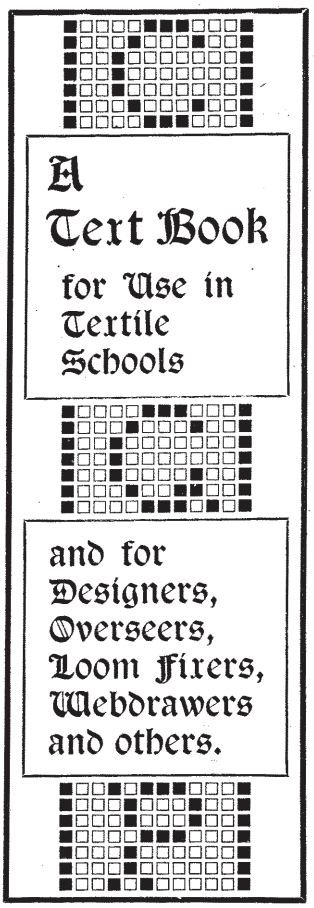
No. 6 1901

Construction of Weaves



By
Charles G. Petzold

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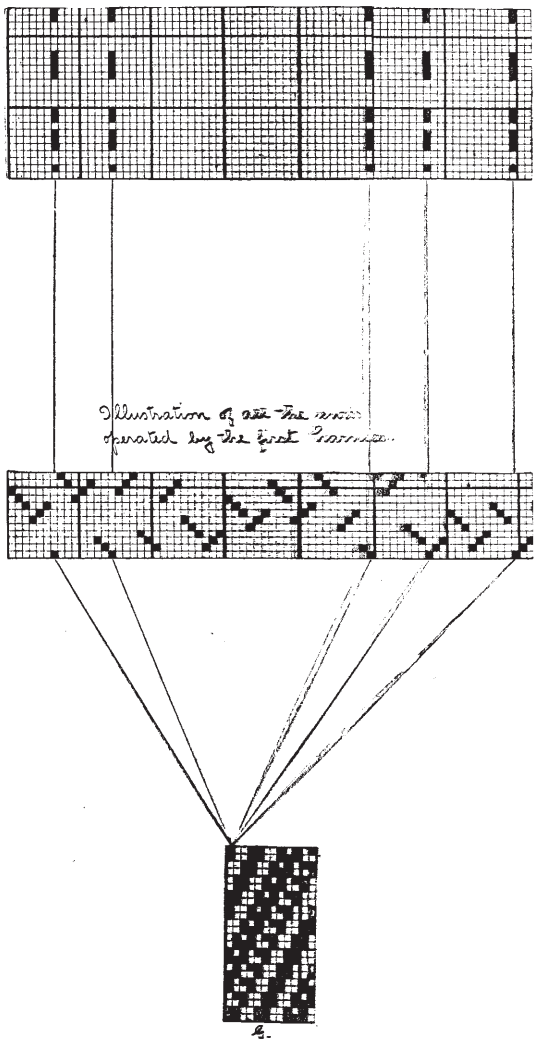
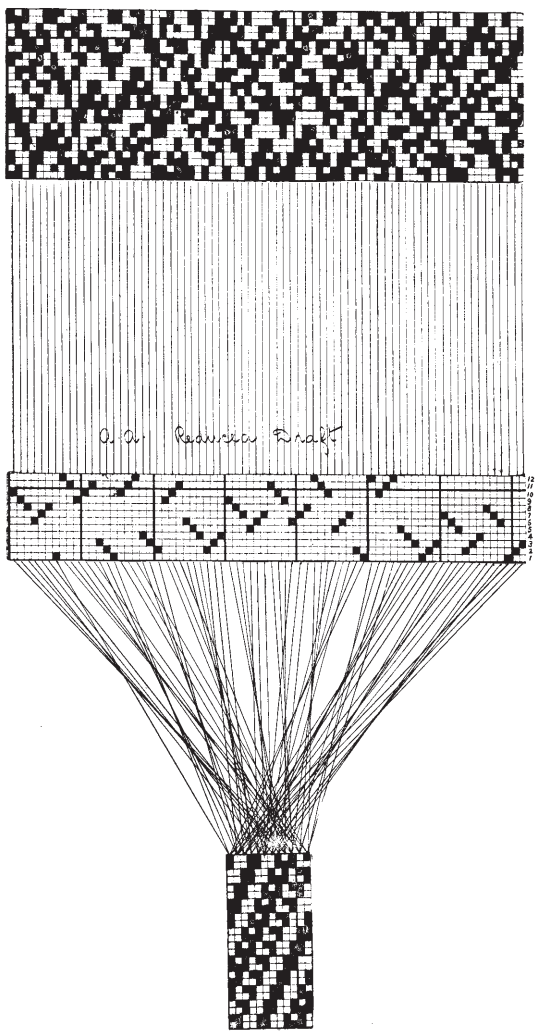


Design for reduced draft



Design for reduced draft

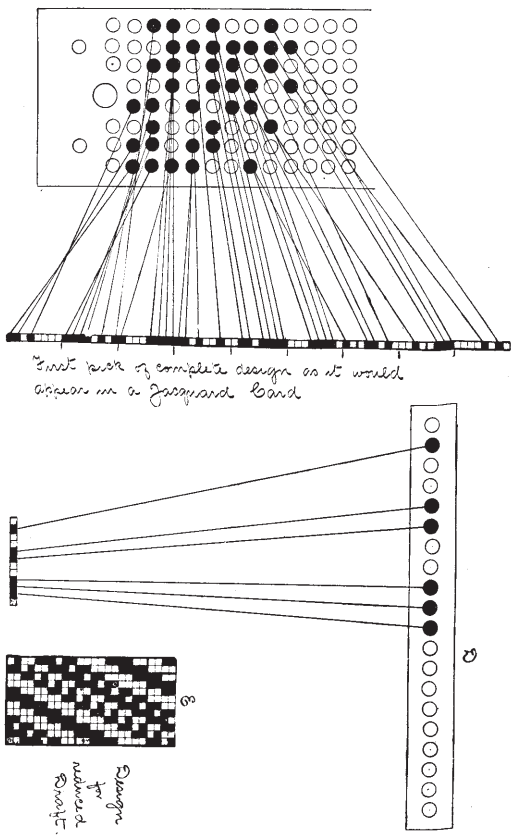


ILLUSTRATION OF DRAFTING.

Drafting, or Reducing the Number of Harnesses by Means of the Reduced Draft.

However simple and unassuming the word "drafting" may sound, the process is nevertheless a very important factor in the manufacture of cloth, and we have in our previous chapters made no mention of this part. Our reason for this was that its explanation requires the knowledge of the fundamental principles of the construction of weaves. By the name of "draft" the weaver designates the operation by which the single ends of the warp are drawn into the harness eyes.

For the purpose of illustration take figure 348 which is formed from figure 347 by reproducing the separate lines of figure 347 in irregular order, numbering them from 1 to 8 inclusive.

In figure 348 the odd numbers are placed above, the even numbers below the design. Now on comparing those lines in figure 348 bearing the same number we find they are alike, which fact must necessarily follow from our method of construction.

As for example, all those lines numbered 8 are alike and correspond with the line marked 8 in our weaving plan, figure 347. Further, all lines marked 8 are placed on the eighth harness, all lines marked 1 are placed on the first harness, and so on, in this manner forming the reduced draft figure 348A.

The picking out of those ends where the lines occur in like positions and attaching them to the same harness is called making a reduced draft and enables the weaver to produce a larger pattern than the harness number ordinarily would allow. In this special case the number of ends was 36, but by the aid of the reduced draft the design can be produced on 8 harnesses.

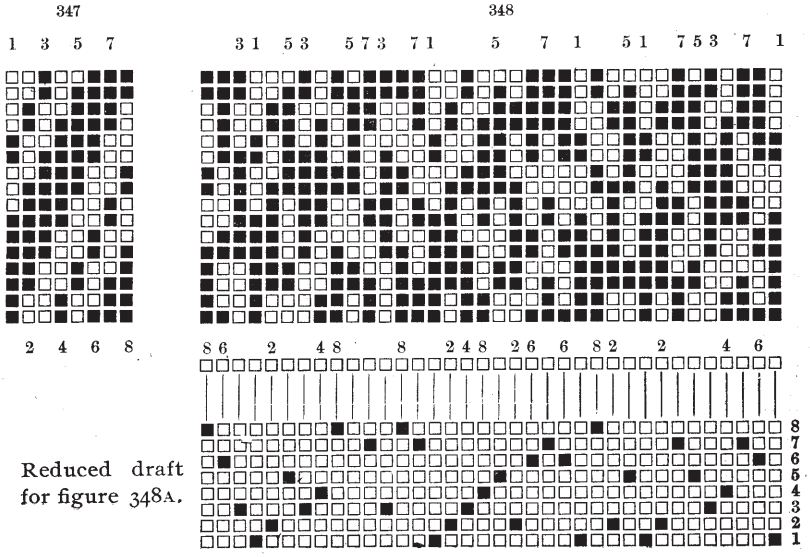


Figure 347 is also the weaving plan for 348.

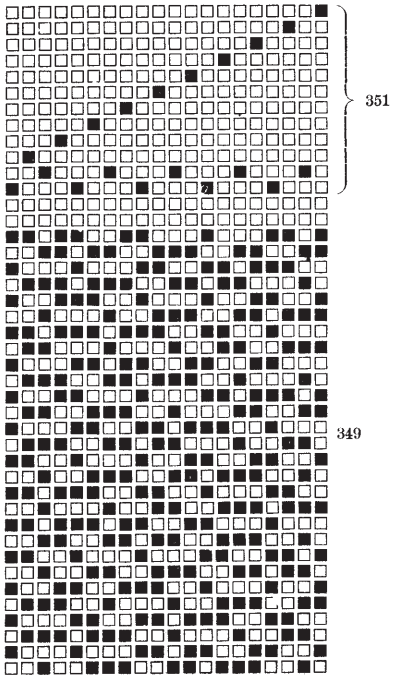
Reduced draft for figure 348A.

The foregoing principle can not always be followed exactly, for the reason that if there should be too many ends on one harness it would be well to distribute them over two harnesses, or even four, if the construction of the loom will permit.

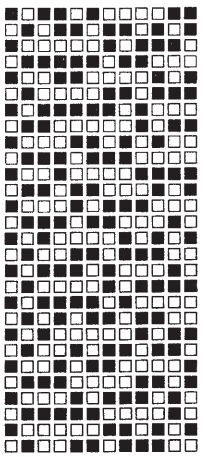
In other words, the reduced draft can never be larger than what the loom is rigged up for.

It may be well to state that those harnesses that have to operate the most ends should be nearest the reed, or as near as possible. The weaving plan to be worked out to correspond to this operation is explained and shown in figures 349, 350 and 351.

