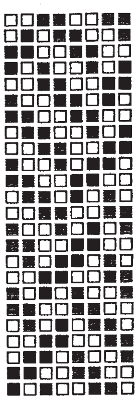


Figure 315 is based on seven-harness $\frac{3|}{|4}$ twill; the difference in picks is two for each twill part; but 7 being not divisible by 2, fourteen ends equal to seven twill parts are necessary for the complete design.

Figure 316 is based on eight-harness $\frac{3|\quad|1|}{\quad|2|\quad|2}$ twill, with twill parts of two ends each; the difference in picks is two $8 \div 2 = 4$. Therefore four twill parts are necessary for the complete design. This twill of the above class is extensively used in all kinds of manufacturing, and is known by the name of Mayo weave. Figures 317, 318, 319, 320 and 321 are worked out on the same principle as figures 312, 313, 314, 315 and 316 and need no further explanation.

Broken Twills in Cross Twill Forms.

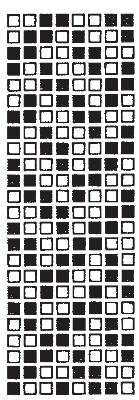
322



This class of cross twills has the appearance of spirals running through the entire fabric and shows their value to great advantage if the cloth is made with two distinct colors in warp and filling.

Examples are illustrated with figures 322 to 331 inclusive. In figure 322 we have used twill parts taken from regular four-harness $\frac{2\,|}{|\,2}$ twill. Each twill part has a difference of two ends and six picks, and is indicated in black ■ type. The remaining space is filled in with the same twill, but these twill parts are running in the opposite direction and are indicated in shaded ▩ characters. The design is carried out on eight ends, the difference being two ends for each twill part; therefore four twill parts are necessary to complete the design. The rule for these weaves now stands as follows: Divide the total number of ends on which the design is to be constructed by the difference of ends in each twill part, which is two, then multiply the difference in picks, which is six: 8÷2=4×6=24 picks are required for the repeat of the design. You will observe in the design that the spirals of these twills appear to be of uneven sizes; although on close examination it will be found that each twill part extends over the same number of ends.

323



Should even-sized spirals be required, the original twill parts which are running from left to right must extend over more ends than we have used in figure 322. *For illustration see figure 323.* The original twill parts extending over six ends, and the opposite running twill parts over two and four ends alternately, the result is that the spirals appear to be of equal size.

324

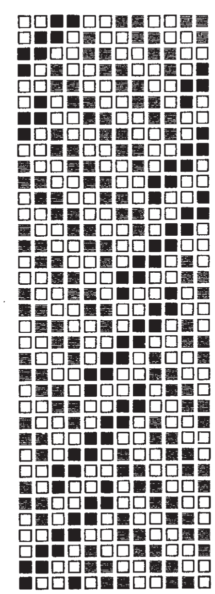


Figure 324 is also designed from four-harness $\frac{2\,|}{|\,2}$ twill on twelve ends; the difference for each twill part being two ends and six picks. Therefore 12÷2=6—6×6=36 picks are required to complete the design.

325

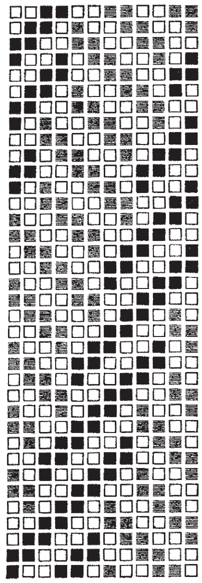
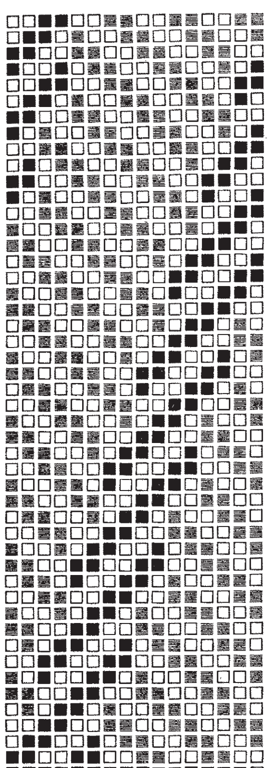


Figure 325 is also constructed from regular $\frac{2|}{|2}$ twill on twelve ends; each original twill part extends over eight ends, and the opposite running twill over four and six ends alternately.

The difference of each twill part is the same as in figure 324, and requires also thirty-six picks to complete the design.

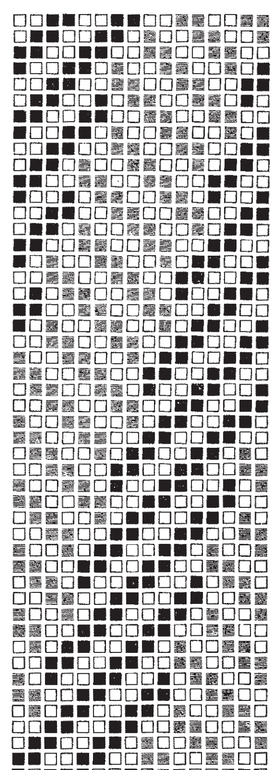
326



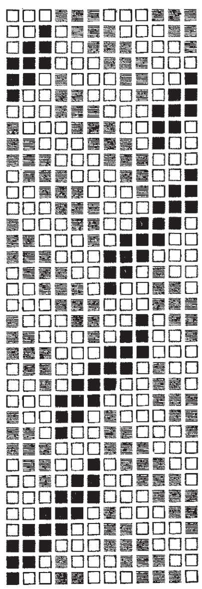
Figures 326 and 327 are designed from four-harness $\frac{2|}{|2}$ twill on sixteen ends; the difference of ends for the twill parts is two, 16÷2=8. The difference of picks in each twill part is six, 8×6=48 picks are required for these designs.

It may be well to state here in working out designs of this class from four-harness $\frac{2|}{|2}$ twill, only such numbers of ends can be used which are divisible by four.

