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

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

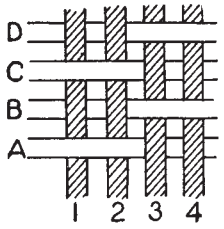


Fig. 130.

Fig. 131.

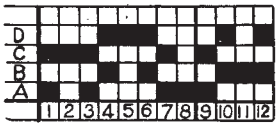
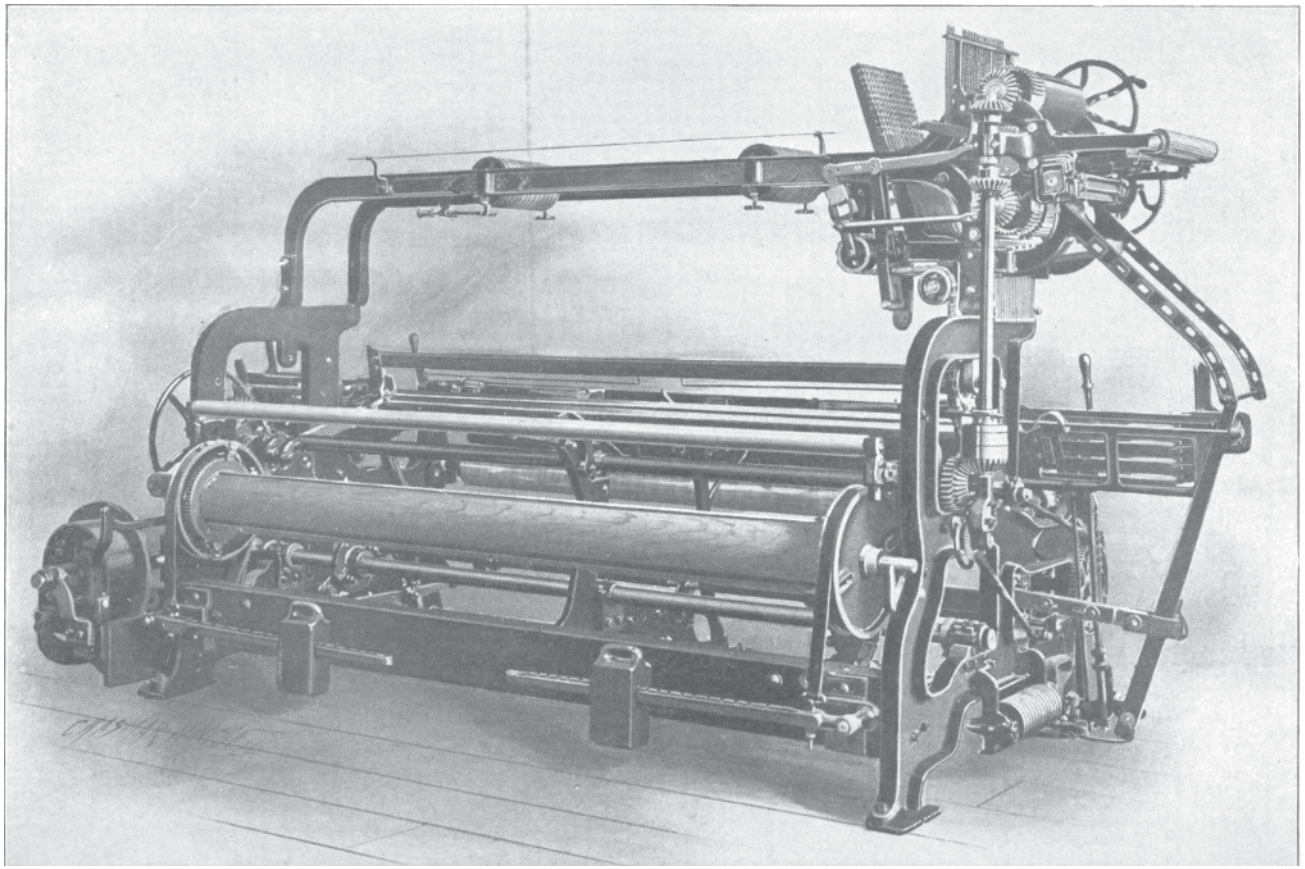


Fig. 132.

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



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

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

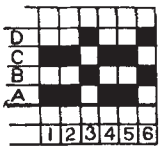


Fig. 133.

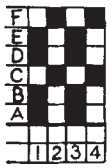


Fig. 134.

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

EXERCISES FOR PRACTICE.

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

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

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

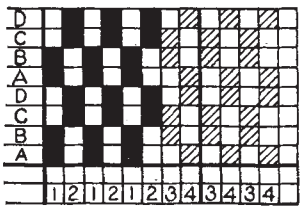


Fig. 135.

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

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

WARP EFFECT, FIGURED RIB WEAVES.

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

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

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

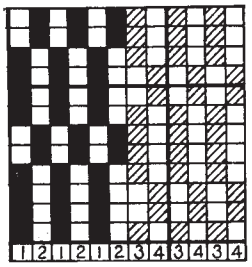


Fig. 136.

FILLING-EFFECT, FIGURED RIB WEAVES.

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

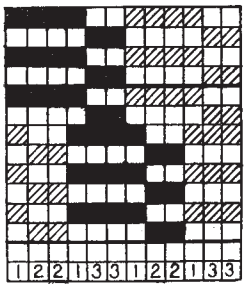


Fig. 137.

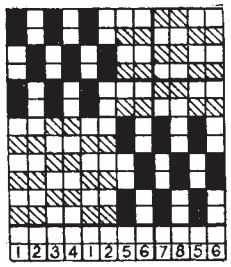


Fig. 138.

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

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

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

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

Fig. 139.

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

EXERCISES FOR PRACTICE.

1. Make this weave (Fig. 139), which will require 32 ends and 32 picks; also make two other designs of this same class.

2. Make designs for three of the figured warp-effect rib and three of the figured filling-effect, marking number of ends used for each weave. Eight designs in all.

OBLIQUE RIB WEAVES.

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

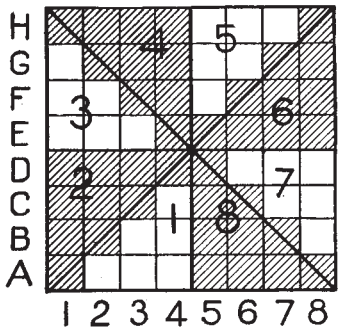


Fig. 140.

To design these weaves first mark off on the design paper the repeat of the weave; that is, if it must be woven on 8 harnesses, mark a square containing 8 ends and 8 picks; subdivide this square into eight parts, as shown in Fig.140; number each triangle in rotation 1, 2, 3, 4, 5, 6, 7, 8. To design an oblique rib weave, mark in each uneven numbered square the warp-effect rib weave (see Fig. 141), and in each even numbered square the filling-effect rib weave, which produces the completed oblique rib weave (Fig. 142). This procedure can be reversed; that is, the filling-effect rib can be designed in the uneven numbered triangles, and the warp-effect rib in the even numbered triangles, which will produce the finished weave (Fig. 143).

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

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

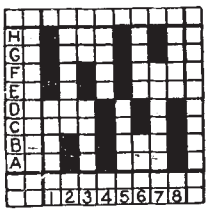


Fig. 141.

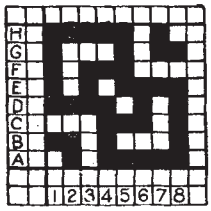


Fig. 142.

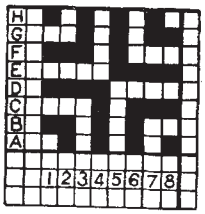


Fig. 143.

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

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

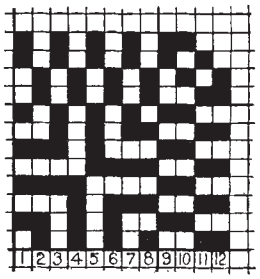


Fig. 144.

EXERCISES FOR PRACTICE.

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

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

BASKET WEAVES.

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

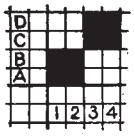


Fig. 145.

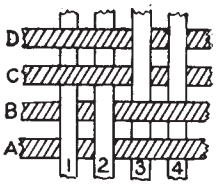


Fig. 146.

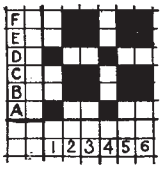


Fig. 147.

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

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

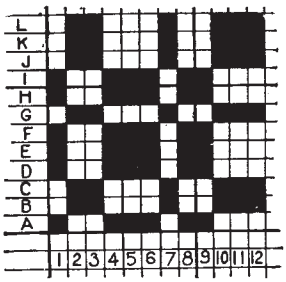


Fig. 148.

Fig. 147 is an illustration of these weaves. There is combined the plain and the two basket to form a weave which repeats on 3 ends and 3 picks. Fig. 148 shows the combination of a more complicated weave of this class. It is the 1, 2 and 3 combined, and consists of three changes. It repeats on 12 ends and 12 picks. In designing these weaves always commence at the left-hand corner and run the weave across the paper to the upper right-hand square. Two repeats of the original weaves are necessary before a complete repeat of the weave

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

EXERCISES FOR PRACTICE.

1. Make the designs for example 1, 3 and 3; example 2, 4 and 4; example 3, 5 and 5.

2. Combine the following in fancy basket weaves: example 4, 2–4; example 5, 1–4–2; example 6, 2–3–1–2–1; example 7, 1–1–2–2–3; example 8, 2–3–4.

CORKSCREW AND DOUBLE-TWILL WEAVES.

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

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

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

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

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

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

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

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

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

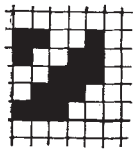


Fig. 149.

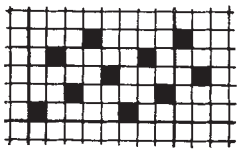


Fig. 150.

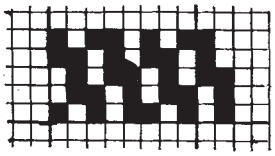


Fig. 151.

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

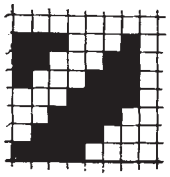


Fig. 152.

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

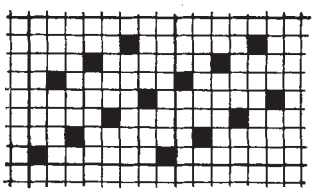


Fig. 153.

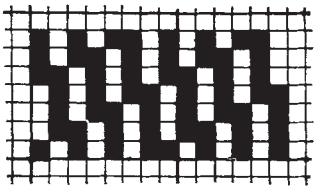


Fig. 154.

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

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

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

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

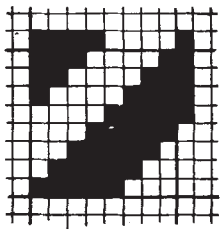


Fig. 155.