Fig. 349 shows the complete design and extends over 20 lines. We find that the lines 1, 5, 9, 13 and 17 are in like positions, and can be operated by the first harness; we also find the 3, 7, 11, 15 and 19 are in like position, and these can be operated from the second harness. The remaining lines all differ from one another and require one new harness each. Therefore the design 349 can be made on 12 harnesses. *See Fig. 350. Draft herewith in Fig. 351.*

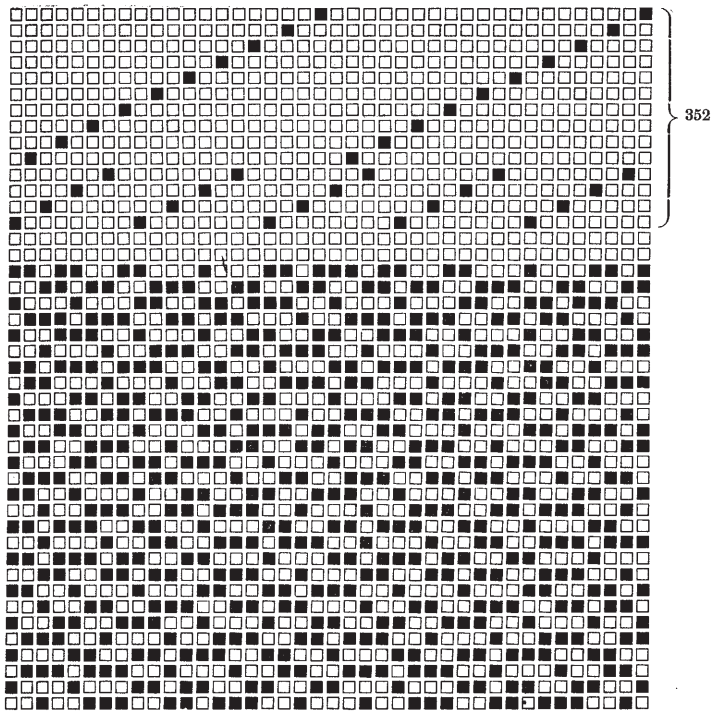


350

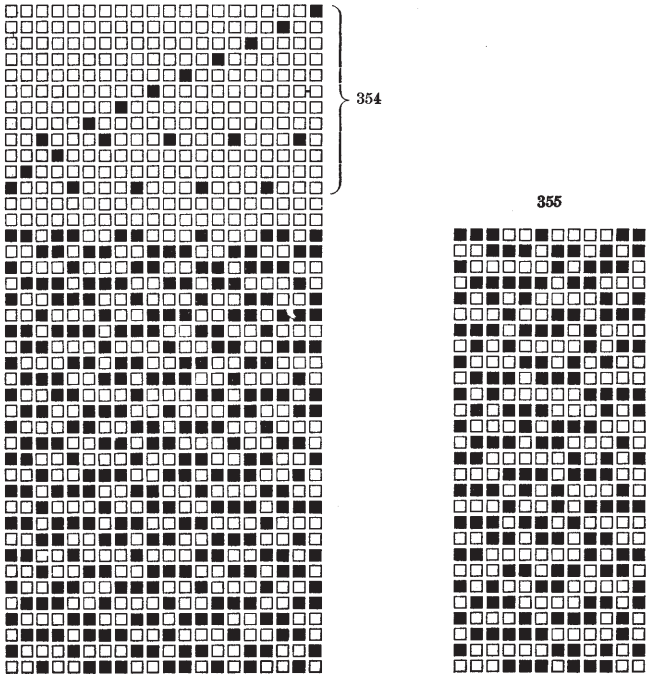


By this draft we find that one-half the threads are operated from the first and second harnesses, and in practice this may cause too much friction on the yarn.

We can apply two operations to avoid this difficulty. The first operation would be to distribute these ends over four harnesses; by doing so, the complete draft would require 14 harnesses. *See Fig. 352 and weaving plan Fig. 353 herewith.* Design and draft are carried out twice in width.



In the second operation we retain the original harness number 12, but separate the first and second harnesses, by placing the second harness in the position of the fourth, and the third in place of the second, the fourth in place of the third. *See draft figure 354 and weaving plan fig. 355 herewith.*



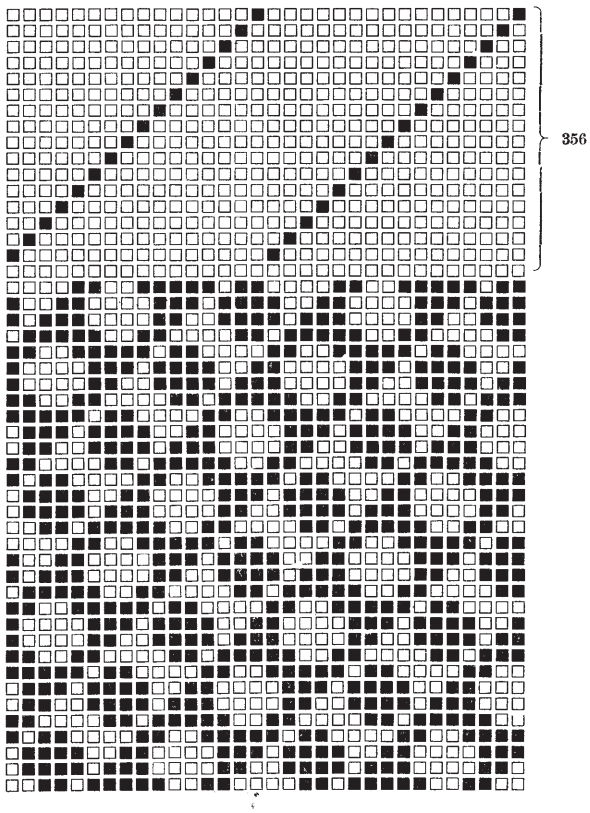
Fabrics produced with either draft and the corresponding weaving plan will remain exactly the same.

Classifying of Drafts.

STRAIGHT DRAFT.

Under straight draft we understand that each following thread has another position than the preceding one.

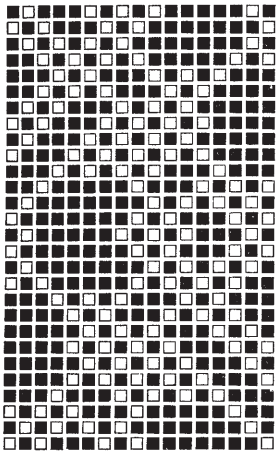
In figure 356 we illustrate a sixteen-harness weave, and since each thread works differently, sixteen harnesses will be required to produce the weave. For purpose of illustration the design and draft are carried out two times.



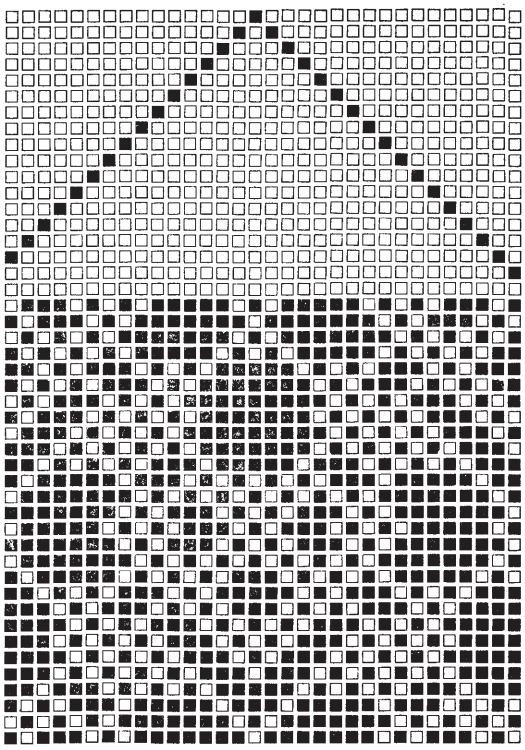
The next class of drafts is known as Point or Diamond drafts. Figures 357, 358, 359 and 360 are worked out for seventeen harnesses, and by the aid of regular point or diamond draft we can produce designs extending over 32 ends. The number of picks is not limited. We can use as many picks as we choose or as the design may require.

Figure 357 has 32 ends and 28 picks.
Figure 358 " 32 " " 32 "
Figure 359 " 32 " " 36 "
Figure 360 " 32 " " 40 "

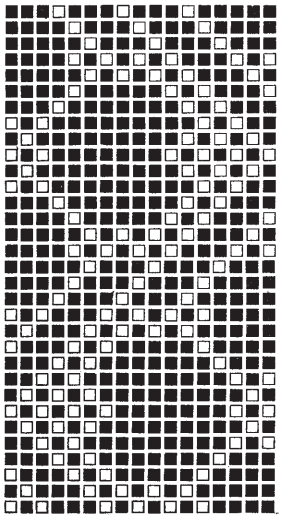
All these designs are based on the same draft, but the draft on 359 and 360 has been omitted.