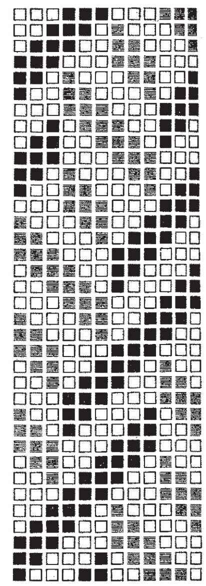
327



328



329



Figures 328 and 329 are constructed from regular $\frac{3|}{|3}$ twill, on 12 ends; the difference of each twill part is three ends, $12\div3=4$. The difference in picks is nine, therefore $4\times9=36$ picks are necessary for the complete design.

330

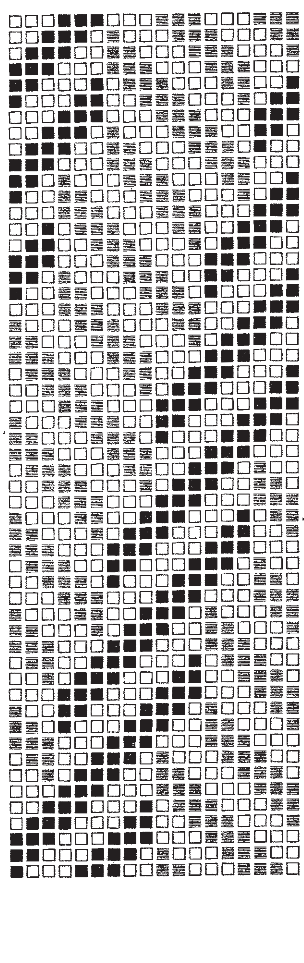
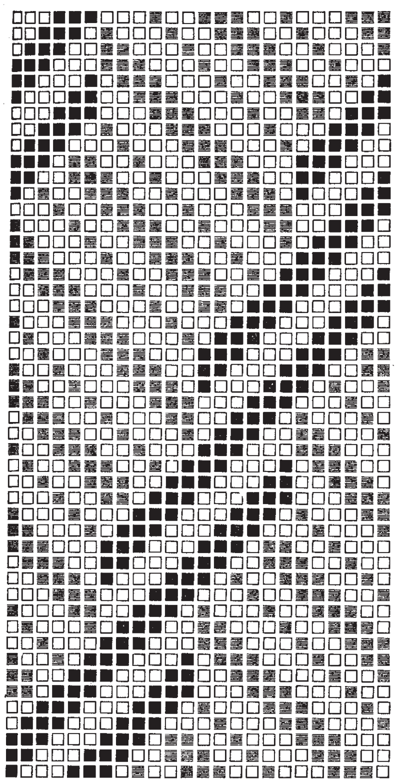


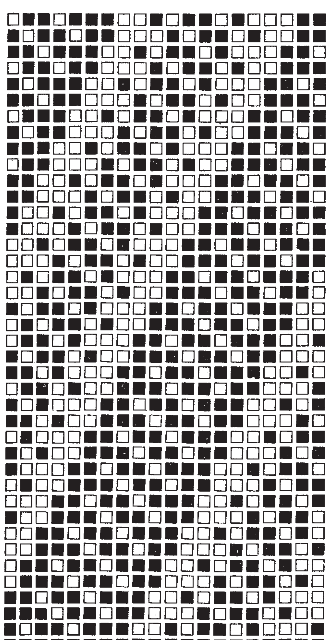
Figure 330 is also constructed from regular $\frac{3|}{|3}$ twill, on eighteen ends; the difference of each twill part is three ends, $18\div3=6$. The difference in picks is nine. Therefore $6\times9=54$ picks are necessary for the complete design.

331

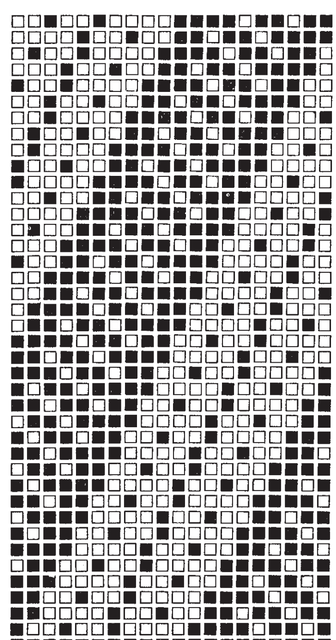


In figure 331 we have used the original twill parts regular $\frac{3|}{|3}$ twill on twenty-four ends. The difference in ends for each original twill part is six, $24 \div 6 = 4$. The difference in picks is twelve, $4 \times 12 = 48$ ends are necessary for the complete design. The opposite running twill parts are filled in with $\frac{3|\quad|1|\quad|}{|3|\quad|2|}$ twill.