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

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

Fig. 155 is a 9-harness weave. Nine divided into two parts, one of which will exceed the other by one point only, 5 and 4 equal 9. $\frac{5}{4}$ 45-degree twill, with 5 for the move number. Fig. 166, harness draft. Fig. 157, extended design.

Uneven balanced weaves will always produce more perfect

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

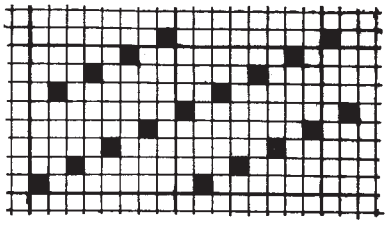


Fig. 156.

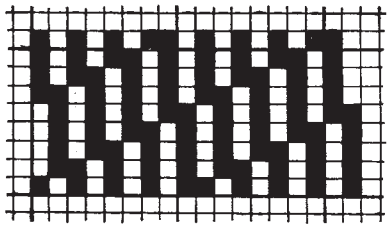


Fig. 157.

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

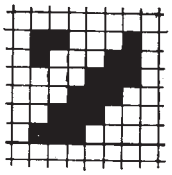


Fig. 158.

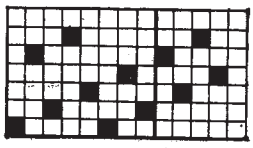


Fig. 159.

Fig. 160.

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

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

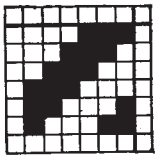


Fig. 161.

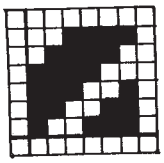


Fig. 162.

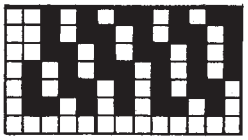


Fig. 163.

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

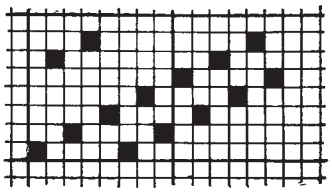


Fig. 164.

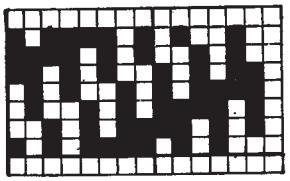


Fig. 165.

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

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

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

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

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

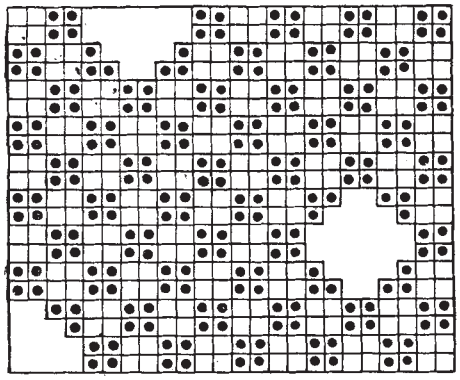


Fig. 27.

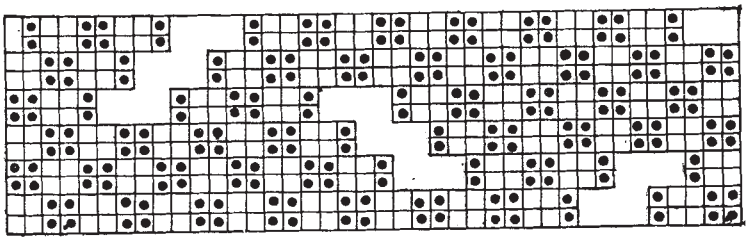
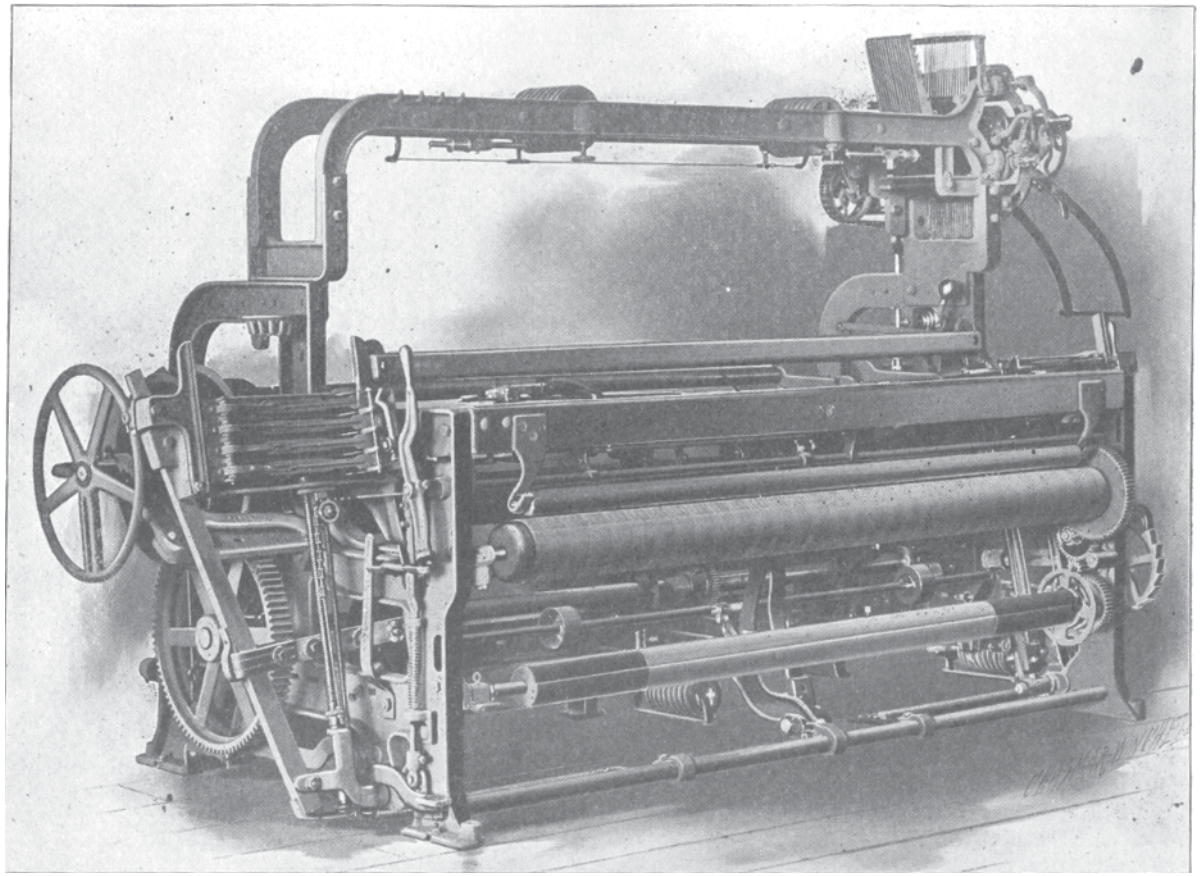


Fig. 28.



KNOWLES HEAVY GEM LOOM FOR DRESS GOODS

Crompton & Knowles Loom Works

TEXTILE DESIGN.

PART III.

CLOTHS BACKED WITH FILLING.

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

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

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

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

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

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

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

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

There are three methods of backing a fabric:

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

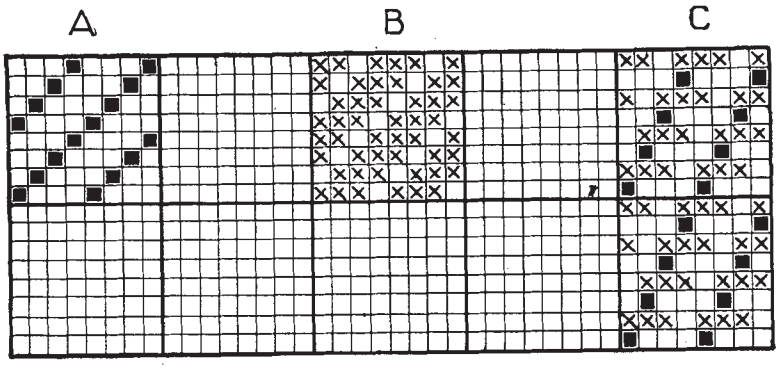
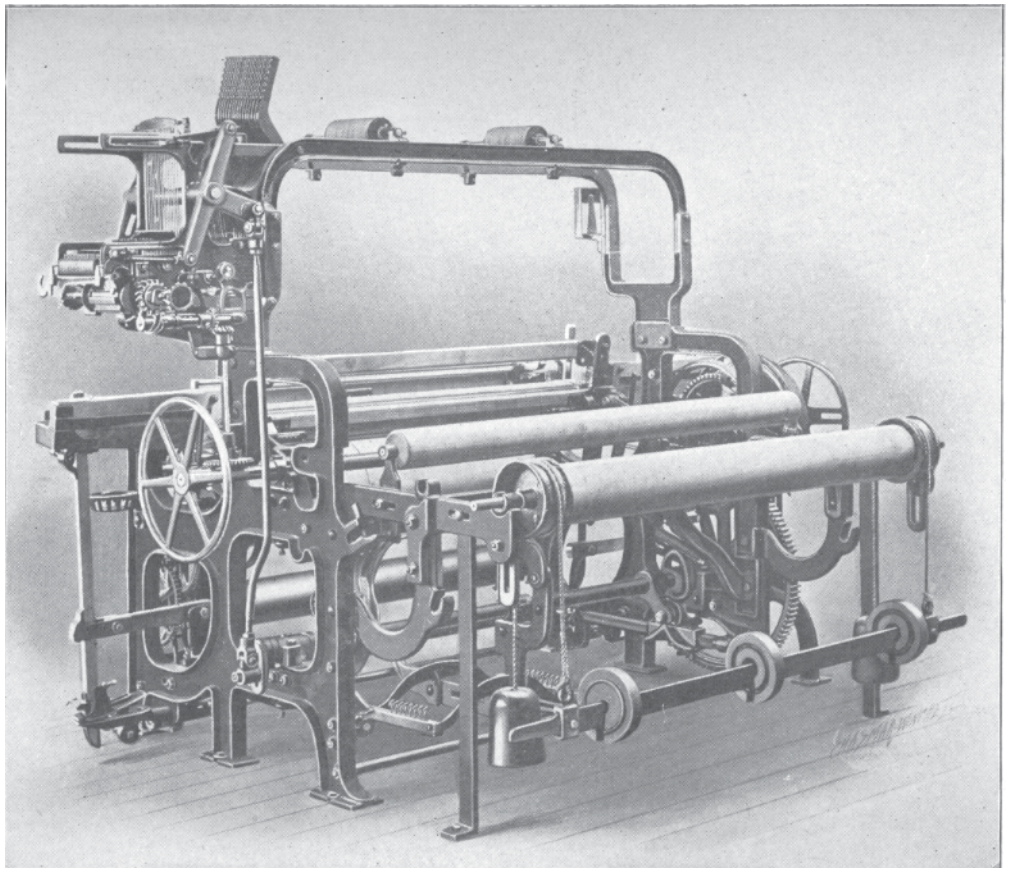


Fig. 166.