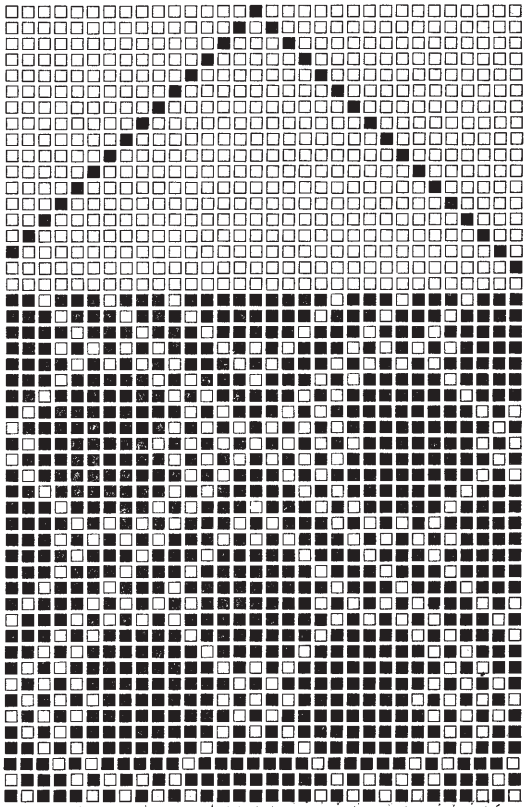
Weave for 357



357

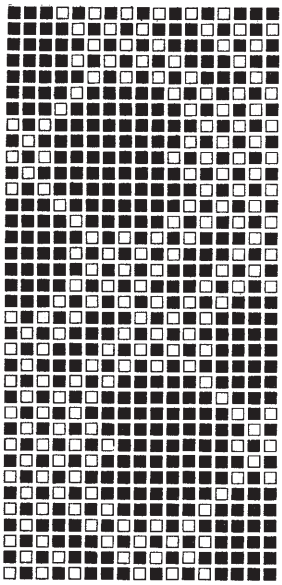


Weave for 358

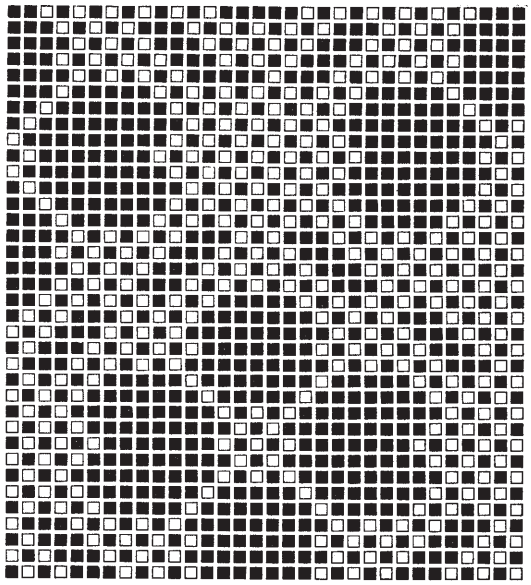


358

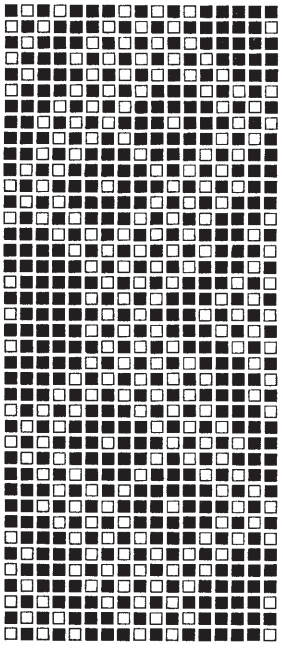
359



Weave for 359



360



Weave for 360

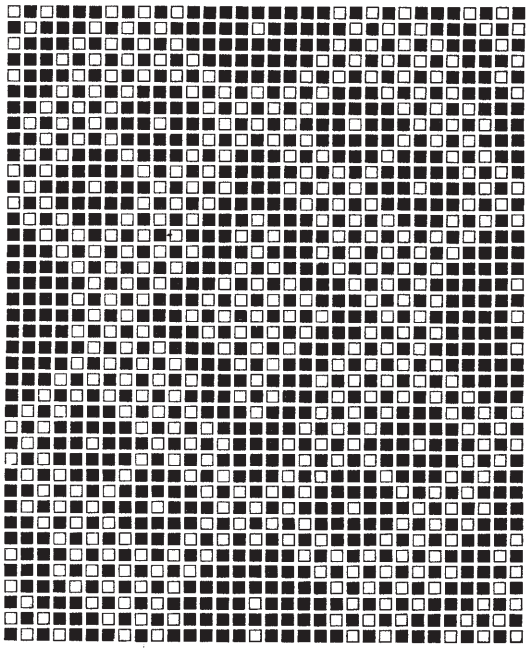
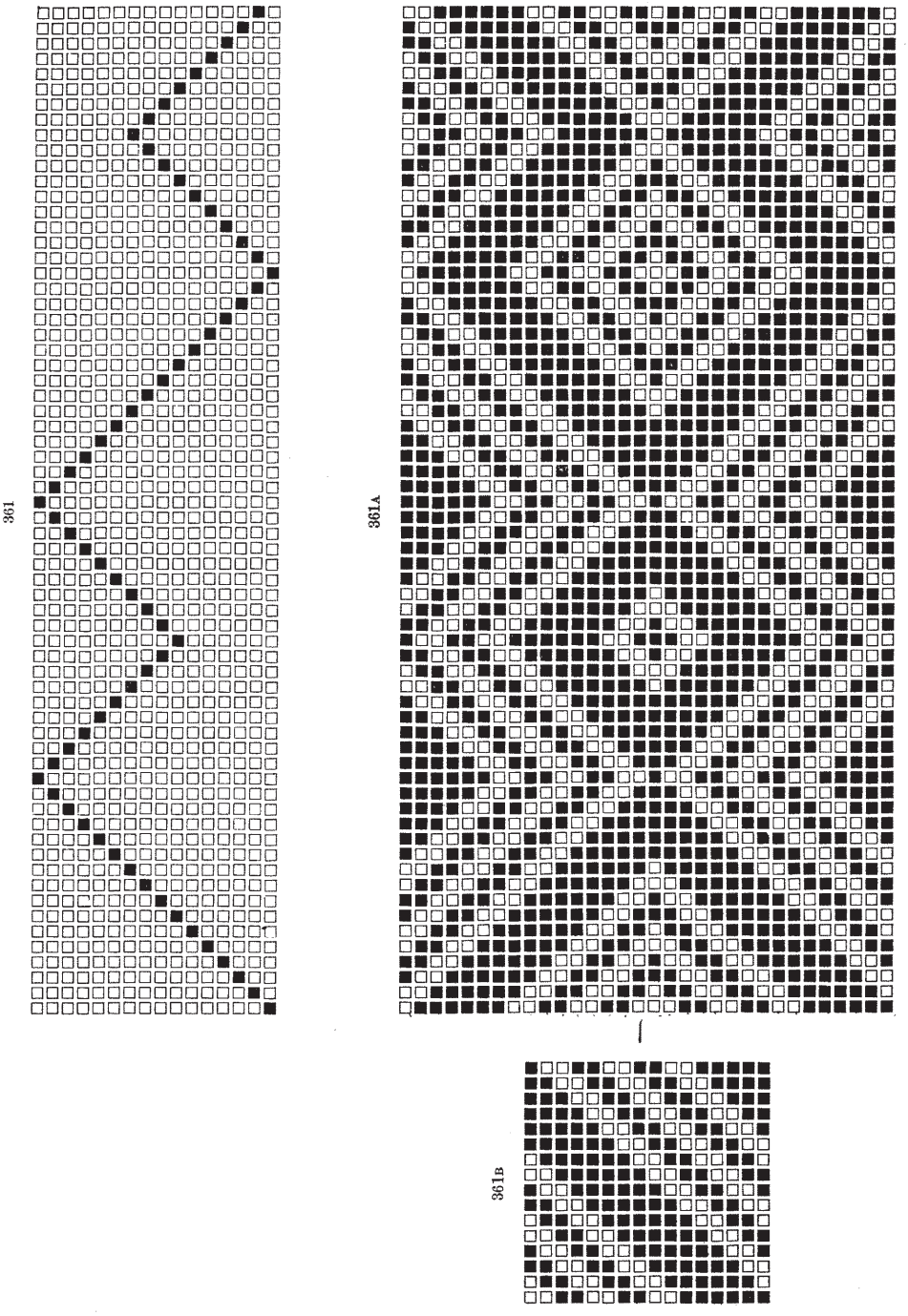
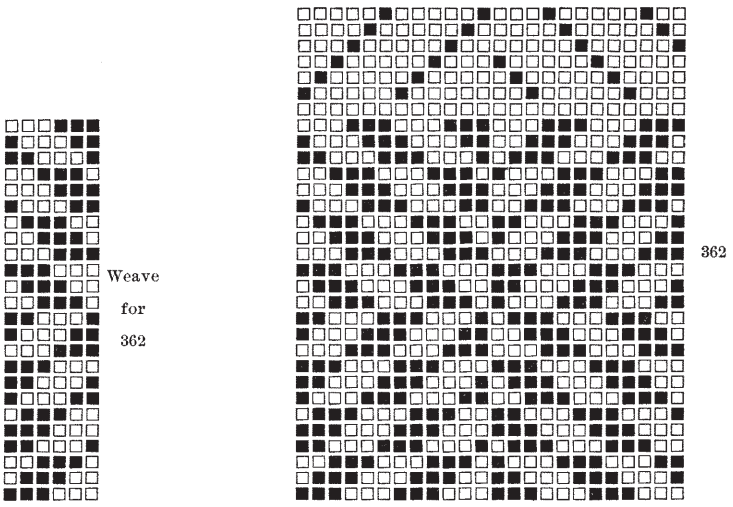


Figure 361 illustrates a sixteen-harness repeating point or diamond draft, and by the aid of this class of drafts much larger designs can be produced than in the foregoing class. Figure 361 extends over 16 harnesses, but for the point of repeat 66 ends are required. *For the complete design see Figure 361a.* As a foundation from which this design is constructed, we have used a sixteen-harness $\frac{|6|\ |2|\ |2|\ |2|\ |}{|\ |2|\ |2|\ |2|\ |2|}$ twill. *Ssee Figure 361b.*

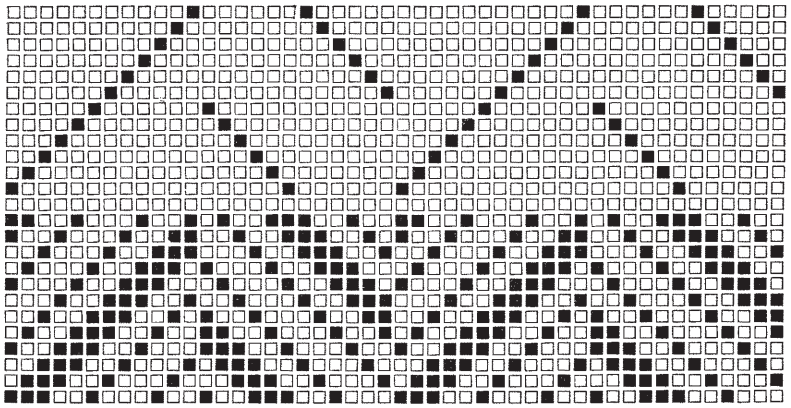


The next class of drafts are the broken drafts. Figures 362 and 362B illustrate two of these drafts. In figure 362 we have taken a regular six-harness $\frac{3|}{|3}$ twill; we now draw twelve ends from left to right on six harnesses and then draw twelve ends from right to left, beginning in the centre of the first twelve ends. Figure 362 illustrates the draft and design.



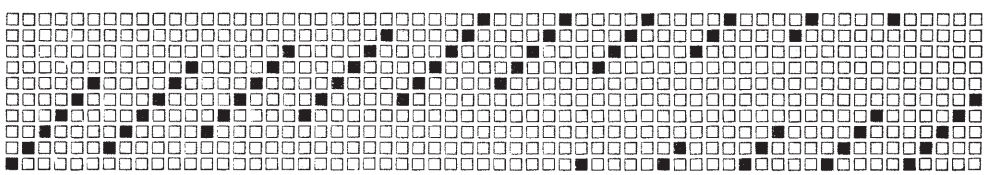
In figure 362B we have taken twelve ends from left to right on twelve harnesses and twelve ends from right to left, beginning in the centre of the first twelve ends.

362B



The next class of drafts is known as the stepping up or repeating drafts. In this class we take a group or several groups of numbers. For purpose of illustration we use ten harnesses and a group number of six ends. We now take six ends from the first to the sixth harness, next we step up one harness and take six ends again, beginning on the second and ending on the seventh; next we begin on the third and end on the eighth harness, and so on until we reach the point of repeat, stepping up one harness in every new group of six. Ten groups of six ends each will be required to reach the point of repeat. *See Figure 363.*

363



We can extend this principle still further by starting in the preceding manner, but with the second group of numbers we step up two harnesses instead of one as

before. By this procedure we complete the draft with five groups of six ends each. *See Figure 364.*

364

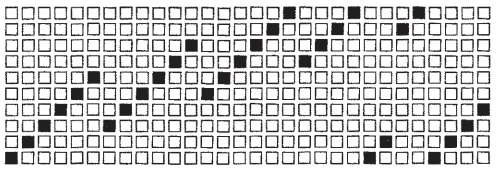


Figure 365 illustrates another example of this class of drafts. In this instance there is a stepping up of three harnesses, and sixty ends will be required to complete the draft.