332



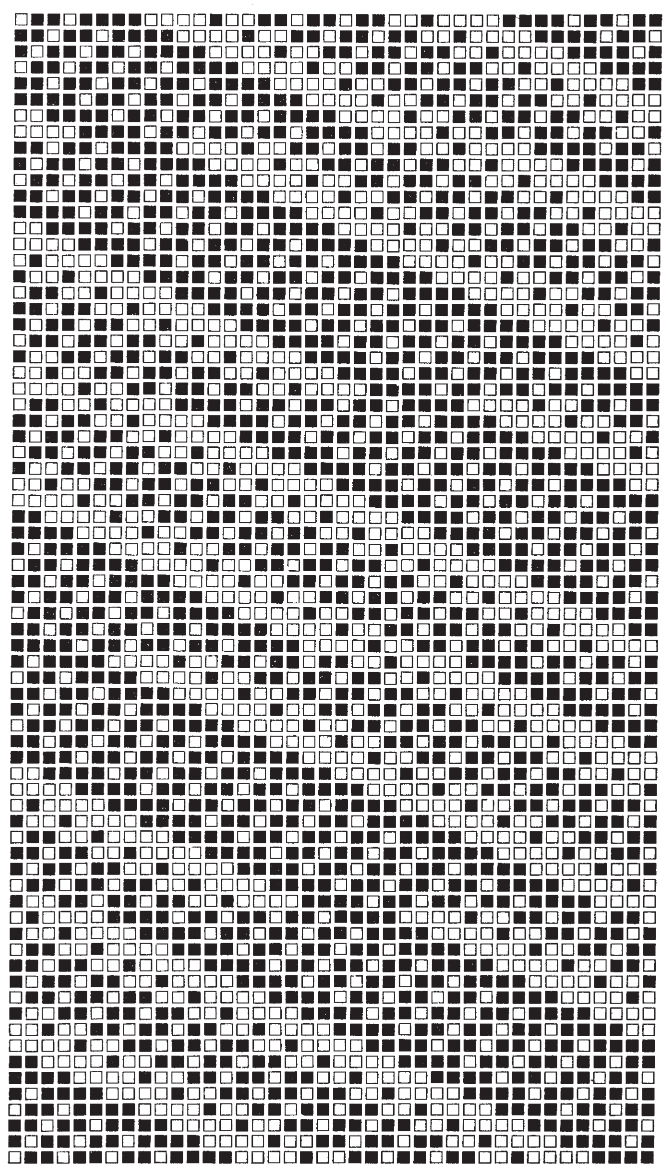
332B



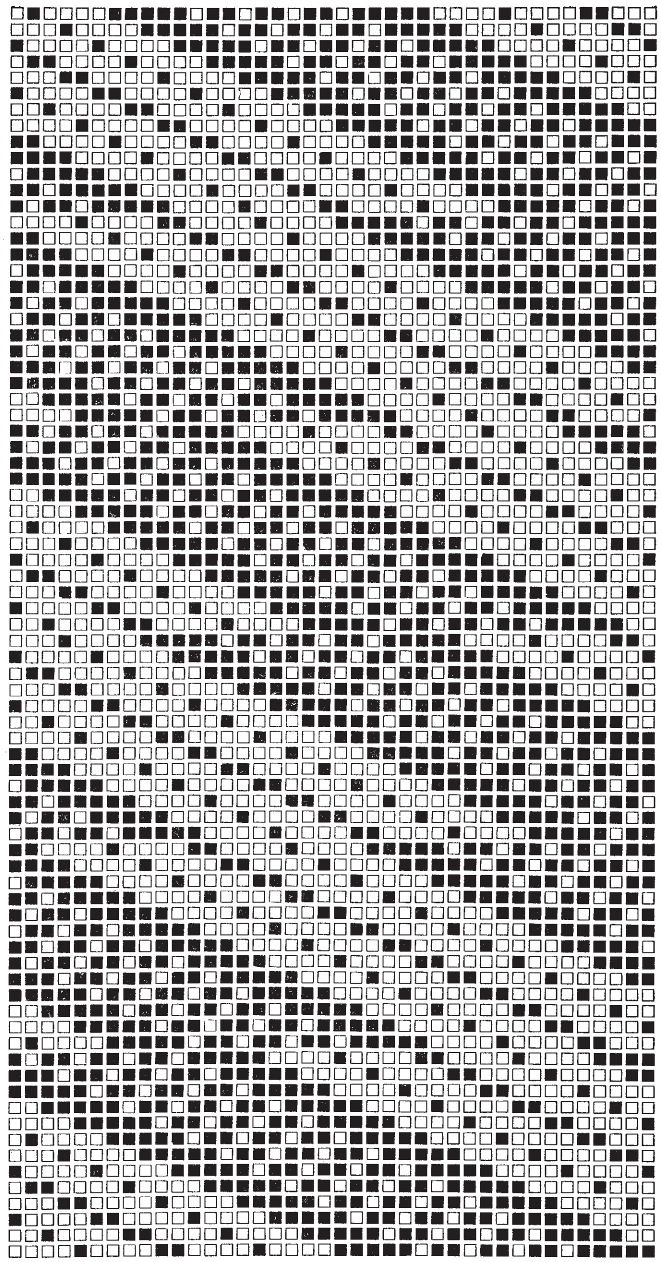
Another method of designing these broken twills is illustrated with figures 332 and 333. For foundation we use a twenty-harness diagonal represented in figure 332. From this we produce figure 333 in the following manner:

We take from figure 332 a certain number of ends, in this case sixteen, and reproduce this much of figure 332 in figure 333. We now count back seven ends from the sixteenth end and beginning again with the tenth end of figure 332 we add sixteen more ends to figure 333. Again do we count back seven, and beginning with the nineteenth end add sixteen more ends to figure 333, and so on until the design is completed. For lack of space figure 333 is not carried out to the point of repeat, since this would require three hundred and twenty ends to complete the design.

Figures 332B and 333B may illustrate another example of these twills. Thirteen ends from figure 332B, counting back six ends. Again for lack of space the design is not carried out to the point of repeat. The design complete would require two hundred and eighty ends.



333



333B

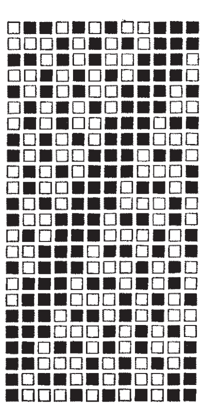
The last method of forming this class of broken twills is based on mathematical rules. Figures 334 and 335 illustrate the first principle; we take for foundation twelve-harness diagonal represented in figure 334. We now select a series of numbers "for our example four". These numbers if added together should not equal the harness number, neither should the number 1 be included in this group of numbers. From these numbers we lay the foundation for our new method. The ones selected are 4, 3, 8 and 2=17, which we place above a straight line, making four columns of figures. Underneath the first number und below the line we place the first figure (4) again. To this add the second number 3

(4+3=7) and set the 7 in the second column of figures and beneath the line. To 7 add the figure at the head of the third column, thus 7+8=15. But since 15 is larger than our harness number 12, we use only the difference between it and the harness number, 15—12=3, and we place the 3 underneath the 8 in the third column. To 3 add the fourth number 2, 3+2=5, and put this as the second figure in the fourth column. We now go back to the first column, and add the first number above the line 4 to the last number in the fourth column as 5+4=9, placing the 9 in the first column. To 9 add the second figure above the line, 9+3=12, and put sum in second column, and so on. Note that the number always added is taken from above the line, and that when the sum exceeds the harness number, we use the difference between it and the harness number. We continue the operation till the columns of numbers have reached the point of repeat, in this case taking twelve lines of numbers. *See table of numbers.*