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

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

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



DOBBY SILK LOOM FOR TAFFETAS AND OTHER BROAD SILKS

Crompton & Knowles Loom Works

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

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

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

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

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

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

down or stitch. The 2d pick of face, 4th and 5th threads down.

Thus, the first backing pick in Fig. 167, C, takes down the fourth thread, which has been depressed by the first face pick and

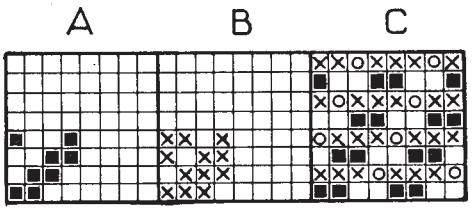


Fig. 167.

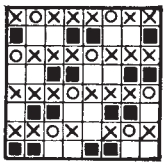


Fig. 168.

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

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

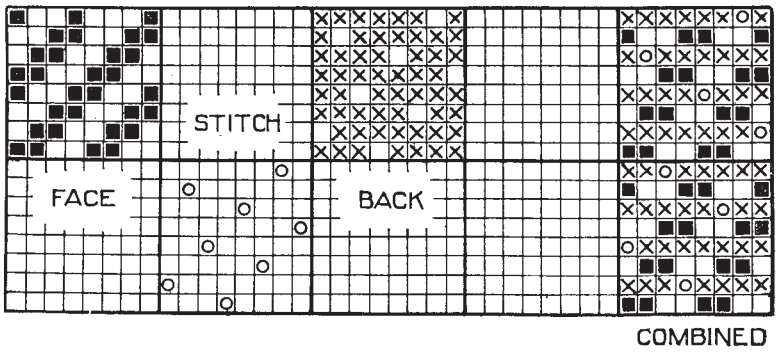


Fig. 169.

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

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

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

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

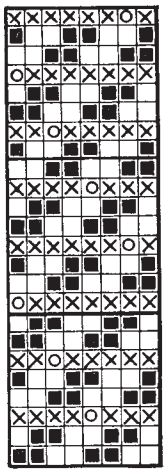


Fig. 170.

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

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

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

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

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

sale, and the designing principles of which are very similar to those just referred to; cotton warp, worsted or woolen face, woolen back. The weave is generally a filling flush, as represented in Fig. 175. The chief object in this class of work is to hide the cotton warp, so that the face represents a perfect and smooth worsted or woolen surface. As the weave is made of long filling flushes, it is not a very difficult matter to find a suitable place to join the back and face to the cotton warp.

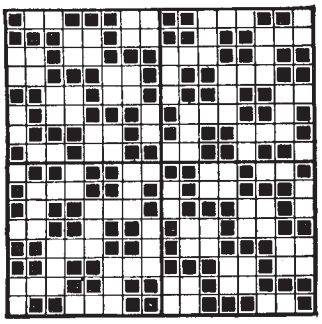


Fig. 171.

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

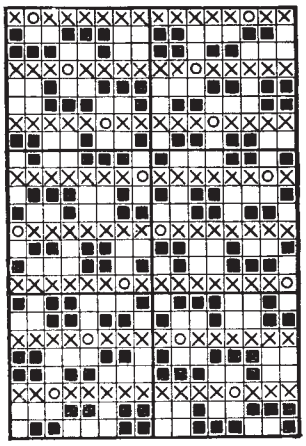


Fig. 172.

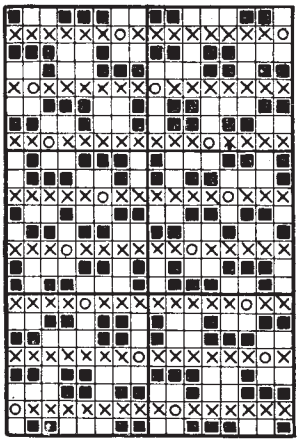


Fig. 173.

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

CLOTHS BACKED WITH WARP.

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

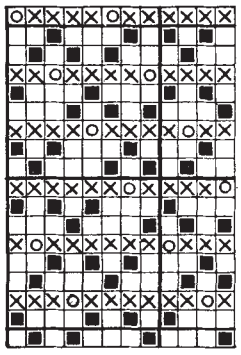


Fig. 175.

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

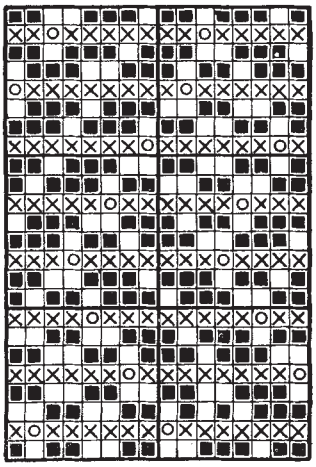


Fig. 174.

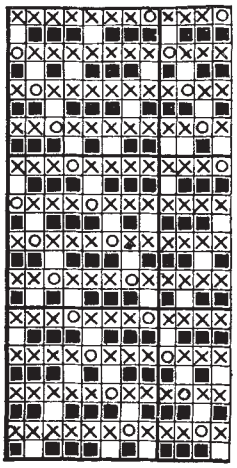


Fig. 176.

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

one advantage to be gained by using an extra warp; on each side of the fabric an entirely different design can be made, and as it takes extra harnesses to weave a warp back, the designer can utilize them to vary the figure. There is not much diversity applied to the under surface. This is usually of a sateen character, but the face weaves have every variety of design. The point of tie is as important in this type of cloth as in the previous one; the binding should fall in such positions as have face warp threads elevated on both sides, exactly as flushes of face-filling are necessary to effect the successful binding when backing with filling. Flushes of face warp are as essential to cover the ties when backing with warp as are filling flushes when backing with filling. The order of laying out this class of fabric is on the one-and-one principle. To arrange the threads on the two-and-one system, would necessitate the use of a heavier yarn for the back, and even then would produce a rather open texture on the under-surface. The yarns used for warp backs are, as a rule, about the same size of thickness as those used for the face fabric; the yarn is set close in the reed, and the warp contains a large number of threads per inch in proportion to their counts or sizes.

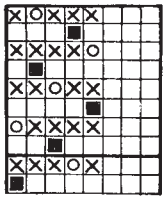


Fig. 177.

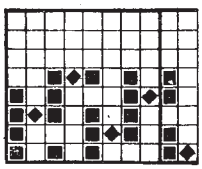


Fig. 178.

EXERCISES FOR PRACTICE.

1. Back plans 1 and 2 with weft 3 picks face to 2 picks back; plans 3, 4 and 5, 2 picks face to 2 picks back.

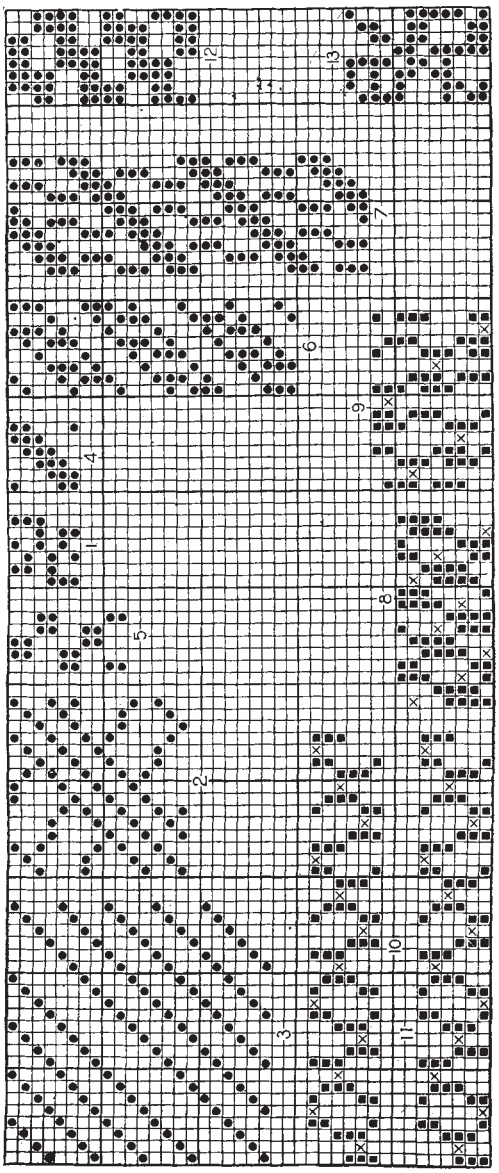
2. Back plans 6 and 7 with weft, 3 picks face to 1 pick back.

3. Point out any defect in plans 8 and 9 and give connected plans.

4. Plans 10 and 11 show two methods of backing the same weave with warp 2 and 1. Which do you consider the better of the two and why?

5. Back plan 12 with warp, 2 ends face to 1 end back so that there may be one pick only in each shed.

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



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

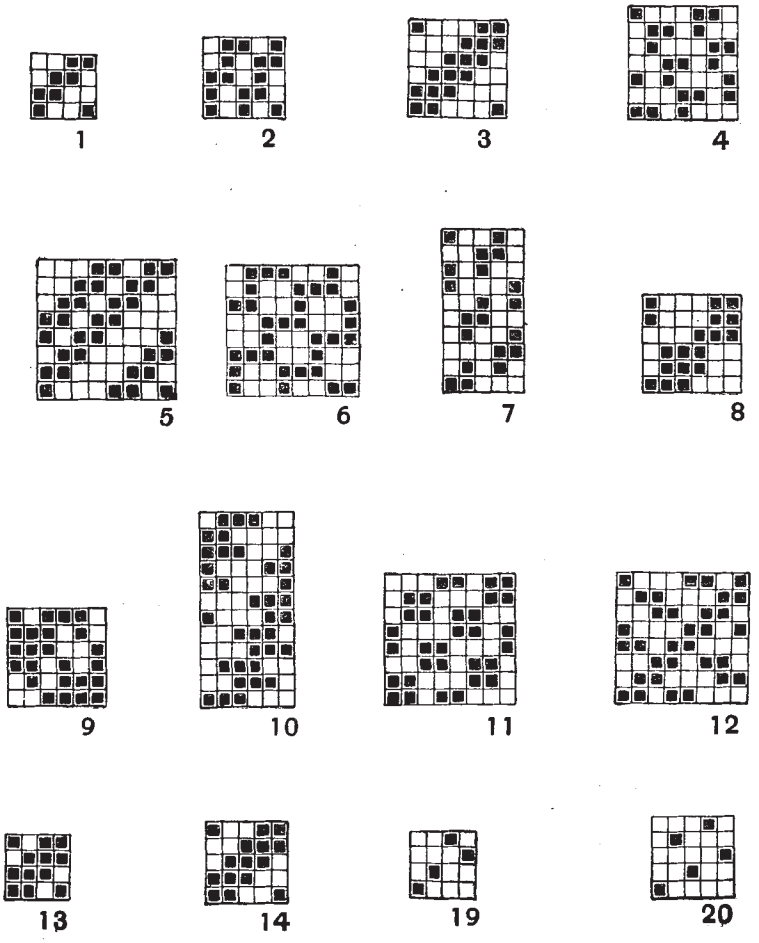
EXERCISES FOR PRACTICE.