365

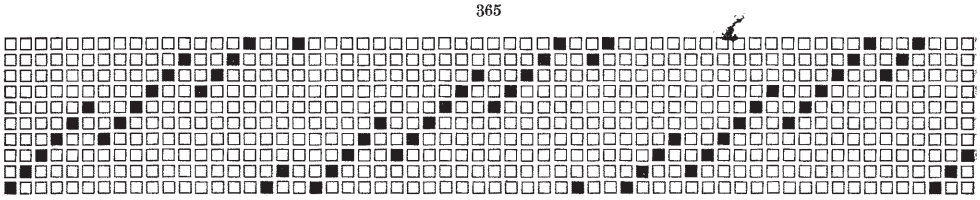
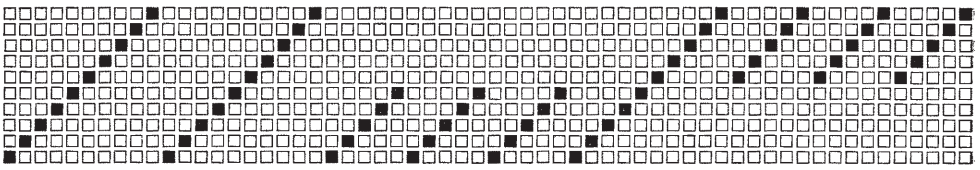
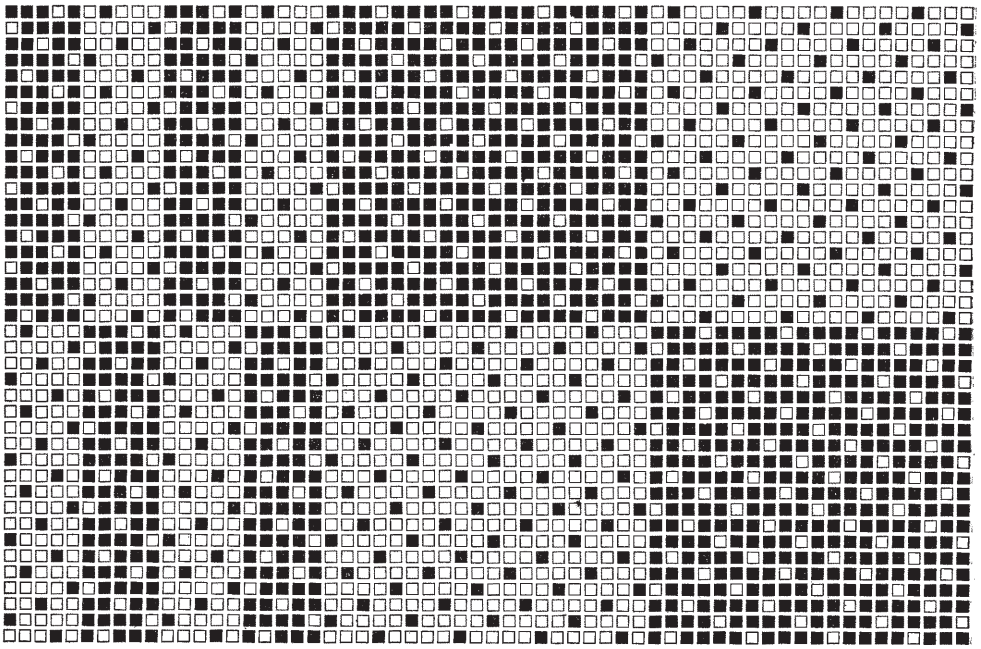


Figure 366 illustrates a section draft. This class of drafts is frequently used in the manufacture of towels and table clothes. Figure 366B illustrates the design which is constructed from five-harness warp and filling sateen.

366



366B



Drafts with Two Divisions.

These drafts are frequently used for fabrics made with fancy effects, and figure 367 illustrates one of this class.

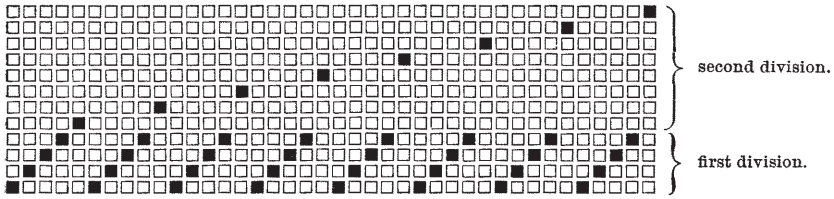
The ground weave is a regular four-harness $\frac{2|}{|2}$ twill, for which all the ends are drawn into the first division of four harnesses.

The fancy effect ends are placed in the eight-harness sateen order and are drawn into the second division of eight harnesses; these fancy effect ends are floating over four picks of filling, and are tied into the cloth between two ground ends with a float over one; to tie these floating-effect ends between two ground ends has the advantage that each half of these two ground ends will cover one-half the effect end and thus cover its appearance where it is not desirable.

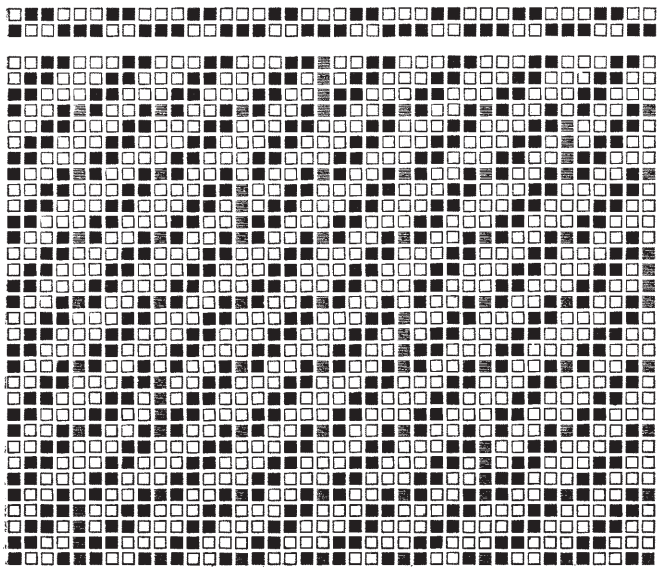
Figure 367A shows the design, and above this we have indicated the plan in which the threads are drawn into the loom reed, and you will notice that the effect ends are placed between two ground ends in one reed space or dent.

Figure 307B is the weaving plan from which we build the harness chain for the reduced draft. The design requires forty ends to the repeat, but in taking advantage of the reduced draft we can produce the design on twelve harnesses.

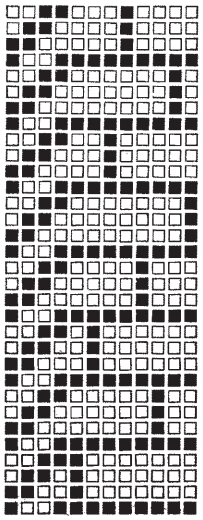
367



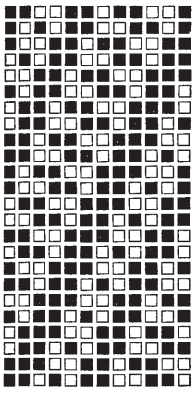
367A



367B



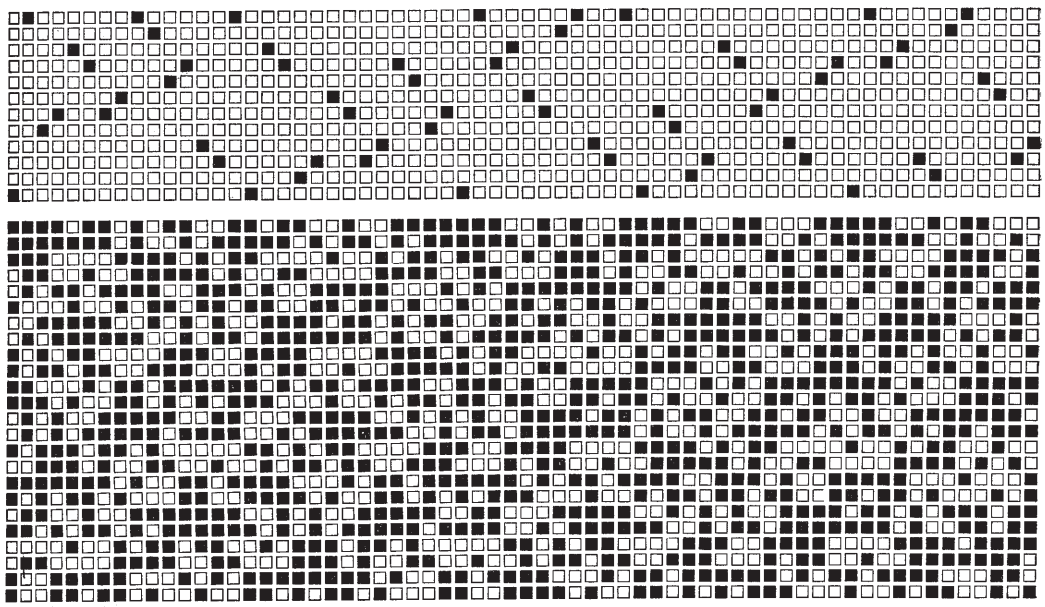
368B



The next class of drafts are known as irregular drafts, and figure 368 illustrates a draft of this description.

Figure 368A represents the complete design and 368B is the plan for the harness chain. The draft has been worked out in arbitrary manner with groups of two ends each running in opposite direction on twelve harnesses.

368



368A

Figures 369 and 369B illustrate the mixed draft. In figure 369 we have used a regular braided twill based on twenty-four ends and picks, and in looking this design over we find that the

1st	and	21st	ends	are	in	like	position	
2nd	"	22nd	"	"	"	"	"	
3d	"	19th	"	"	"	"	"	
4th	"	20th	"	"	"	"	"	
5th	"	17th	"	"	"	"	"	
6th	"	18th	"	"	"	"	"	
7th	"	15th	"	"	"	"	"	
8th	"	16th	"	"	"	"	"	
9th	"	13th	"	"	"	"	"	
10th	"	14th	"	"	"	"	"	
11th	"	24th	"	"	"	"	"	
12th	"	23d	"	"	"	"	"	

and therefore the design can be woven on twelve harnesses.

For the complete weaving plan to build the harness chain we use the 1st, 2nd, 3d, 4th, 5th, 6th, 7th, 8th, 0th, 10th, 11th, 12th line from figure 369, and these are represented for illustration in figure 369A.