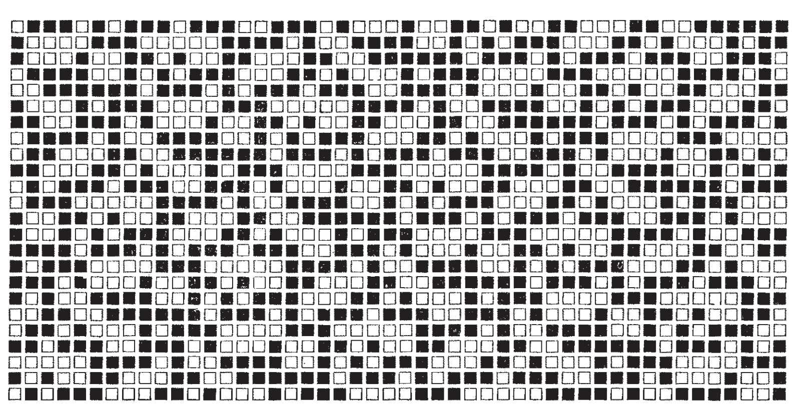
4	3	8	2
4	7	3	5
9	12	8	10
2	5	1	3
7	10	6	8
2	3	11	1
5	8	4	6
10	1	9	11
3	6	2	4
8	11	7	9
1	4	12	2
6	9	5	7
11	2	10	12

To work out the design proper as given in 335, we begin with the number at the head of the first column and progress to the right; then back to the second line of numbers, and so on, using that end in the design 334 that is denoted by the figure on the table; for instance, our first end in figure 335 is a reproduction of the fourth end in figure 334, the second in figure 335 corresponds to the seventh in 334, the third in 335 to the third in 334, the fourth to the fifth, the fifth to the ninth and so on till the table is exhausted and the design complete.

334



335



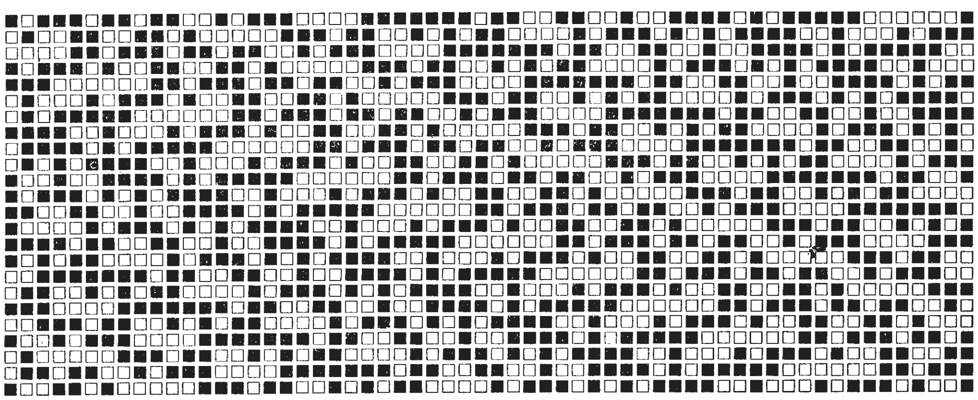
Another example is illustrated with figure 336. We select the following numbers and again use for foundation design figure 334.

5	3	7	4	4
5	8	3	7	11
4	7	2	6	10
3	6	1	5	9
2	5	12	4	8
1	4	11	3	7
12	3	10	2	6
11	2	9	1	5
10	1	8	12	4
9	12	7	11	3
8	11	6	10	2
7	10	5	9	1
6	9	4	8	12

In looking over our group of numbers we find that each number from 1 to 12 inclusive is represented five times, once in each column. Therefore 5×12=60 ends are required to complete the design.

The reason why the number 1 should never enter into our selection is that this would bring two adjacent ends from the original design adjoining each other in the new design, and this arrangement must be avoided.

336



We are now able to form innumerable new designs by the aid of the foregoing principle; for another example we use the following series of numbers: 5, 4, 6, 5, 4, 4, and develop the table as in the preceding design.

5	4	6	5	4	4
5	9	3	8	12	4
9	1	7	12	4	8
1	5	11	4	8	12

For foundation weave we again make use of figure 334, and produce from the six columns of numbers figure 337.

We now take figure 337 and reproduce each end on every other line, leaving a blank line between, thus forming figure 338.

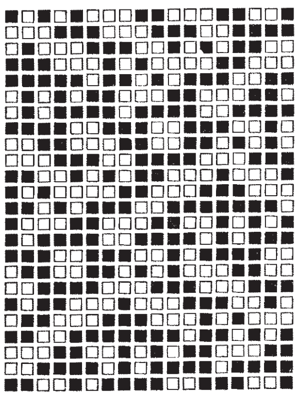
We now add to figure 338 each next following end from the original figure 334, and produce figure 339.

The analysis of the design is as follows:

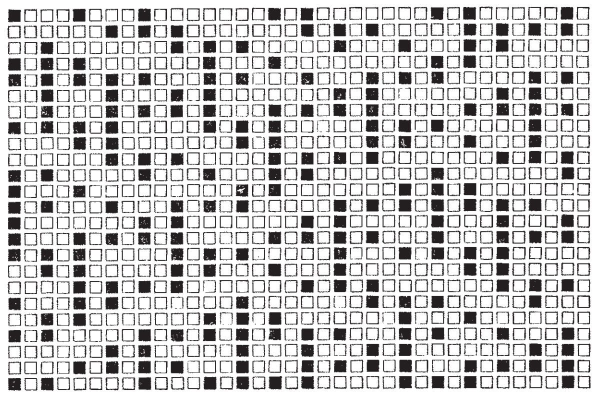
The	1st	line of design	338	is the	5th	from	334,	we	add	the	6th	from	334
"	2nd	" " "	338	" "	9th	"	334,	"	"	"	10th	"	334
"	3d	" " "	338	" "	3d	"	334,	"	"	"	4th	"	334
"	4th	" " "	338	" "	8th	"	334,	"	"	"	9th	"	334
"	5th	" " "	338	" "	12th	"	334,	"	"	"	1st	"	334
"	6th	" " "	338	" "	4th	"	334,	"	"	"	5th	"	334

and so on until design 339 is completed.