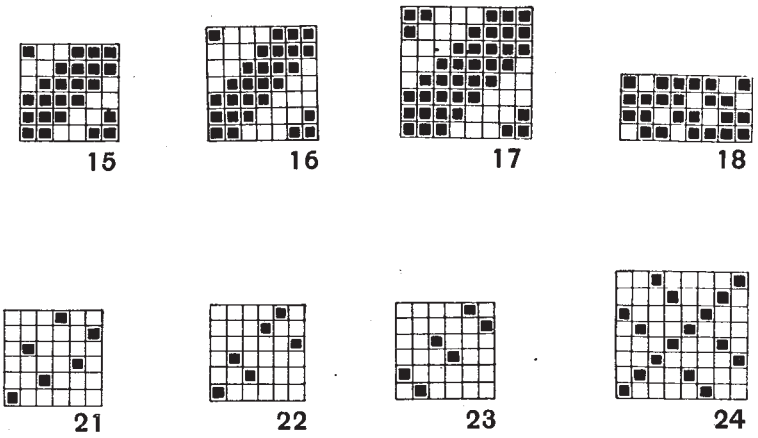
1. Back with warp 1 face to 1 back, plans 1–6, stitching firmly.

2. Back with weft 1 face to 1 back, plans 7–12, stitching once in the repeat.

3. Back with warp 1 face and 1 back, plans 13–18, stitching so that the back will be like the face.

4. Back with weft 1 face to 1 back, plans 19–24, stitching so that the back will be like the face.



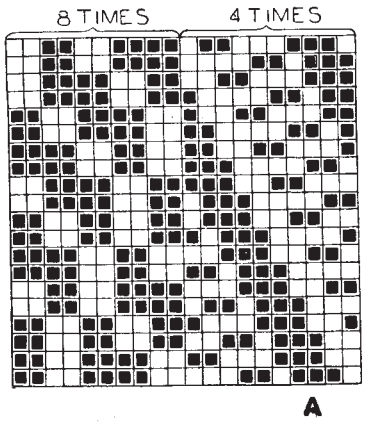


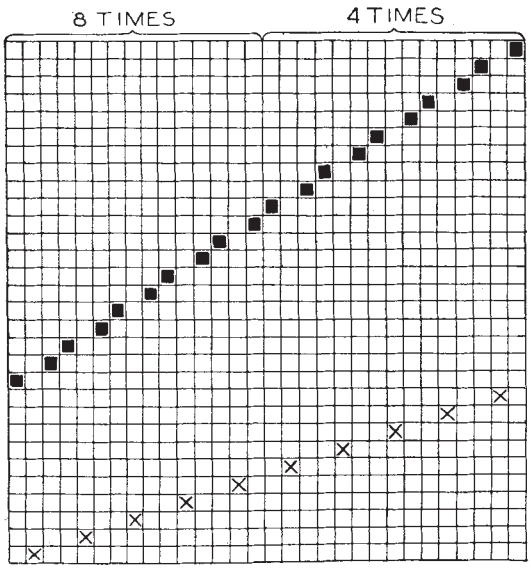
5. Back plan A with warp, 2 ends face to 1 end back, and give peg plan to weave it with draft B.

6. Back plans C D and E with warp, 3 ends face to 2 ends back.

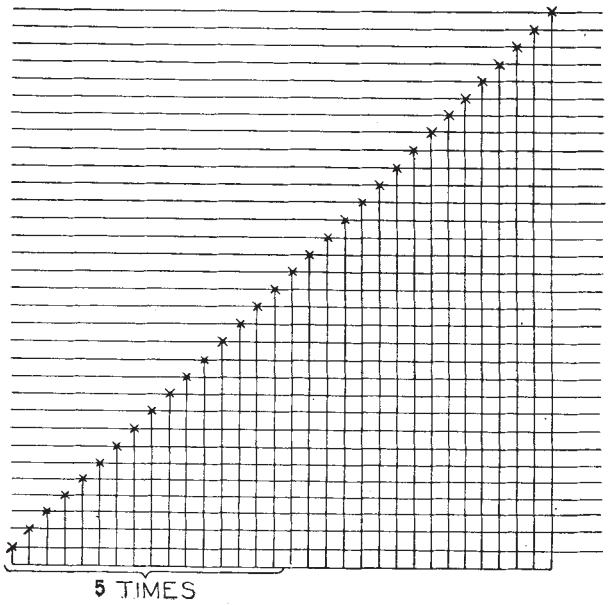
7. Back plan F with warp, 2 ends face to 1 end back, so that there may be one pick only in each shed.

8. Give draft and peg plan to weave design G with a warp back, 1 end of face to 1 end of back.

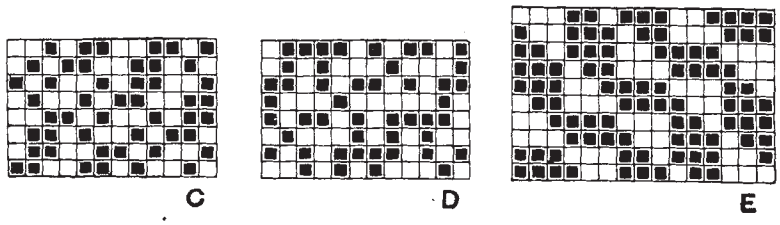


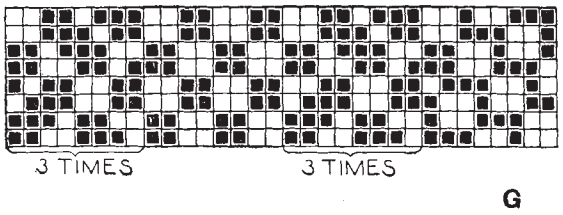


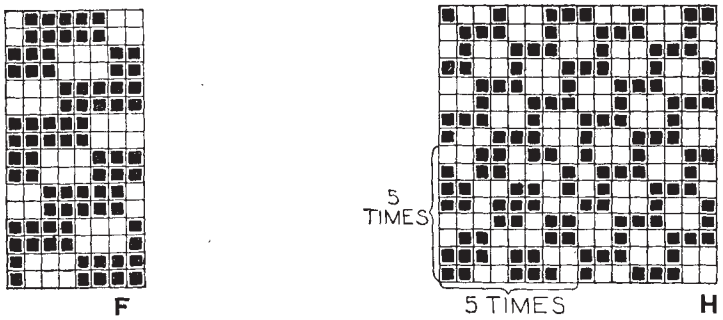
B



J







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

EXERCISES FOR PRACTICE.

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

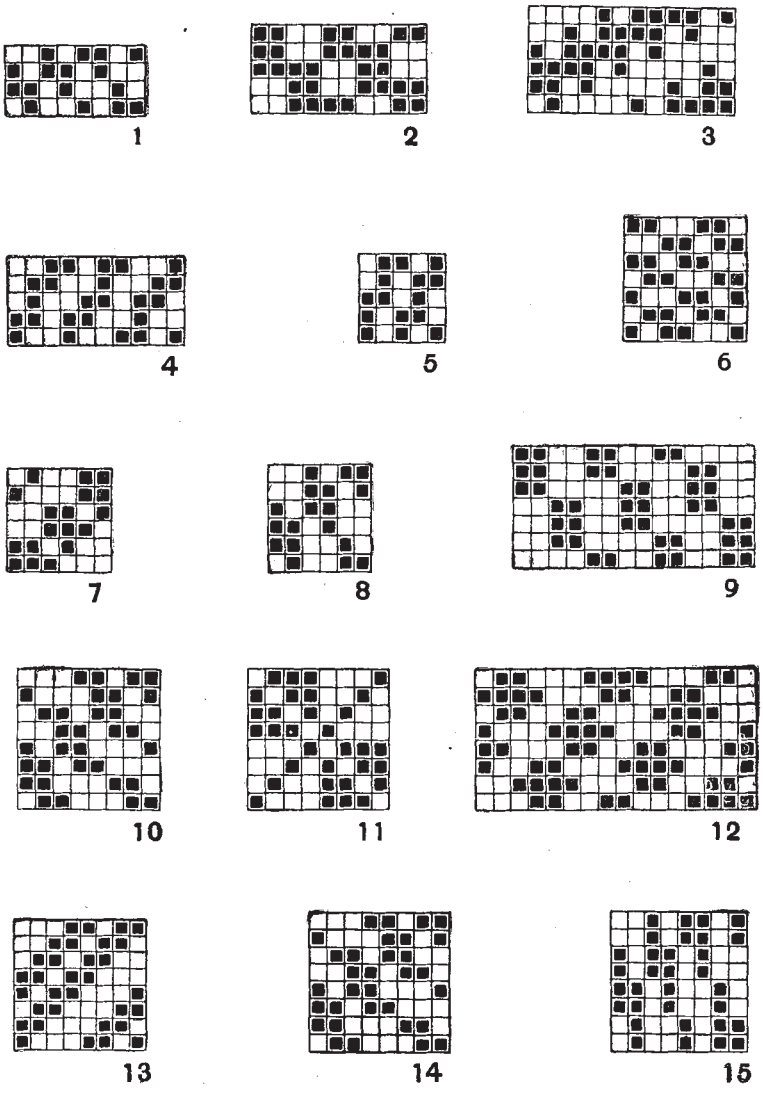
2. Back plans 7–12 with warp 2 face to 1 back, stitching twice in a repeat.

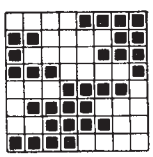
3. Back plans 13–18 with weft 2 face to 1 back, stitching twice in a repeat.