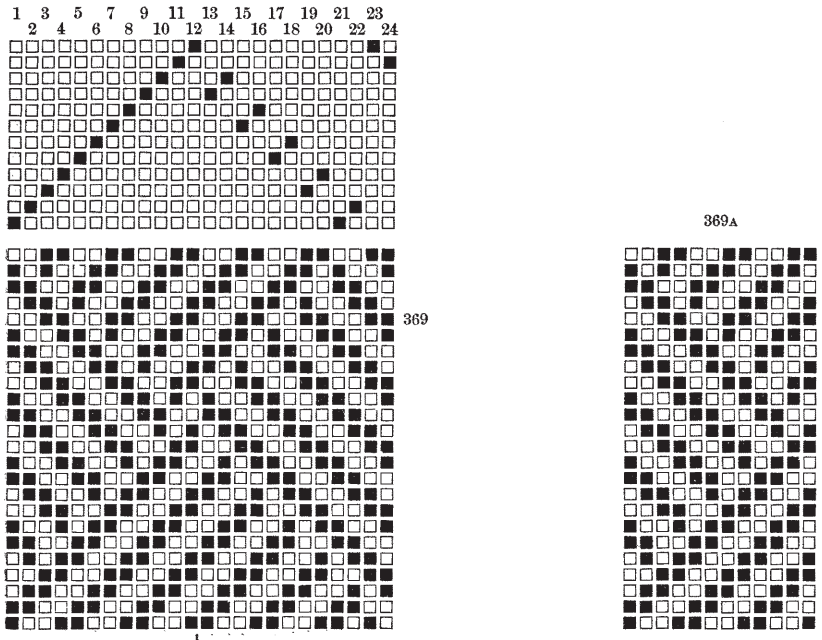
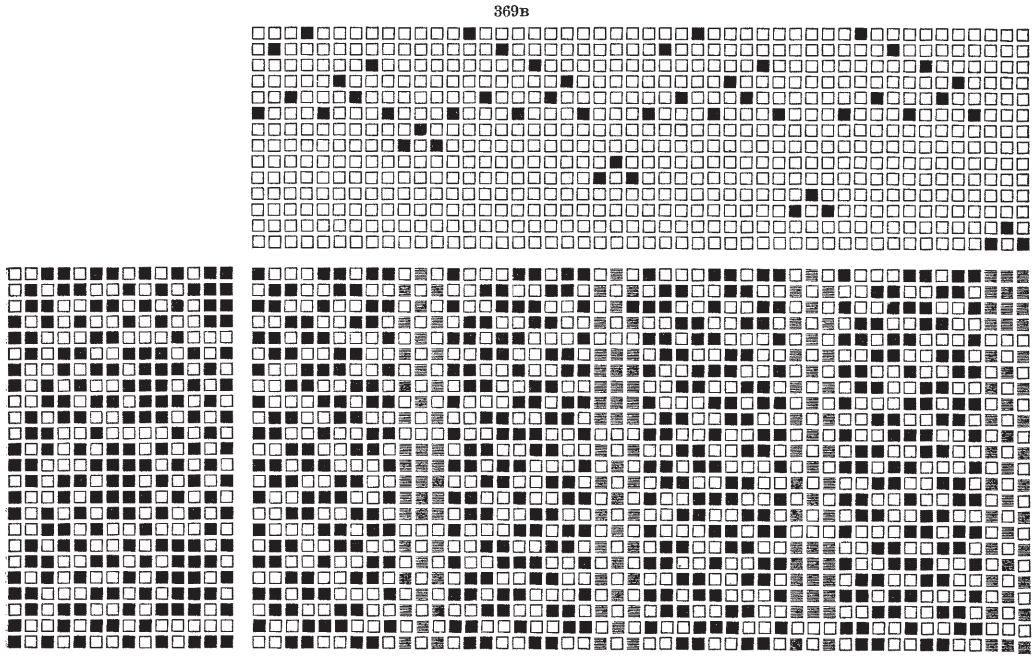


Figure 369B may illustrate another example of mixed drafts.

The design is constructed from granite ground and fancy effects placed in four-harness cross twill position on plain weave.

The design would require 48 ends for the repeat, but by the aid of drafting we have reduced this number (which equals the harness number) from 48 to 14.



In figuring out the necessary number of harness eyes for a straight draft we have to divide the total number of ends used in the cloth by the number of harnesses of the weave, and again divide the number thus found by the width of the

cloth in the loom. The product will be the number of harness eyes necessary per inch. In applying this rule to the straight draft, the number of harness eyes will be the same on each harness. For example we use a sixteen-harness weave and construct the cloth with 3200 ends of warp. 3200÷16=200 eyes per harness. We now divide the total number of eyes per harness by the width of cloth in the loom which is 50 inches. Therefore 200÷50=4 eyes per inch for each harness.

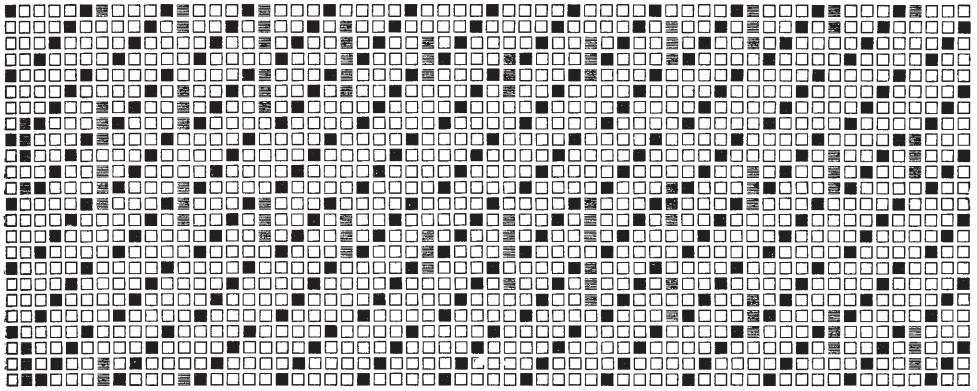
In figuring out the number of eyes per harness from a reduced draft, first we we must know how wide to set the cloth in the loom reed, second the number of dents per inch in the reed, third the number of patterns or repeats in the full width, fourth the number of ends which go together into one dent or space of the loom reed, fifth the draft and reeding plan.

In our example the reeding plan is indicated above the draft and is illustrated in figure 370. The repeat or pattern has sixty ends; the width in the loom reed is 41 inches and we put two and three ends into a dent; the reed has 32 dents per inch. 41×32=1312 dents for the full width, less 16 dents for selvage. 1312—16=1296 dents. The number of dents required for a repeat or pattern is 24. 1396÷24=54 patterns.

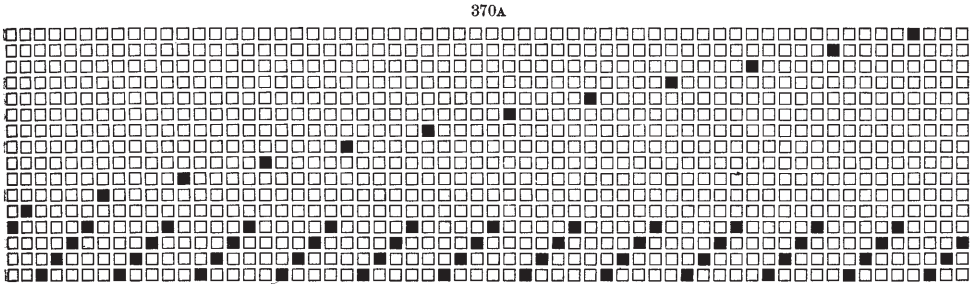
We find on the first, second, third and fourth harness twelve ends in a repeat or pattern. Therefore we must have 12×54=648 eyes on a spread of 41 inches for each of the four harnesses. On the 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th and 16th harness we find one end in each repeat or pattern and each of these harnesses must have 54 eyes on a spread of 41 inches. This formula applies to knitted harnesses only. If wire headles are to be used, the term "Spread" in inches should be omitted, and only the number of eyes for harness stated.

Figure 370 is the complete design. Figure 370A is the draft. Figure 370B is the reeding plan, and figure 371 is the plan from which we build the harness chain.

370



370A



370B

Construction of Cloth and Complete Dressing and Weaving Plan for a Tartan Plaid, Stuart Dress.

2720 ends 60 two-fold worsted for warps
40 " 60 two-fold " " selvages } 2.78 ounces per running yard.

Reed, 15 dents per inch, 4 ends into one dent=60 ends per inch.

Weave, four-harness $\frac{2|}{|2}$ twill.

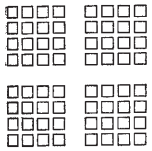
Dress, 48 inches wide on loom beam.

60 picks of 40 single worsted for filling=1.256 ounces per running yard.

Weight of cloth, 4.036 ounces per running yard.

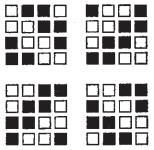
| | | |

372



We now fill in the first and second part with four-harness $\frac{2|}{|2}$ twill from left to right, and the third and fourth part with the same twill from right to left. *See figure 372a.*

372A



With this procedure we obtain the lines which at even angle are running from the centre in opposite directions.

Figures 374, 375, 376, 377 are constructed on the same principle.

Figure 374 is based on ten ends and picks divided into four equal parts of five ends and picks each.

376

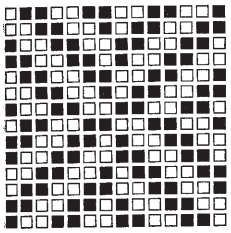
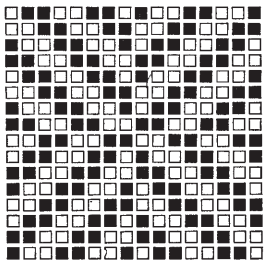


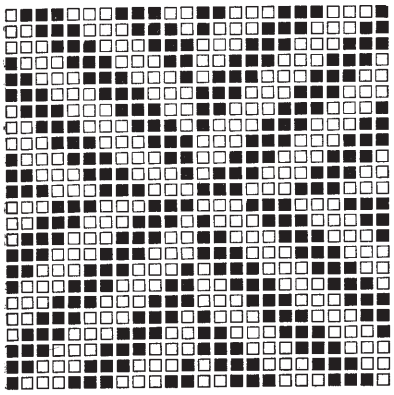
Figure 375 is based on twelve ends and picks divided into four equal parts of six ends and picks each. Figures 376 and 377 are worked out with the same principle, on a larger scale, and since this is only a matter of degree we make no further comment.

377

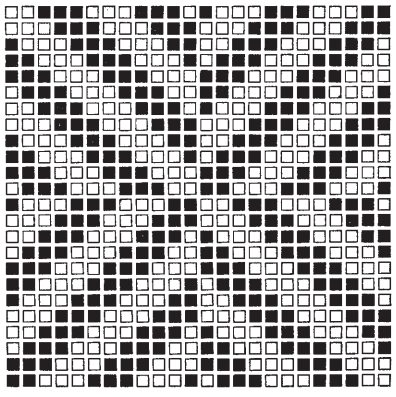


In constructing this weave it is of importance to begin the weave at such a point as to get the best result. For illustration we take Figures 378 and 379. In both designs we have used regular $\frac{3|}{|3}$ twill on twenty-four fields divided into four equal parts of twelve ends and picks each; but in design 379 we have started the design one pick lower and the result is very marked; the more preferable design for goods made from two colors is illustrated in figure 379. For piece dye goods use design figure 378.