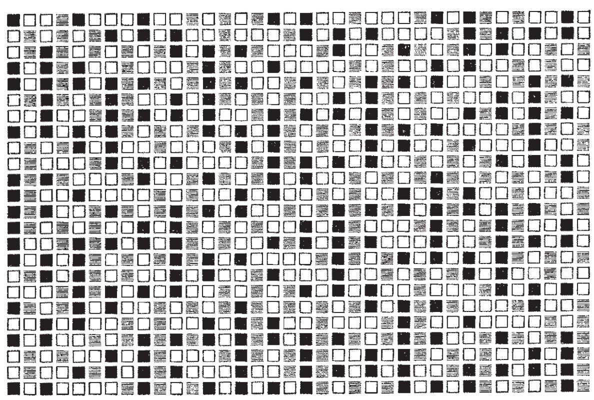
337



338



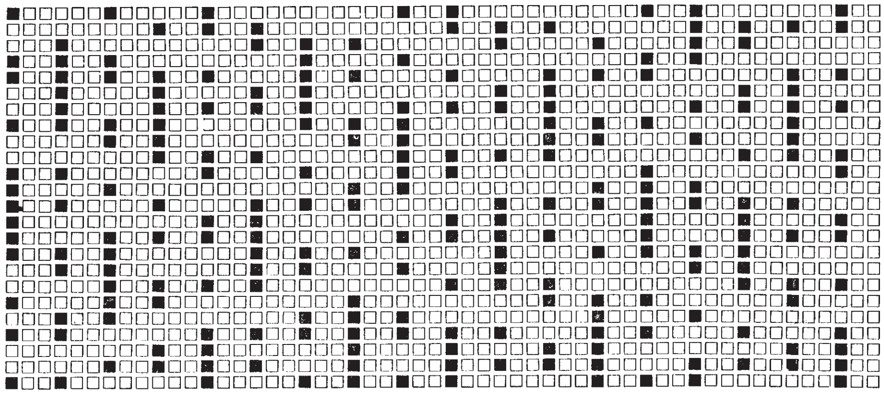
339



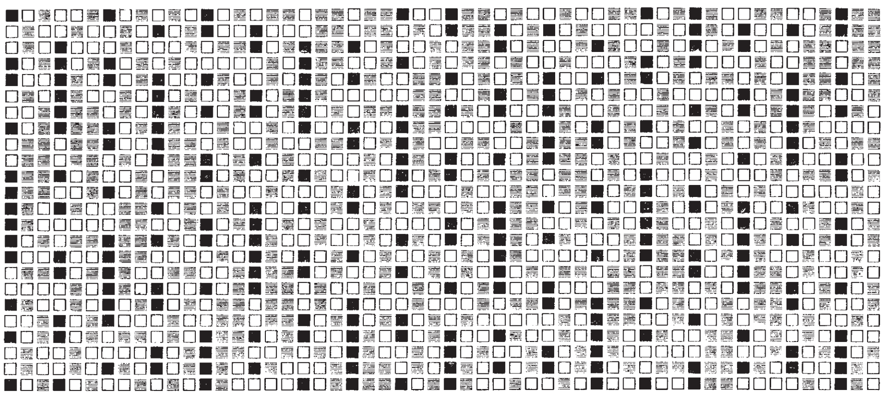
We can still further extend our method in this manner. Take again figure 337 and reproduce each end on every third line, leaving two blank lines between. *See figure 340A*. To this we now add alternately the two following and the two preceding lines from the original design 334. The analysis is as follows:

The	1st	line in figure	340A	is the	5th	from	334,	we	add	the	6th	and	7th	from	334
"	2nd	" " "	340A	" "	9th	"	334,	"	"	"	8th	"	7th	"	334
"	3d	" " "	340A	" "	3d	"	334,	"	"	"	4th	"	5th	"	334
"	4th	" " "	340A	" "	8th	"	334,	"	"	"	9th	"	10th	"	334
"	5th	" " "	340A	" "	12th	"	334,	"	"	"	10th	"	9th	"	334
"	6th	" " "	340A	" "	4th	"	334,	"	"	"	5th	"	6th	"	334
"	7th	" " "	340A	" "	9th	"	334,	"	"	"	8th	"	7th	"	334
"	8th	" " "	340A	" "	1st	"	334,	"	"	"	2nd	"	3d	"	334
"	9th	" " "	340A	" "	7th	"	334,	"	"	"	6th	"	5th	"	334
"	10th	" " "	340A	" "	12th	"	334,	"	"	"	1st	"	2nd	"	334

and so on until the table is exhausted. *For complete design see figure 340.*



340A



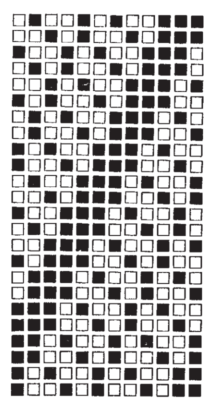
310

3	5	7	2
3	8	3	5
8	1	8	10
1	6	1	3
6	11	6	8
11	4	11	1
4	9	4	6
9	2	9	11
2	7	2	4
7	12	7	9
12	5	12	2
5	10	5	7
10	3	10	12

Another example is illustrated in figure 342. For foundation weave we use figure 341 and the following numbers: 3, 5, 7 and 2, from which we form the table of numbers below in the usual manner.

We now take from figure 341 the lines corresponding to our table and leave four blank lines between *(see 342);* then we add alternatingly the four following and the four preceding lines from the original figure 341, thus forming figure 342A. For lack of space this design is not carried out to the point of repeat. The complete design would require 240 ends.