4. Back plans 19–24 with warp end and end.

5. Back plans 25–30 with warp end and end, stitching so that the back will be like the face.

6. Back plans 31–33 with weft, 1 face to 1 back.

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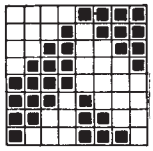
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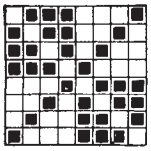
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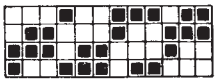
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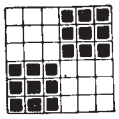
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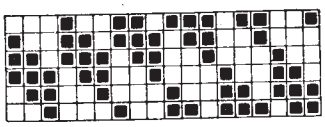
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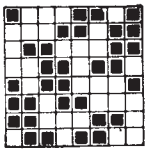
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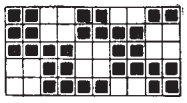
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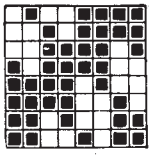
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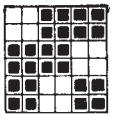
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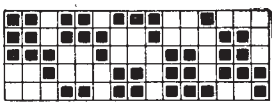
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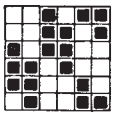
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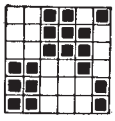
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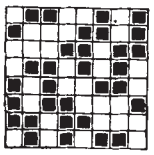
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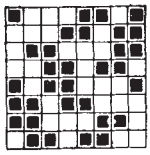
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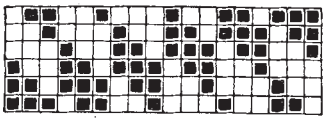

33.

EXERCISES FOR PRACTICE.

PAGE 125.

1. Put a warp back on plans 1–36, binding with a firm stitch. 1 end face to 1 end back.

2. As No. 1, but 2 face to 1 back.

3. Put a weft back on plans 1–36, binding with a loose stitch. 1 pick face to 1 pick back.

4. As No. 3, but 2 picks face to 1 pick back.

EXERCISES FOR PRACTICE.

PAGE 126.

1. Back plans 1–5 with warp, end and end, and with weft 2 picks face to 1 pick back.

2. Back plans 6 and 7 with warp end and end, stitching firmly, and give draft and peg plan for your answer.

3. Back plans 8 and 9 with warp end and end, stitching loosely, and give draft and peg plan for your answer.

EXERCISES FOR PRACTICE.

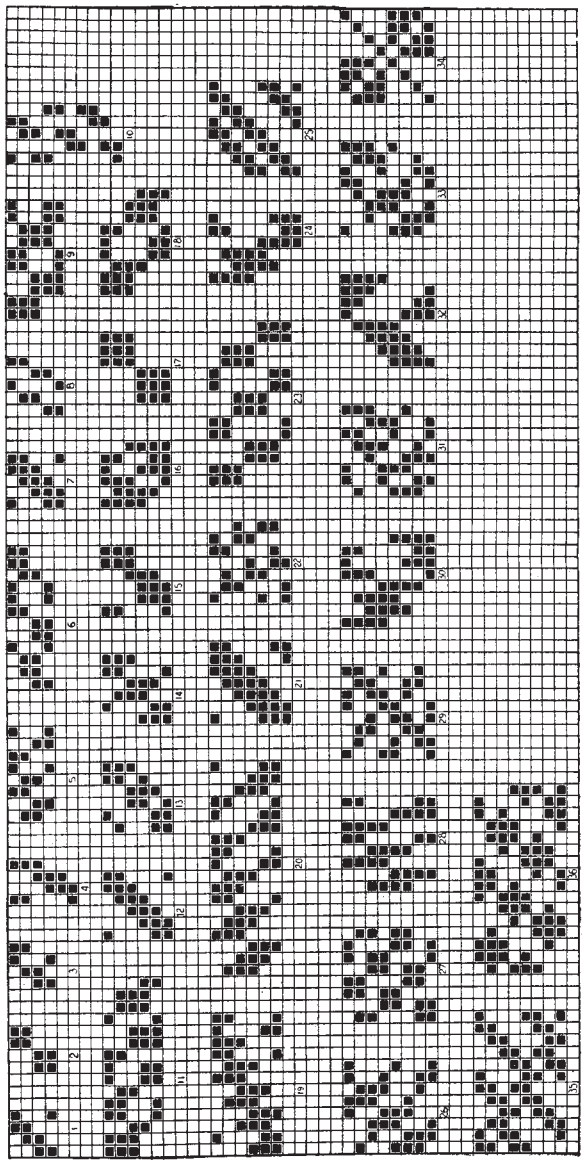
PAGE 127.

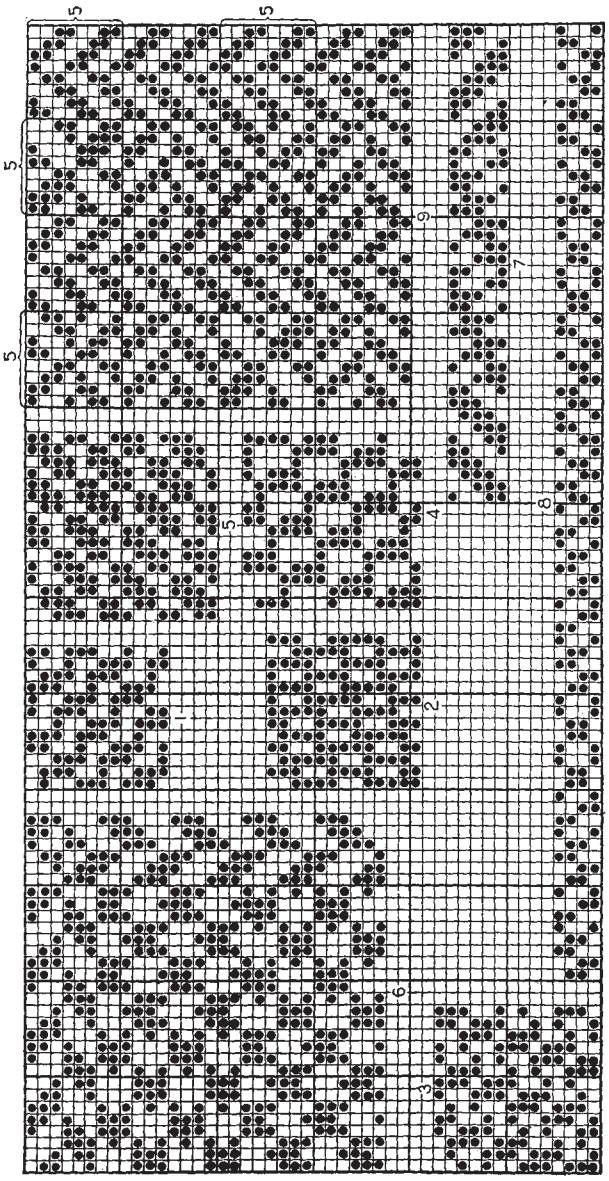
1. Complete design 1, of which 8 picks are given, and back with weft 2 face to 1 back.

2. Back plan 2 with warp, 2 face to 1 back, and give draft and peg plan.

3. Back plan 3 with warp, 2 face to 1 back.

4. Give draft and peg plan to weave design 4 with a warp back. 1 end of face to 1 end of back.

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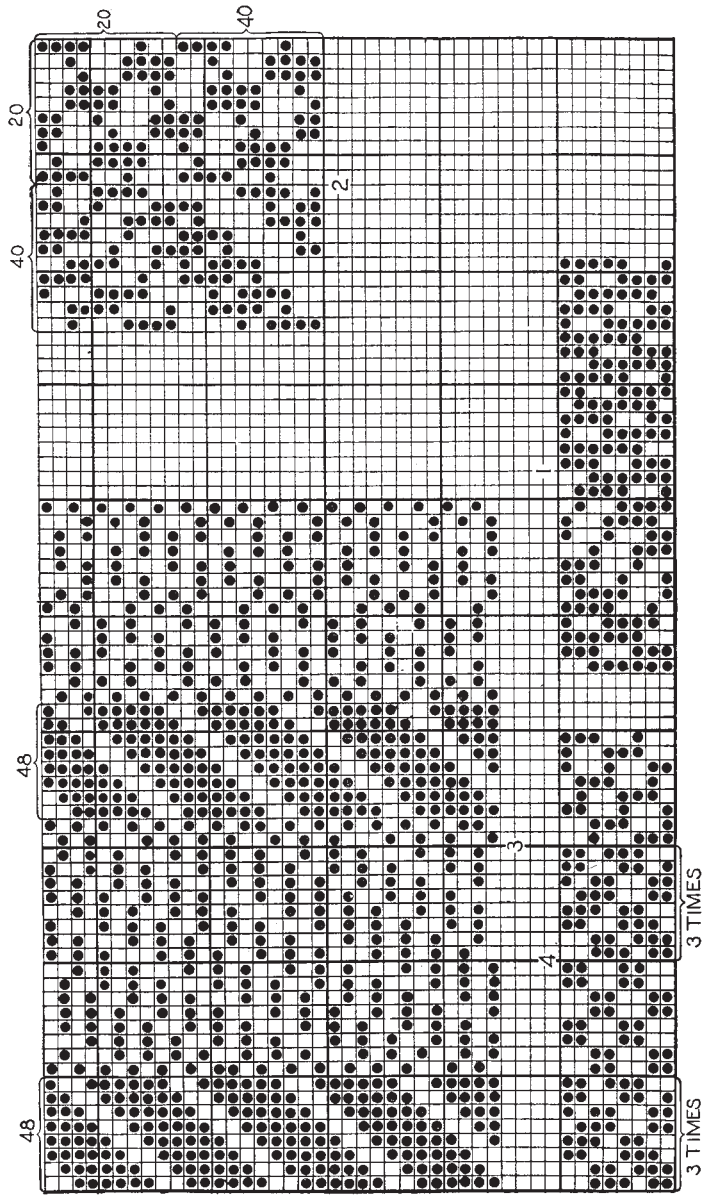
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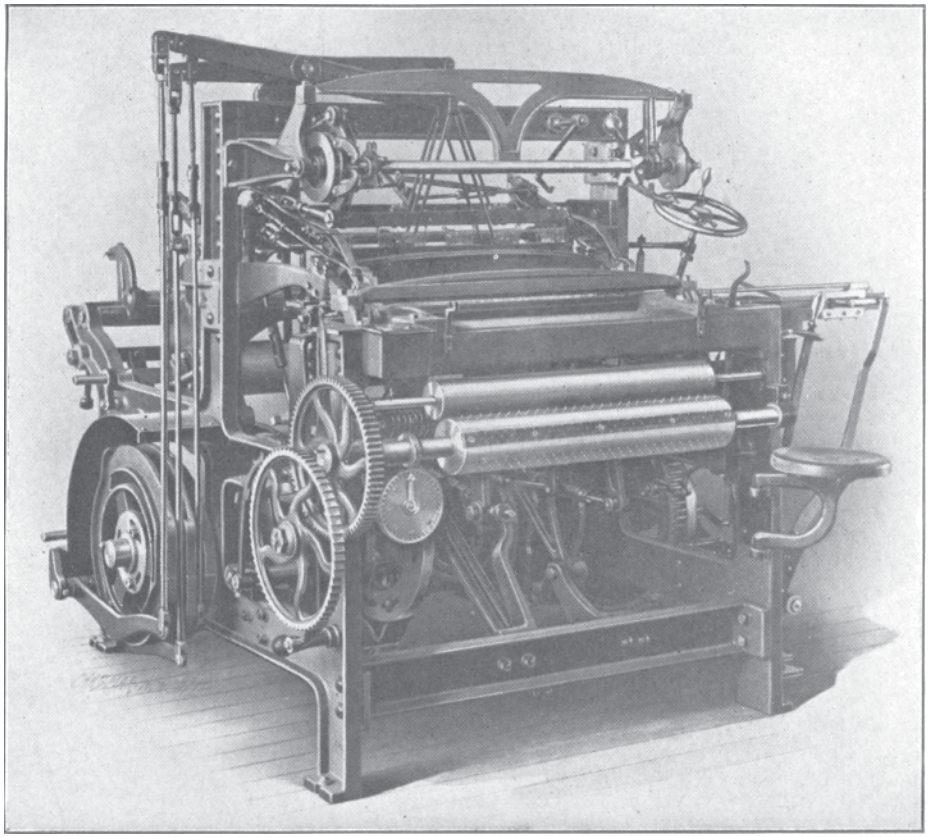
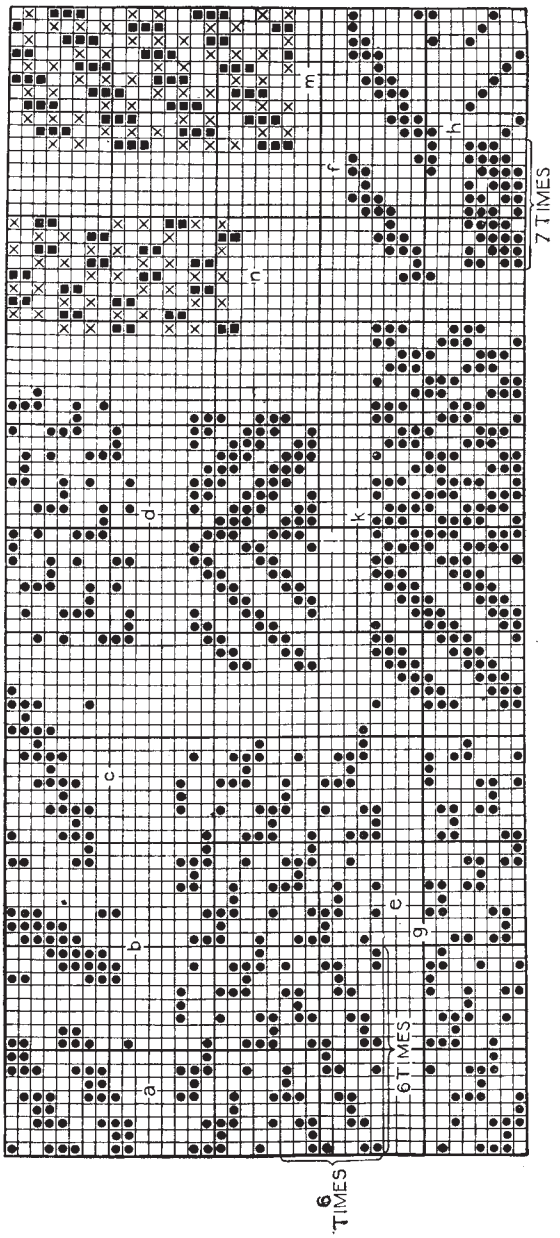
3 TIMES