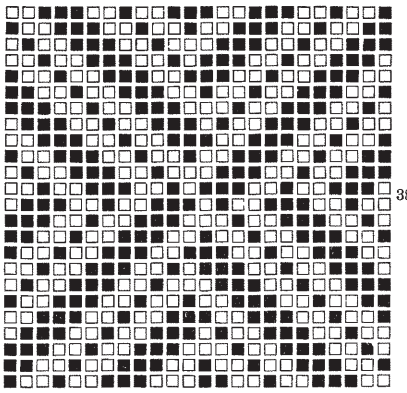
378



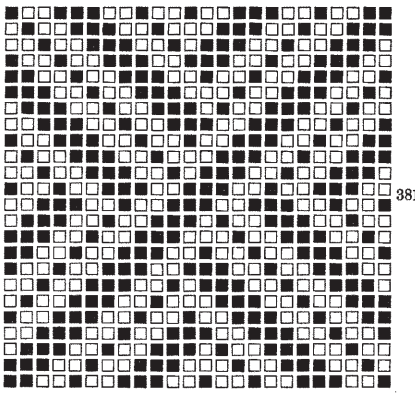
379



For another illustration we take figures 380 and 381. In both designs we use for foundation weave $\frac{3|\ \ |1|}{|2|\ \ |2}$ twill on twenty-four fields divided into four equal parts of twelve ends and picks each, and produce figure 380. If we now adapt the same principle as in figure 379 by beginning the weave one pick lower, the ray-like effect would be lost, for the reason that the twill line in the centre is not broken as is seen in figure 381—and therefore would produce a fancy twill instead of a ray-like weave for which we have aimed.

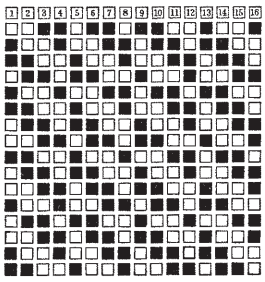


380

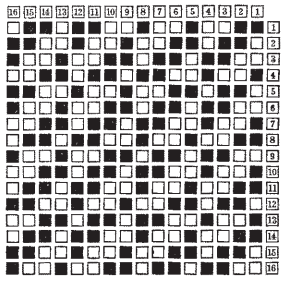


381

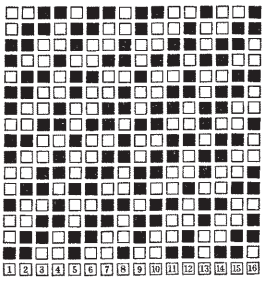
382D



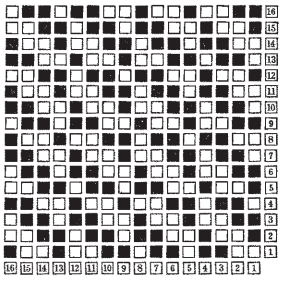
382C



382



382B



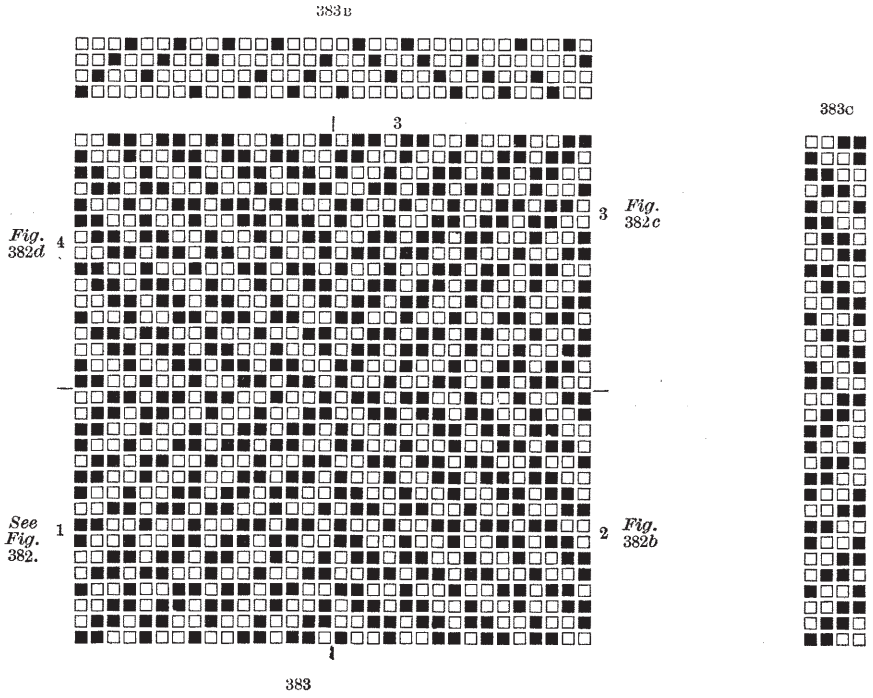
Another example is illustrated with figure 383; for foundation we use regular $\frac{2|}{|2}$ twill on sixteen ends and picks. We divide the sixteen fields into four equal parts of four ends and picks each, beginning each next following part on the point where the preceding part leaves off in width and in height. *See Figure 382.* From this we produce a second square in the following manner: We indicate all the blanks from 382 with marks in opposite direction, and for the the key of this procedure *see number 1 to 16 inclusive below designs 382 and 382b.* In comparing number 16 from 382 with number 16 from 382B the reader will readily see that all blanks above number 16 in 382 are reproduced with marks above number 16 in 382B and this relation holds with every corresponding number in the two designs.

From 382B we now prepare a third square, 882C, as follows: For the first line of 382C we use the top line of 382B but represent the blanks of the latter with marks and vice versa. The second line of 382C reading up the page is the second line of 382B; reading down the page, but changed as noted above, and so on till the sixteen lides are completed. The numbers at the right of each design will aid the student in folloing out the construction.

Figure 382D is constructed from 382C by this same general method. The first line of 382D, beginning at the right, corresponds to the first line of 382C, beginning on the lef, but has the blanks changed to marks, and marks to blanks.

Similarly all the lines of 382D, reading to the left, agrees with 382C, reading to the right, but changed as above.

Figure 383 represents figures 382, 382B, 382C and 382D,closed up into one compact squre and is the complete design.



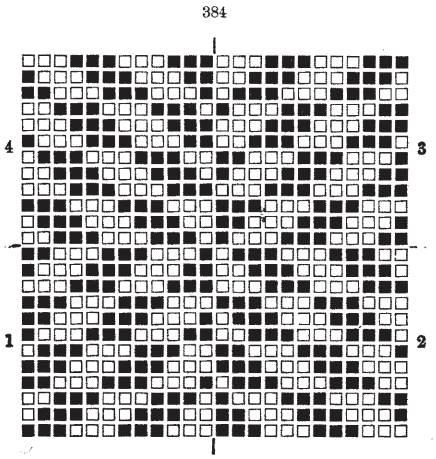
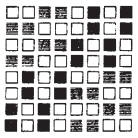


Figure 384 illustrates another example of the foregoing class. It is constructed from regular $\frac{3|}{|3}$ twill on twenty-four ends and picks with twill pieces of three picks each. The design is worked out according to the above principle. The second square is the negative of the first in opposite direction. The third square is the negative of the second, and the fourth square is the negative of the third in the opposite direction. By placing the second and third square face to face over the first and fourth, all the blanks will be covered by the marks of the other.

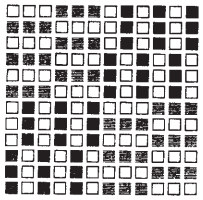
Checkerboard Weaves.

These weaves can also be constructed from all of our preceding weaves, and we commence with the construction of this class of designs from warp and filling rep which has been derived from the plain weave. With figures 385, 386, 387 we illustrate some of this class. All of these designs are produced from warp and filling rep, each one is being worked out on four squares. The first and the third squares contain warp rep, the second and the fourth squares contain filling rep.

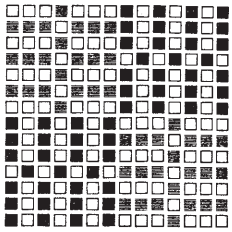
385



386



387

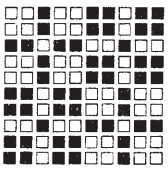


Figures 388 and 389 have been constructed on the same principle from basket weaves. These designs show to very good advantage if made in two colors in the following manner:

For design 388 we take

2 ends and 2 picks medium brown.
1 end and 1 pick light green.
2 ends and 2 picks medium brown.

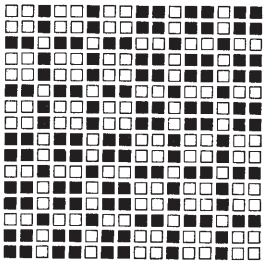
388



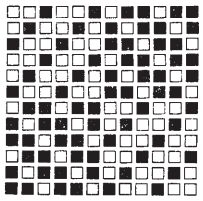
For design 389 we use

2 ends and 2 picks blue } 2 times
1 end " 1 pick white }
2 ends " 2 picks blue
2 ends " 2 picks brown } 2 times
1 end " 1 pick yellow }
2 ends " 2 picks brown

389

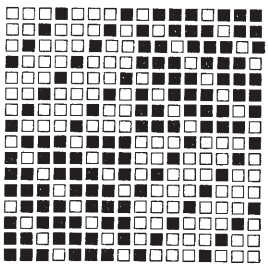


390



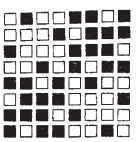
Figures 390 and 391 are formed from warp and filling twills. In figure 390 we have used the three-harness $\frac{2|}{|1}$ and $\frac{1|}{|2}$ twill, and for figure 391 $\frac{3|}{|1}$ and $\frac{1|}{|3}$ twill.

391

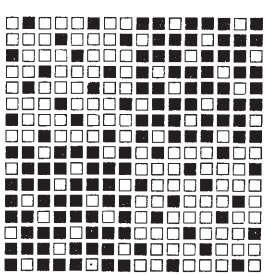


Figures 392 and 393 are worked out from four-harness cross twill. In figures 394, 395, 396 we have used warp and filling sateens for the construction. Figures 397, 398, 399 and 400 are formed from broken twills; and all these designs from 392 to 400 inclusive show the checkerboard effect to good advantage, if the warp is made from some color differing from the color of the filling. It will be sufficient to use only one color, as the light and shadow of the weave itself will produce the checkerboard effect.