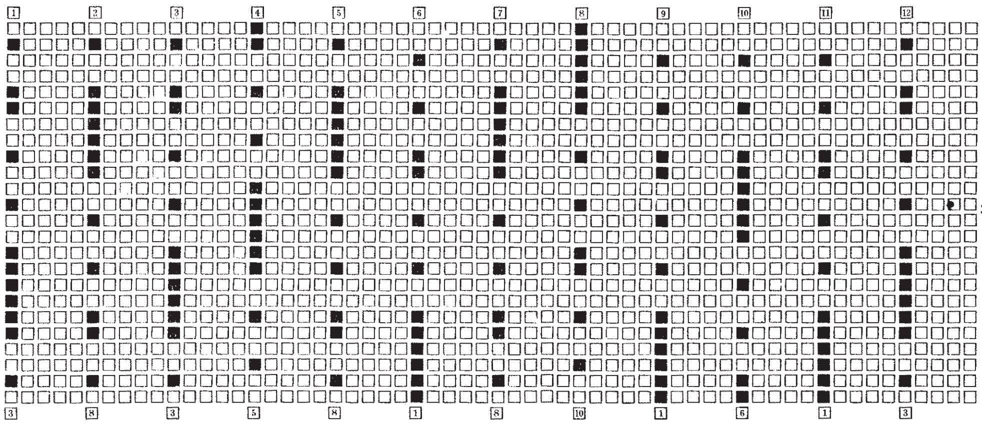
341



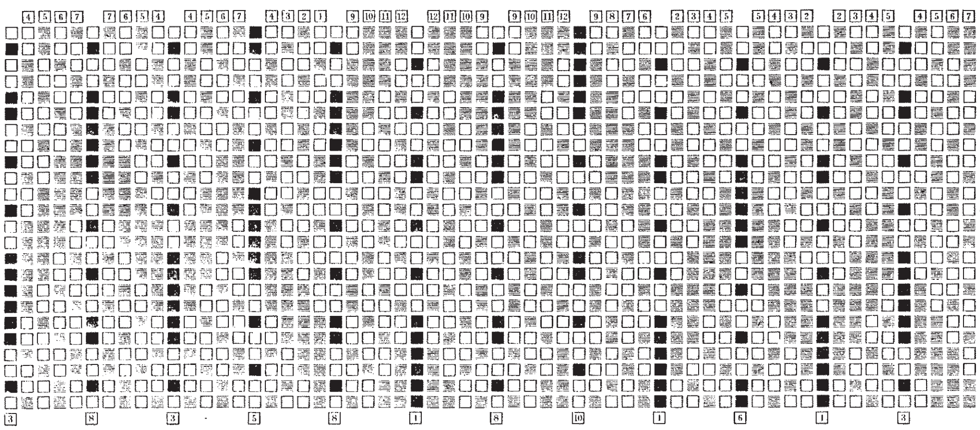
The analysis of figure 342 is as follows:

The	1st	end of	figure	342 is the	3d	from	341, add the	4th,	5th,	6th,	7th	from 341
"	2nd	"	"	" " "	8th	"	" " "	7th,	6th,	5th,	4th	" "
"	3d	"	"	" " "	3d	"	" " "	4th,	5th,	6th,	7th	" "
"	4th	"	"	" " "	5th	"	" " "	4th,	3d,	2nd,	1st	" "
"	5th	"	"	" " "	8th	"	" " "	9th,	10th,	11th,	12th	" "
"	6th	"	"	" " "	1st	"	" " "	12th,	11th,	10th,	9th	" "

and so on until the table is exhausted.



342



342 A

5	4	5	3
5	9	2	5
10	2	7	10
3	7	12	3
8	12	5	8
1	5	10	1
6	10	3	6
11	3	8	11
4	8	1	4
9	1	6	9
2	6	11	2
7	11	4	7
12	4	9	12

Figure 343 is another example of this class, but instead of equal numbers of blank lines between the original lines we have them arranged as follows: 3 blank, 3 blank, 2 blank, 3 blank, and so on.

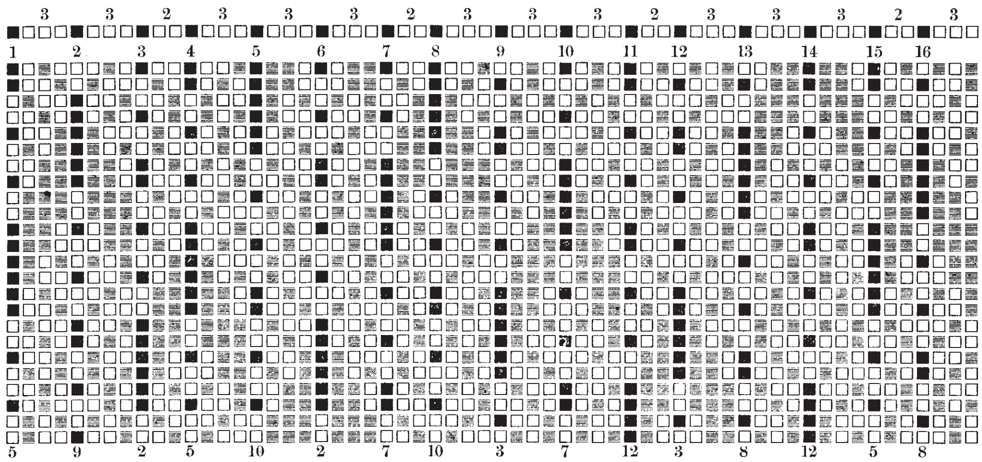
For a series of numbers we have selected 5, 4, 5, 3.

The analysis for design 343 is as follows:

The	1st	end	in	figure	343	is	the	5th	in	341;	add	the	6th,	7th,	8th	from 341
"	2nd	"	"	"	"	"	"	9th	"	"	"	"	8th,	7th,	6th	" "
"	3d	"	"	"	"	"	"	2nd	"	"	"	"	3d,	4th		" "
"	4th	"	"	"	"	"	"	5th	"	"	"	"	4th,	3d,	2nd	" "
"	5th	"	"	"	"	"	"	10th	"	"	"	"	11th,	12th,	1st	" "
"	6th	"	"	"	"	"	"	2nd	"	"	"	"	1st,	12th,	11th	" "
"	7th	"	"	"	"	"	"	7th	"	"	"	"	8th,	9th		" "
"	8th	"	"	"	"	"	"	18th	"	"	"	"	9th,	8th,	7th	" "

and so on until the table is exhausted. Again for lack of space design 343 is not carried out to the point of repeat.