KNOWLES AXMINSTER CARPET LOOM
Crompton & Knowles Loom Works


a
b
c
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h
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m
n
7 TIMES
6 TIMES
6 TIMES

EXERCISES FOR PRACTICE.

PAGE 128.

1. Make a design for a single cloth to weave on one beam and appear like plans a, b, c and d, in the same set.

2. Make a design with single weave to imitate the warp-backed design, e.

3. Make designs with single weaves to imitate designs f and g, then back your designs with weft 2 picks face to 1 pick back, so as to hide the backing weft as much as possible.

4. Back designs h and k with warp, 2 face to 1 back, then make single cloth designs to imitate them, giving suitable setting and counts of yarn for each.

5. Back design 1 with warp, 2 face to 1 back, then make a single cloth design to imitate your backed design and to weave on 30 shafts or less.

6. Make designs for backed cloths to give the nearest effect to plans m and n.

DOUBLE CLOTH.

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

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

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

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

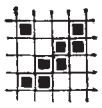


Fig. 179.

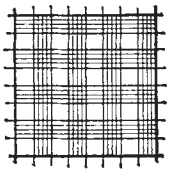


Fig. 180.

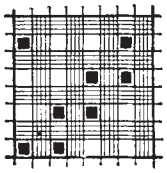


Fig. 181.

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

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

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

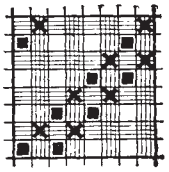


Fig. 182.

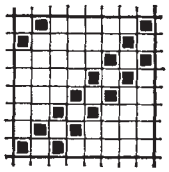


Fig. 183.

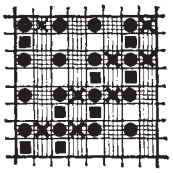


Fig. 184.

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

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

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

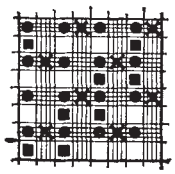


Fig. 185.

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

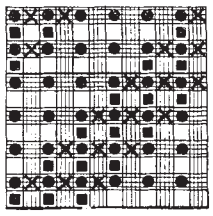


Fig. 186.

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

It will be well to keep the practical application and the

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

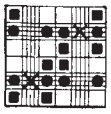


Fig. 187.


Fig. 188.


Fig. 189.

weave it. In the design, Fig. 187, there would be no reduction, because the face weave occupying four threads and the back weave two threads, there would of necessity be six harnesses required, but the matter of arranging the harnesses must be considered; that is, the arrangement of the draft must have particular attention, not only so as to know how the threads will be drawn through the harnesses, but also to determine the actual positions of the face threads and the back threads. Draw the face threads on the four front harnesses and the back on the two back harnesses, as in the draw in Fig. 194 and chain in Fig. 195; then reduce Fig. 190 to the smallest possible number of harnesses, as in the draw in Fig. 196 and chain in Fig. 197; next reduce Fig. 192 to its lowest number of harnesses, as in the draw at Fig. 198 and chain in Fig. 199.

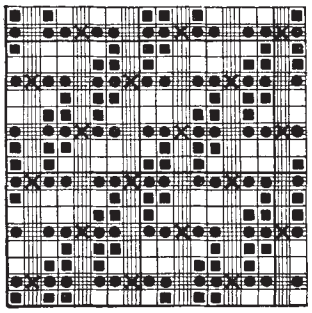


Fig. 190.

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

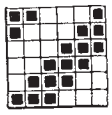


Fig. 191.

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

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

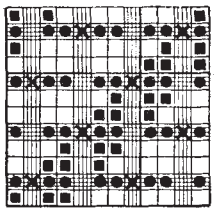


Fig. 192.

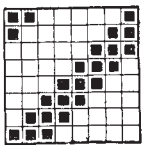


Fig. 193.

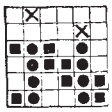


Fig. 194.

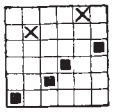


Fig. 195.

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

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

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

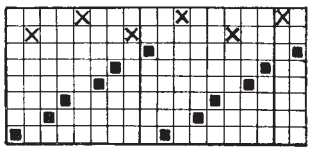


Fig. 196.

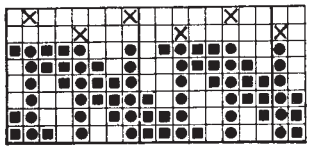


Fig. 197.

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

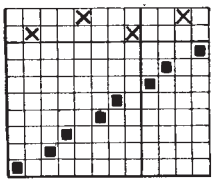


Fig. 198.

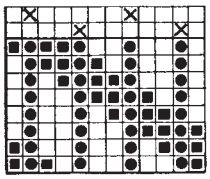


Fig. 199.

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

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

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

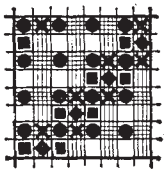


Fig. 200.

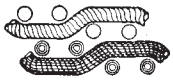


Fig. 201.

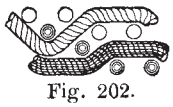


Fig. 202.

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

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

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

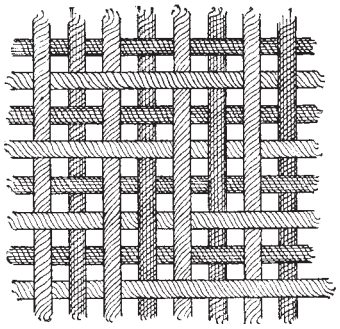


Fig. 203.

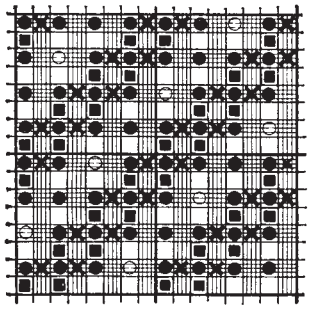


Fig. 204.

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

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

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

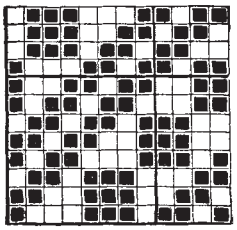


Fig. 205.

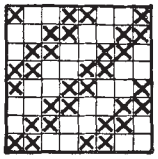


Fig. 206.

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

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

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

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

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

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

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

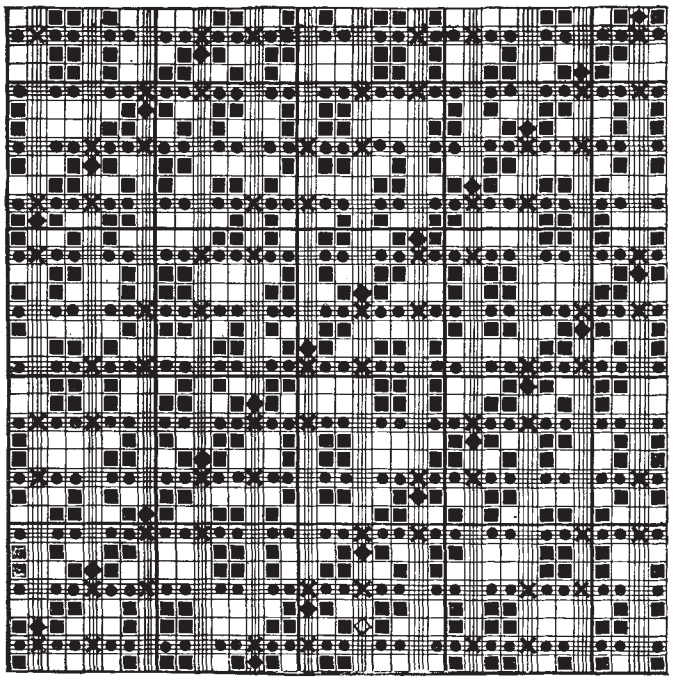


Fig. 207.