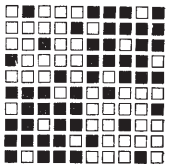
392



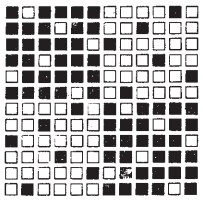
393



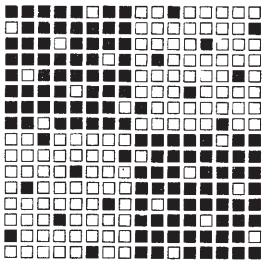
394



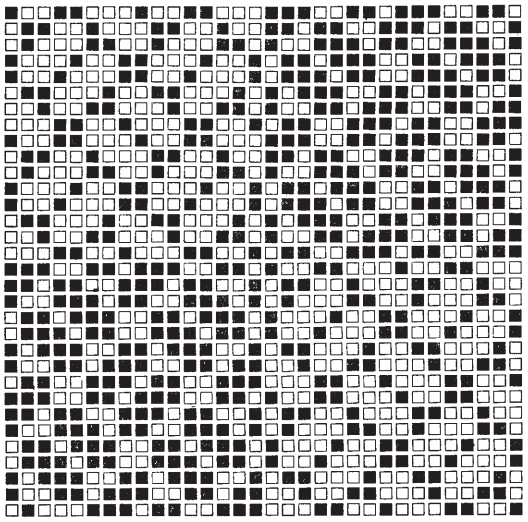
395



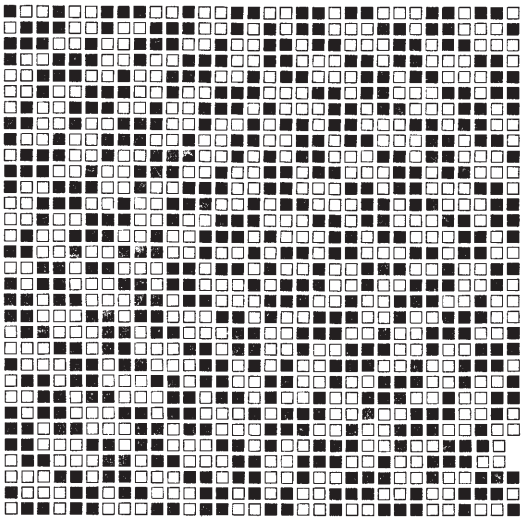
396



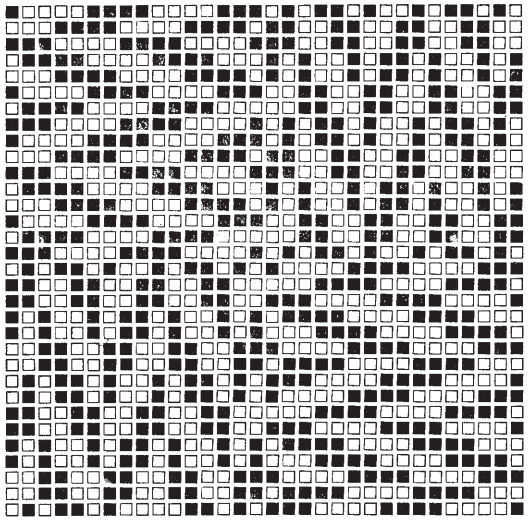
397



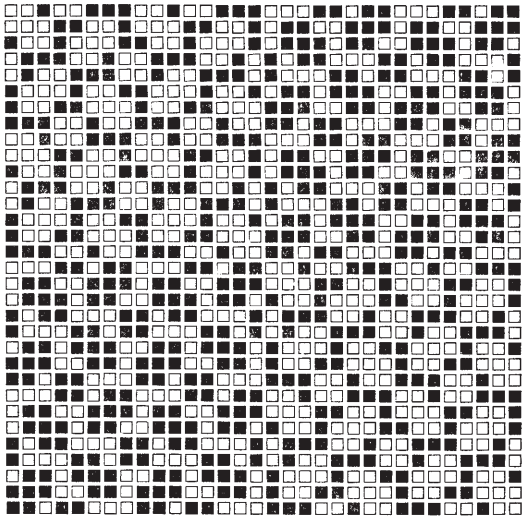
398



399

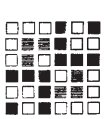


400

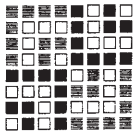


In nearly all the foregoing forms of checkerboard weaves the appearance has been due to the fact that two of the squares had filling, and two squares warp effect. A combination of both methods can be obtained by the use of corkscrew rep. Figures 401 to 405 inclusive will illustrate a series of these weaves. Their construction is indicated by the direction indexes (☞) in figure 407.

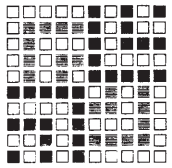
401



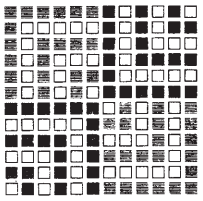
402



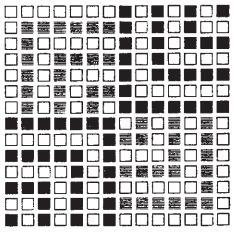
403



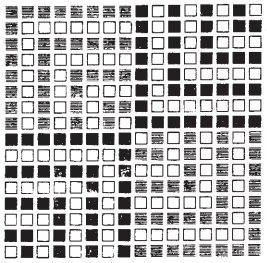
404



405

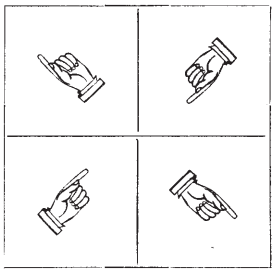


406



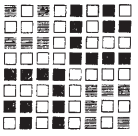
A similar effect is obtained in figures 408 to 412 inclusive, and again the method of their construction is indicated by the direction indexes (☞) in figure 413.

407

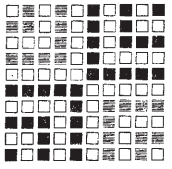


408

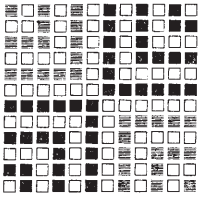
409



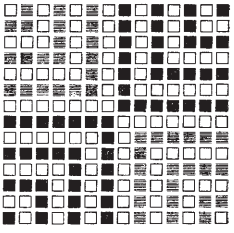
410



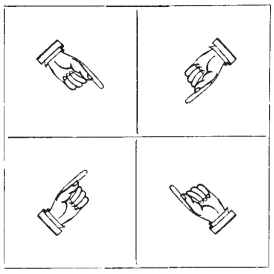
411



412

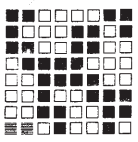


413

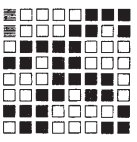


Another method of designing checkerboard weaves is illustrated by the aid of figures 414 to 421 inclusive. All of these eight variations have been produced from figure 414 by starting at different points and running in different directions. The starting point in each of these effects is indicated by the ■ characters.

414



415



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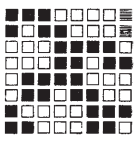

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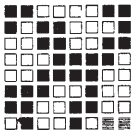

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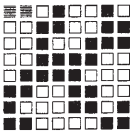
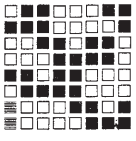
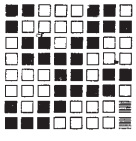


419



420



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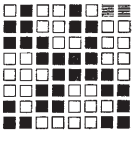
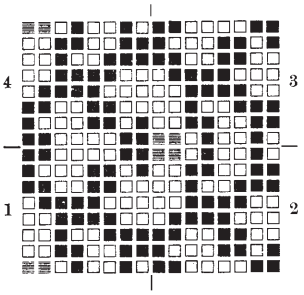


For the construction of figure 422, which is based on sixteen ends and sixteen picks, we divide the sixteen ends and picks into four equal parts. In the square marked 1 we place figure 414; in the next square marked 2 we place figure 418, in the square marked 3 we again place figure 414, and in square marked 4 we place figure 418. Figure 423 is constructed in a like manner from 414 and 419.

Figure 424 is constructed from 414 and 415.
" 425 " " " 414 " 417.
" 426 " " " 414 " 420.
" 427 " " " 414 " 421.
" 428 " " " 414 " 416.

422



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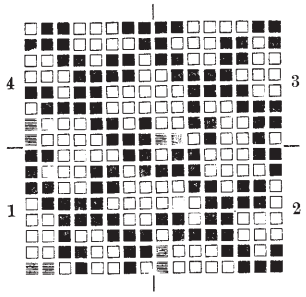

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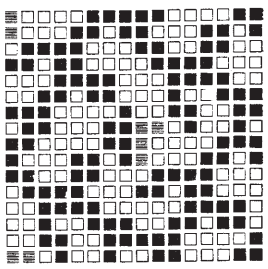
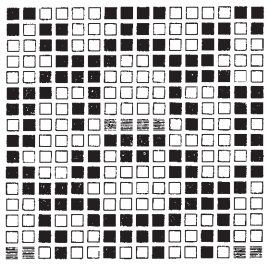
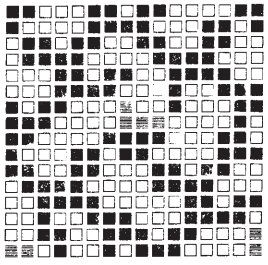


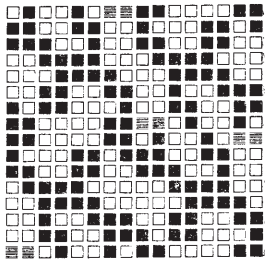
425



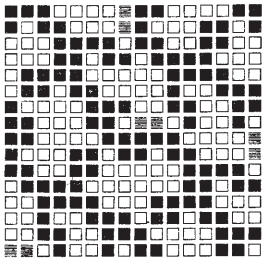
426



427



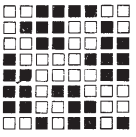
428



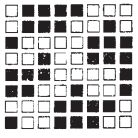
We can still further extend this principle by reversing figures 414 to 421 inclusive in the following manner. All the blank squares in these designs are to be made black, and all the black squares are to be left blank. *See figures 429 to 436 inclusive.*

Figure 429 represents the reverse of figure 414.
" 430 " " " " " 415.
" 431 " " " " " 416.
" 432 " " " " " 417.
" 433 " " " " " 418.
" 434 " " " " " 419.
" 435 " " " " " 420
" 436 " " " " " 421.

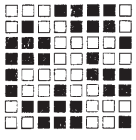
429



430



431



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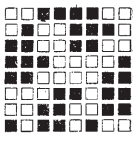

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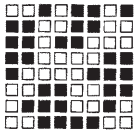

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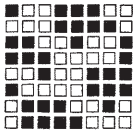

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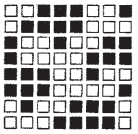

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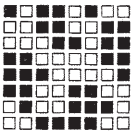
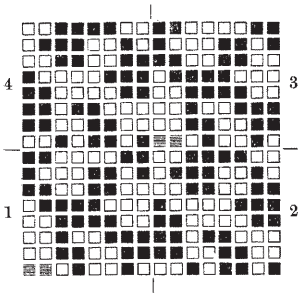


We now use for figure 437 the original figure 414 for the squares marked 1 and 3, and for the squares marked 2 and 4 we use figure 429.

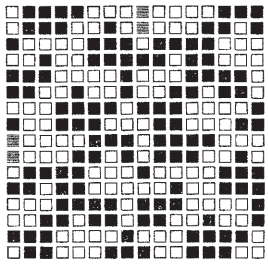
For	figure	438	we	use	415	for	1	and	3	and	430	for	2	and	4
"	"	439	"	"	416	"	"	"	"	"	431	"	"	"	"
"	"	440	"	"	417	"	"	"	"	"	432	"	"	"	"
"	"	441	"	"	418	"	"	"	"	"	433	"	"	"	"
"	"	442	"	"	419	"	"	"	"	"	434	"	"	"	"
"	"	443	"	"	420	"	"	"	"	"	435	"	"	"	"

Figure 421 and 436 has not been combined, but the problem is left open in order that the student may obtain practice in this work.