343

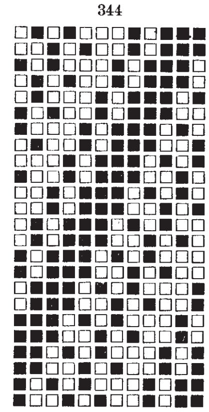


Another example of this class of broken twills is illustrated and described with figure 345. We select the numbers 3, 4, 8, 10, from which we form the following four columns of numbers in the usual way, on the basis of a twelve-harness weave.

3	4	8	10
3	7	3	1
4	8	4	2
5	9	5	3
6	10	6	4
7	11	7	5
8	12	8	6
9	1	9	7
10	2	10	8
11	3	11	9
12	4	12	10
1	5	1	11
2	6	2	12

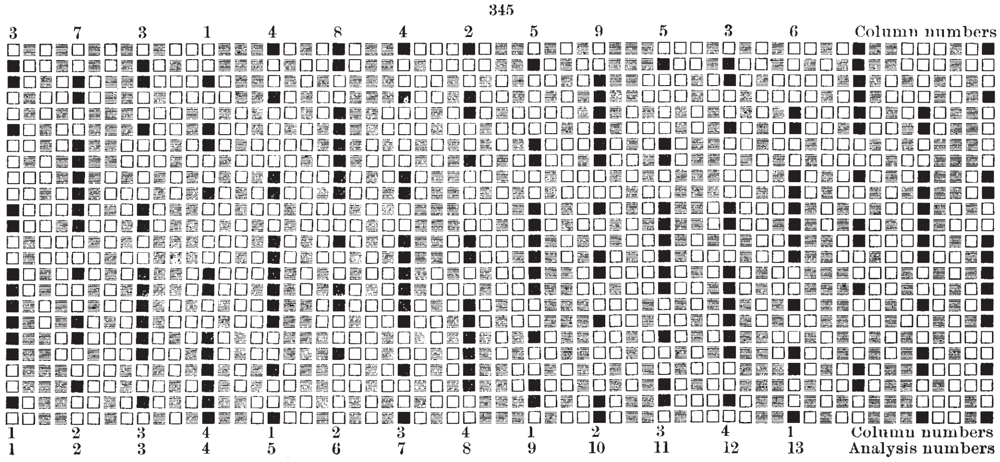
From these four columns of numbers we construct our new weave represented with figure 345. For foundation weave we use figure 344, twelve-harness steep twill, from which we take the corresponding line indicated in our four columns, leaving three blank lines between every original line. We now add to the original lines corresponding to the first and fourth columns the three preceding lines from figure 344 and to the original lines corresponding to the second and third columns the three next following lines from figure 344. The column numbers are indicated below the design 345 and the lines from figure 344 above.

344



The complete design 345 would require 48×4=192 lines; since this number goes beyond our space, design 345 is not carried out to the point of repeat.

345



The analysis of figure 345 is as follows:

The	1st	line	is	the	3d	from figure 344—add	the		2nd,	1st,	12th
"	2nd	"	"	"	7th	"	"	" " "	8th,	9th,	10th
"	3d	"	"	"	3d	"	"	" " "	4th,	5th,	6th
"	4th	"	"	"	1st	"	"	" " "	12th,	11th,	10th
"	5th	"	"	"	4th	"	"	" " "	3d,	2nd,	1st
"	6th	"	"	"	8th	"	"	" " "	9th,	10th,	11th
"	7th	"	"	"	4th	"	"	" " "	5th,	6th,	7th
"	8th	"	"	"	2nd	"	"	" " "	1st,	12th,	11th

and so on until the table of the four columns of numbers is exhausted and thus the repeat of the design complete.