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

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

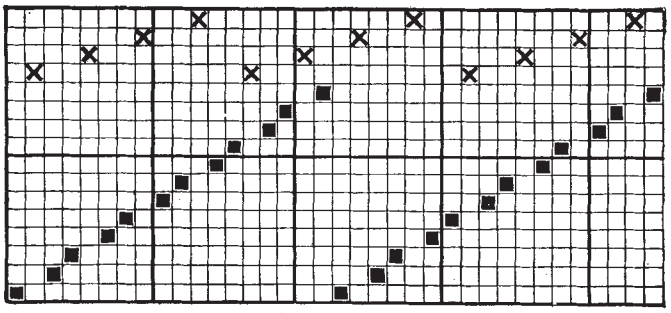


Fig. 208.

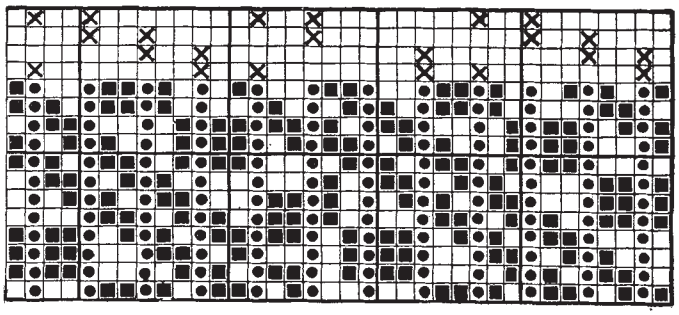


Fig. 209.

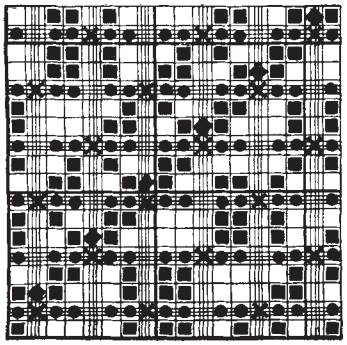


Fig. 210.

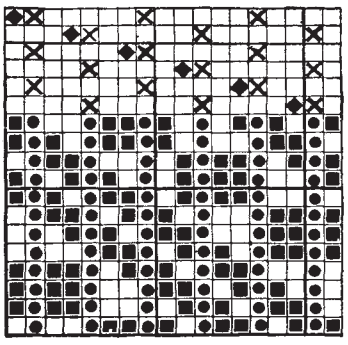


Fig. 211.

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

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

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

TO LAY OUT A DOUBLE-CLOTH DESIGN.

First: Obtain complete dimensions and mark off.

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

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

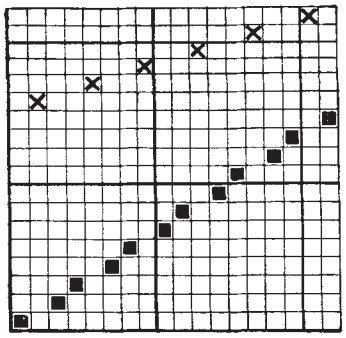


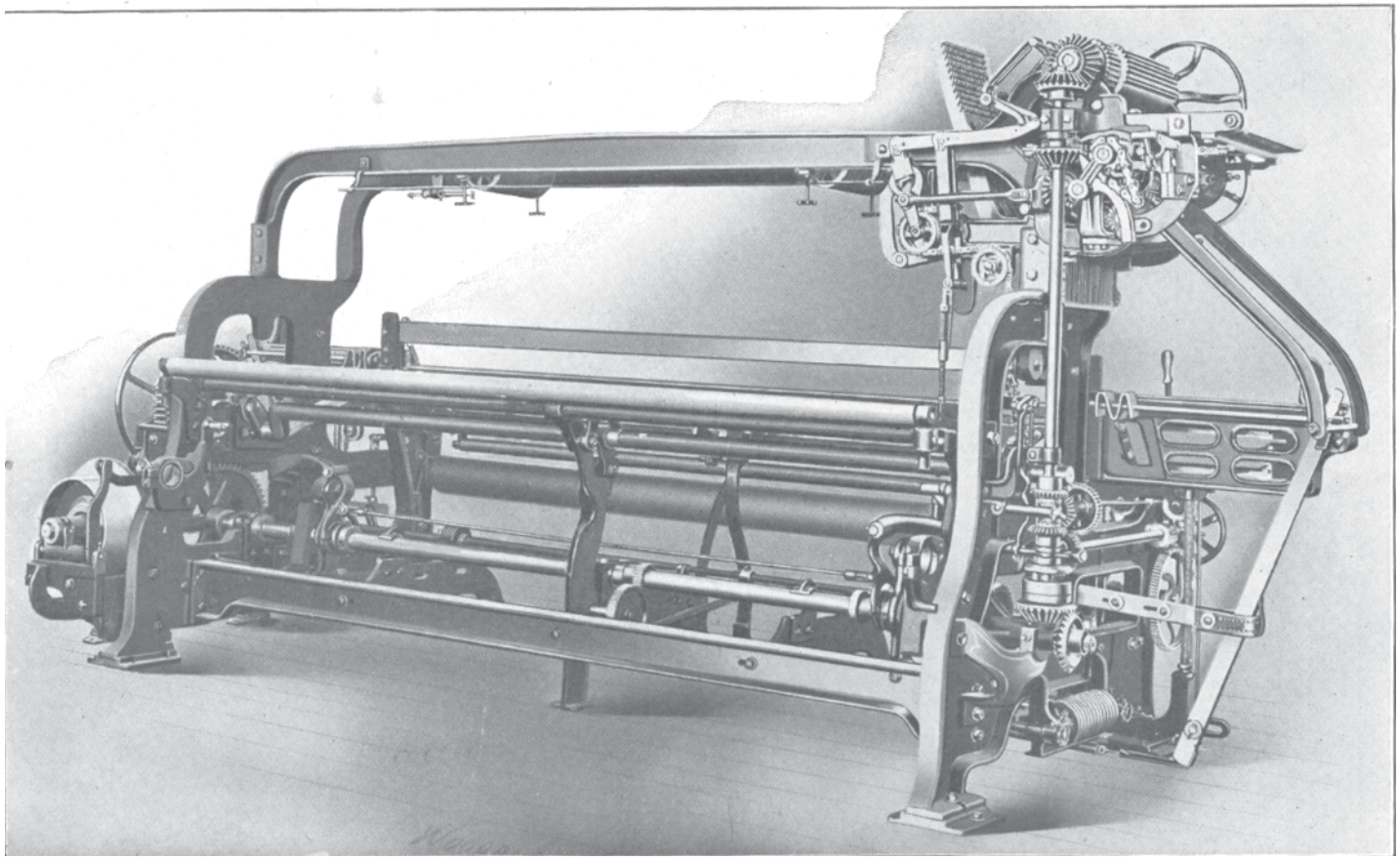
Fig. 212.

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

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

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

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



REAR HARNESS-END VIEW OF HEAVY WORSTED LOOM

Crompton-Thayer Loom Co.

EXERCISES FOR PRACTICE.

PLATE A.

1. Stitch plans 1–5 for double cloths, using both warp and weft for this purpose.

2. Complete plans 6–9 for double cloths, using both backing warp and weft for stitching.

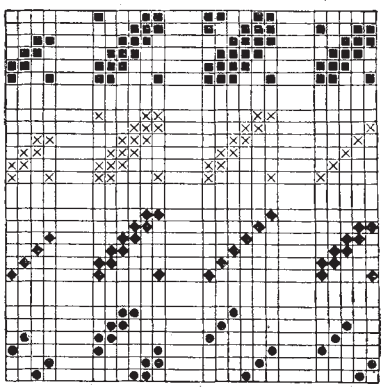
3. Make 4 plans for double cloths from the following particulars:

Plan of Face Weave.

Plan of Back Weave.

Plan of Back Warp stitch.

Plan of Back Weft stitch.



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

PLATE B.

5. Complete plans 1–4 for double cloths, using both backing warp and weft for stitching.

6. Complete plans 5–8 for double cloths, using the backing warp for stitching.

7. Make plans for double cloths 2 face to 1 back in warp and weft, with plain backs, and weaves 9, 10 and 11 for face.

8. Make plans for double cloths 2 face to 1 back warp and weft, with twill backs, and weaves 12, 13 and 14 for face.

9. Point out any defect in plan 15, and give corrected plan.

10. Analyze plans 16 and 17, and give face and back weaves, stitching and separating plans.

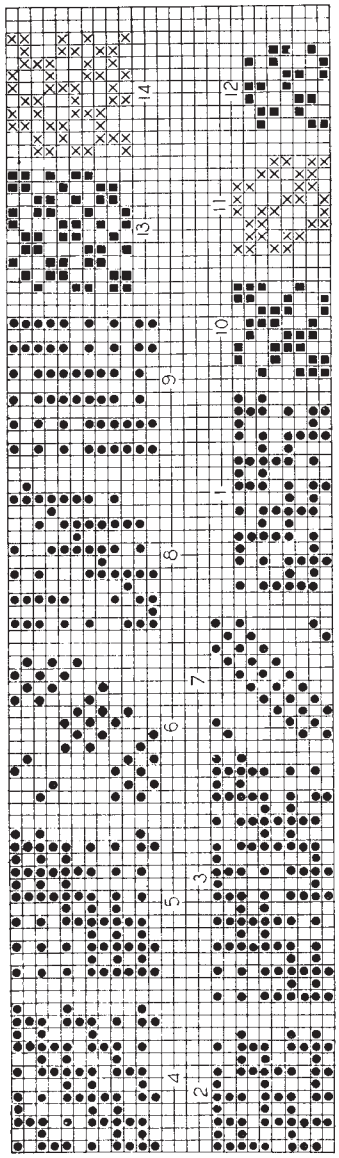


PLATE A.