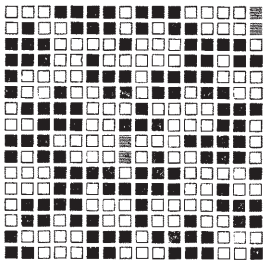
437



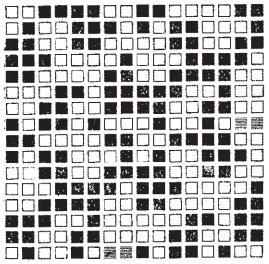
438



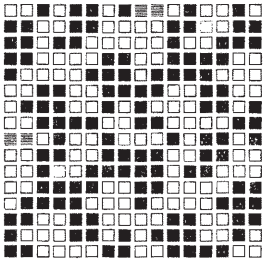
439



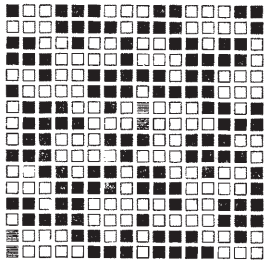
440



441



442



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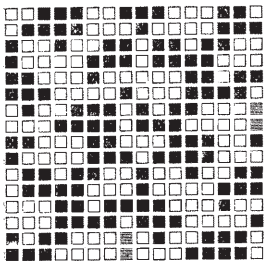


In closing this chapter we wish to state that the number of designs which can be produced is very large, and by the principle of algebra we find that there are possible 20,475 different weaves. Each design is constructed on four squares or the foundation weave four times, therefore we have a total of $4 \times 7 = 28$ different squares at our disposal, the number of a possible composition is therefore $\frac{28}{1} \frac{27}{2} \frac{26}{3} \frac{25}{4}$ equals as stated before 20,475. Likewise the same number of new designs can be produced by using the reversed forms obtained from figures 429 to 436 in combination with the original figures 414 to 421.

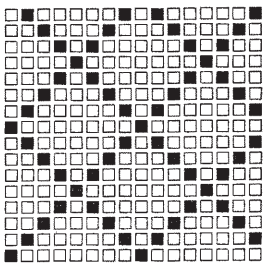
Honeycomb Weaves.

Honeycomb weaves are another series of weaves imparting a checkerboard appearance to the fabric, but the difference between this class of weaves and the foregoing is a very decided one. In our previous chapter of checkerboard weaves the fabric so produced shows a smooth and even face; on a fabric of the same construction where the honeycomb weave has been applied, the checkerboard effect is formed from alternate hollow or pocket-like and raised squares in diamond shape. Where the hollow or pocket-like form appears on the face, the raised form will show on the back of the fabric, and where the raised form appears on the face, the hollow or pocket-like form shows on the back. These facts can be well proven by putting a needle through the cloth at the point where the longest warp and filling floats interlace with each other.

The construction of these honeycomb weaves is very simple. We take a number of lines each way, representing warp and filling, and over these squares we design a cross twill of either single or double lines. The so obtained diamonds are alternately filled in with filling floats and left blank for warp floats. This produces extreme floats of warp and filling, which are contracted by the crossings of the original twill. For the purpose of illustration we use figure 445 which is an eight-harness honeycomb weave. The foundation is a $\frac{1|}{|7}$ cross twill, illustrated in figure 444.

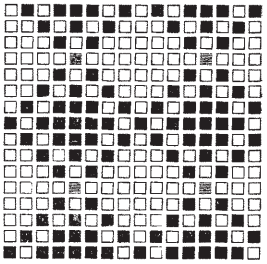
We now fill in every other square with filling floats, thus producing figure 445. The majority of these honeycomb weaves are based on diamond drafts, and therefore the harness number is reduced to nearly one-half of the number of ends which are necessary for the design. Figure 445 can be made on five harnesses.

444

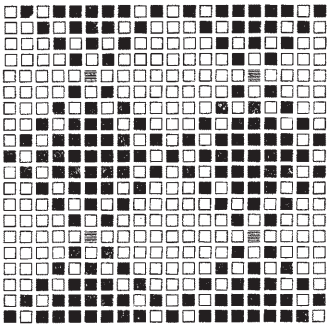


The centres of the formation of the pocket-like squares are indicated with ▪ types. Figures 446, 447, 448, 449 and 450 will illustrate a few of this class of honeycomb weaves, all of which, including 445, are worked out twice in width and height, in order to give a better idea of their appearance.

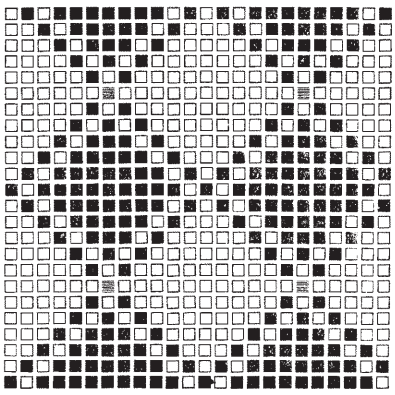
445



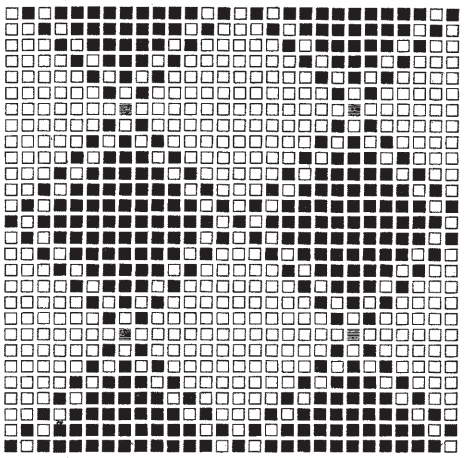
446



447



448



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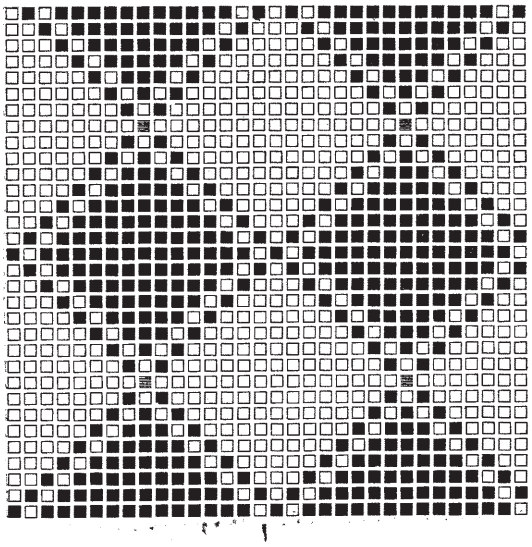
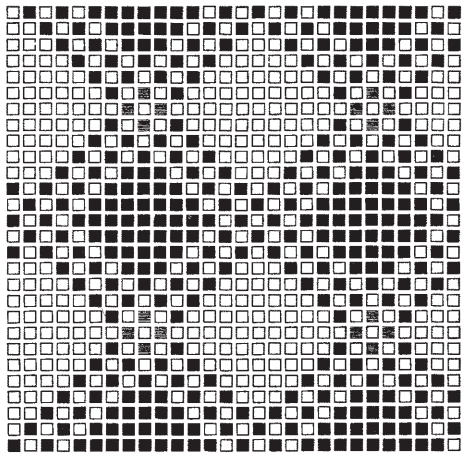


450



Figures 446 to 449 are constructed in the same manner as 445.

446	is	the	ten-harness	honeycomb weave.
447	"	"	twelve-harness	" "
448	"	"	fourteen-harness	" "
449	"	"	sixteen-harness	" "

Figure 450 illustrates another style of honeycomb weave. In the preceding illustration of these weaves we have used single lines of cross twills only; for the foundation in figure 450 we have taken double cross twill lines, and again every other square is filled in with filling floats. In this class the pocket-like and raised forms will appear stronger than they do in the foregoing class.

As before, where the pocket-like forms appear on the fabric, we have indicated the centres with ■ types.

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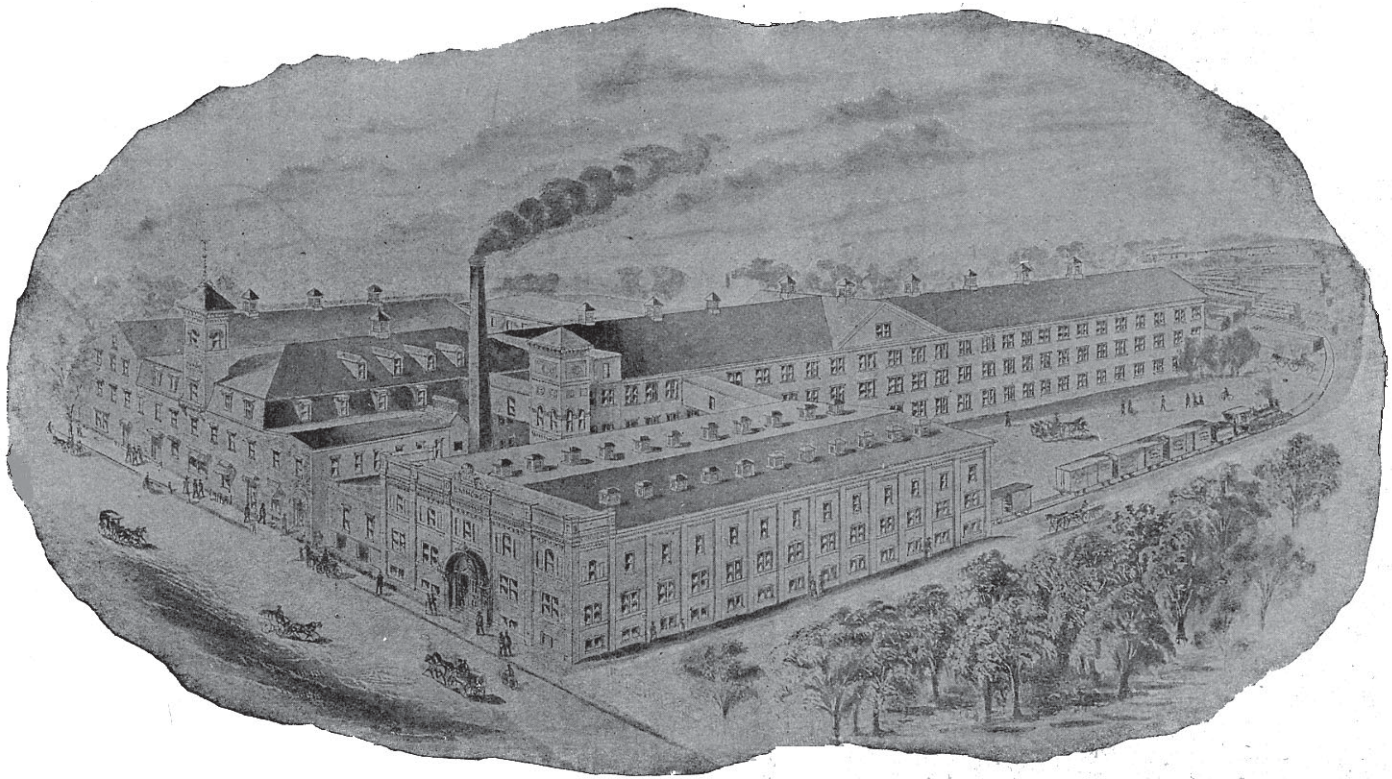

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