346

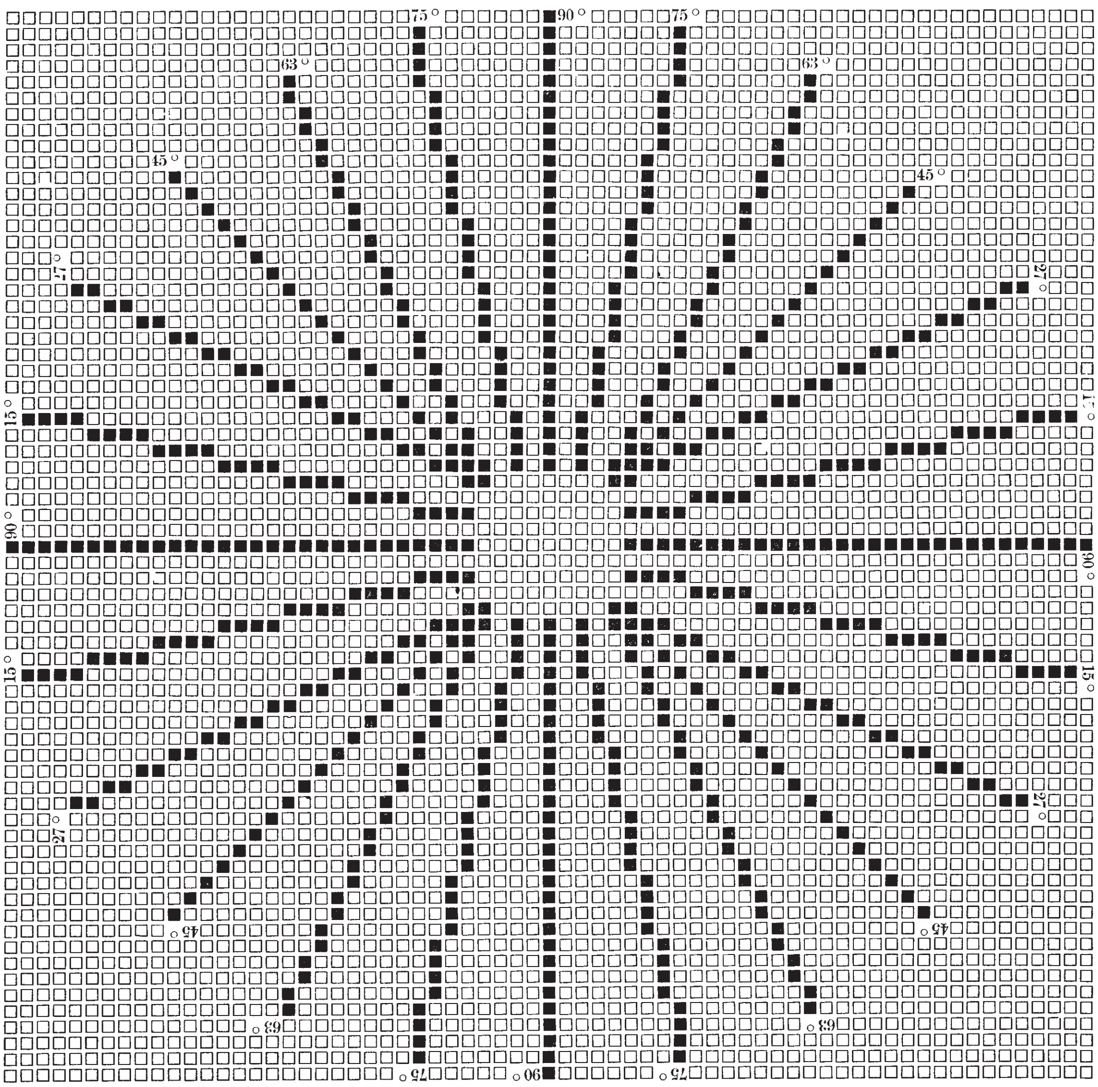


Fig. 346 is a diagram showing the position of twills run at various angles. If the cloth is constructed of a like number of ends and picks, then the position of the twills appears the same in the cloth as in the diagram; but when the picks and ends differ from one another, the angle will vary accordingly. For illustration we construct a cloth which, when finished, will count 90 ends and 60 picks; we use a twill weave which runs at an angle of 45° in the diagram and we find in the cloth that the twill will run at an angle of 63°. This difference is wholly due to the designing paper not being ruled in the same proportions as the counts of the cloth.

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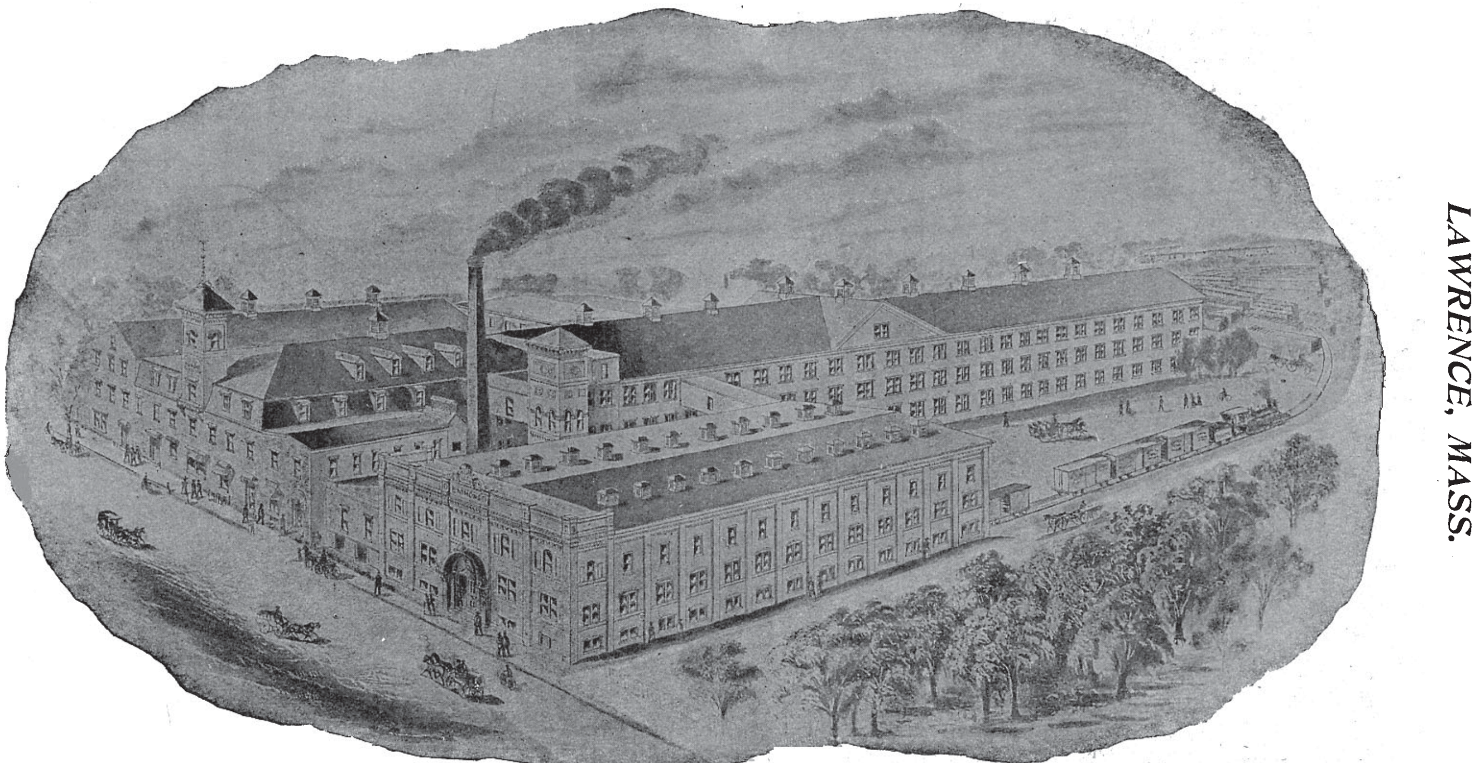

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