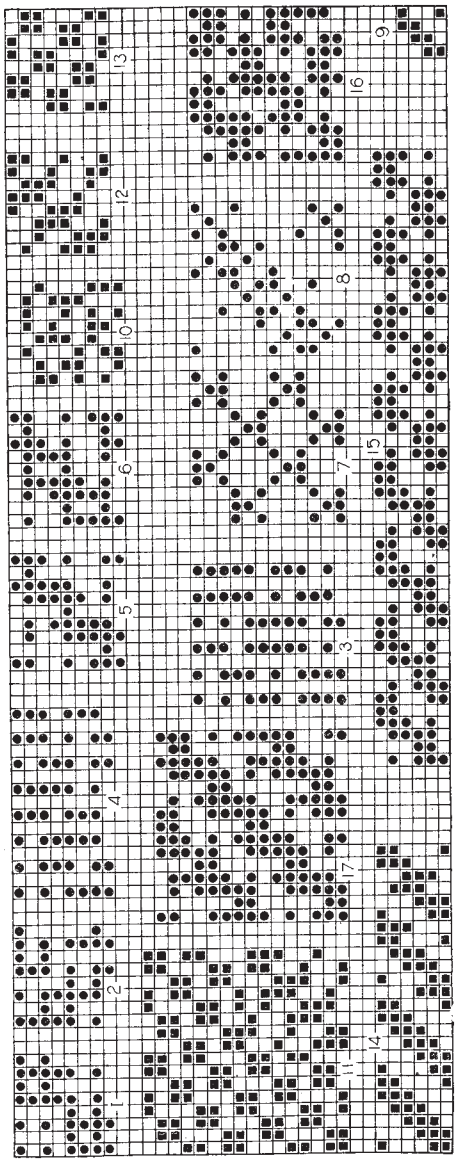
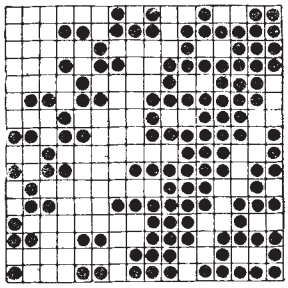


PLATE B.

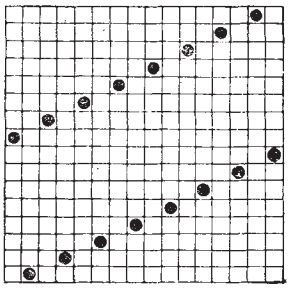
EXERCISES FOR PRACTICE.

1. Plan A is a peg plan for draft B; work out the design that would be produced, analyze it and describe its construction.

2. Give designs for double cloths, 1 and 1 warp and weft with (1) plan C for face and back, (2) plan D for face and back, also give peg plans to weave them with draft B.

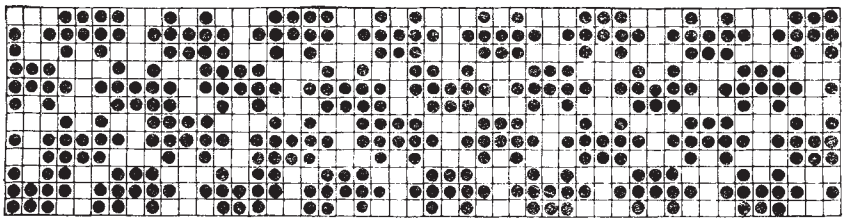


A



B

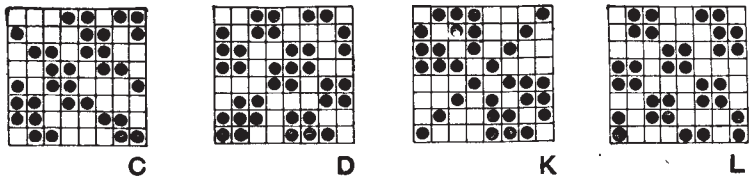
3. Make draft and peg plan to weave design E, backing healds to be in front, and give two peg plans for original designs to be woven in the same draft.

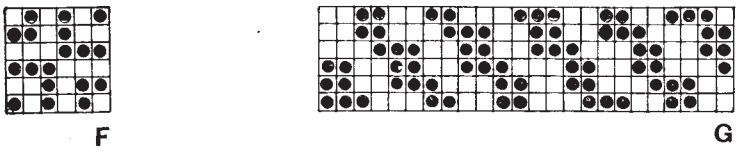


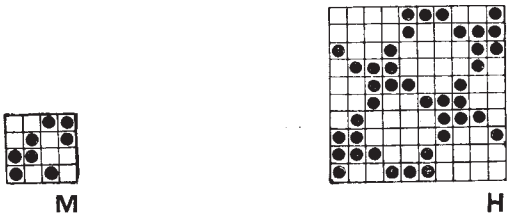
E

4. Put a plain back on plans F, G, H, 2 ends and picks of face to 1 end and pick of back; give peg plans to weave all in same draft.

5. Make plans for double cloths with weaves K, L, M for face and same for back, 1 end and pick of face to 1 end and pick of back, and make a diagram showing section between 2d and 3d picks of plan M.

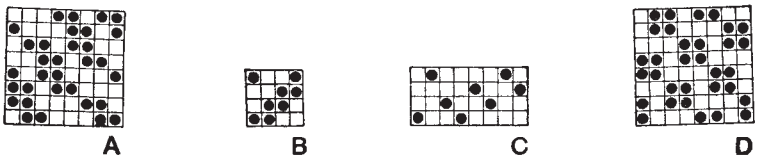






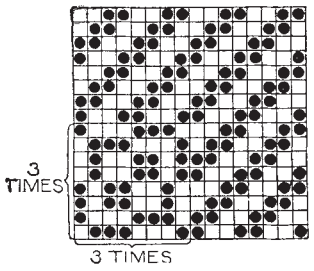
EXERCISES FOR PRACTICE.

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



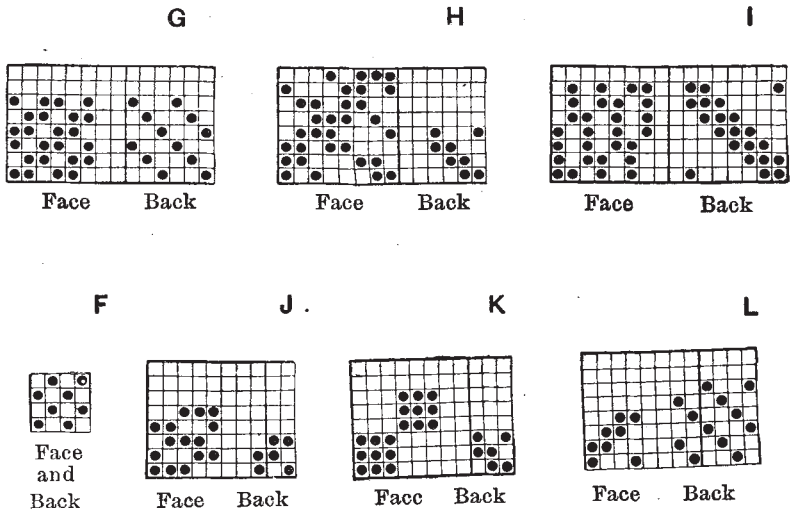
2. Make a double cloth with design E for face and a wadded satin back.

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



E

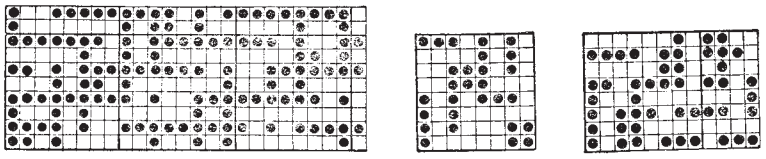
4. Make designs for double cloths A to G with the following weaves: 1 thread face to 1 thread back, warp and weft, using extra warp for stitching.



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

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

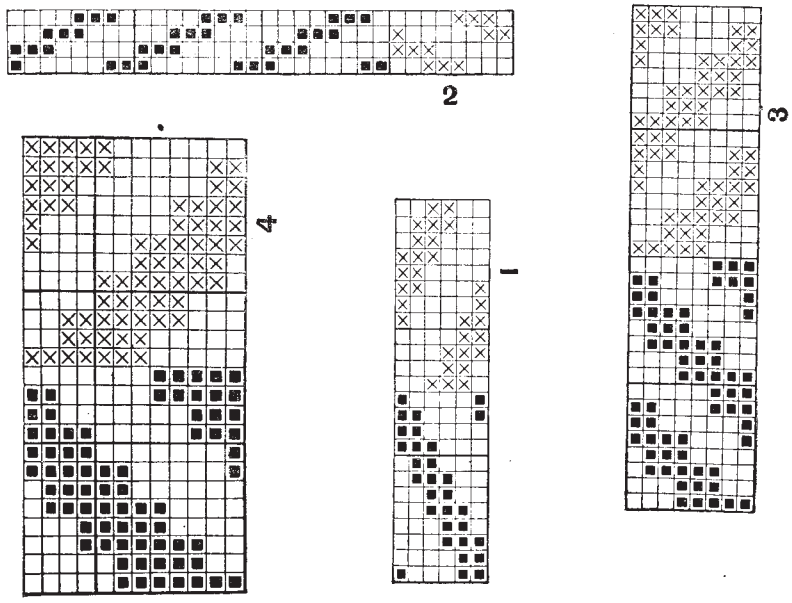
7. Point out any defect in the plans K and L for double cloths, and give the correct plan in each case.



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

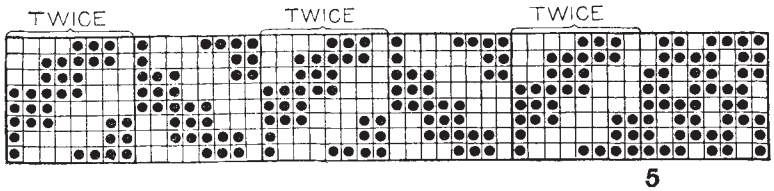
EXERCISES FOR PRACTICE.

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



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

Warp No. 1 Color — . 1 1 . 1 1 } = 72 Weft No. 1 Color — 1 1 } = 8
Warp No. 2 Ground — 2 1 3, 2 2 2 } Weft No. 2 Ground — 3 2 1 }
8 times

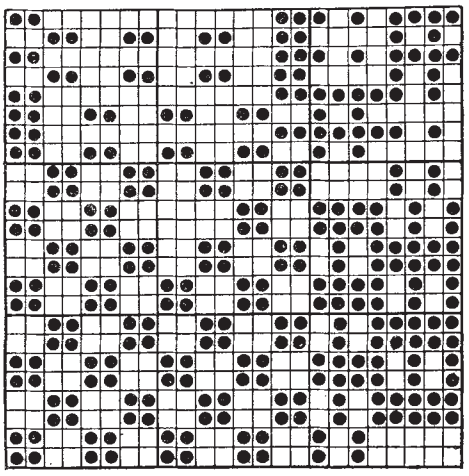


5

3. With a similar design, make an original color figure.

4. Color design 6, thus showing the effect produced in a cloth woven as follows:

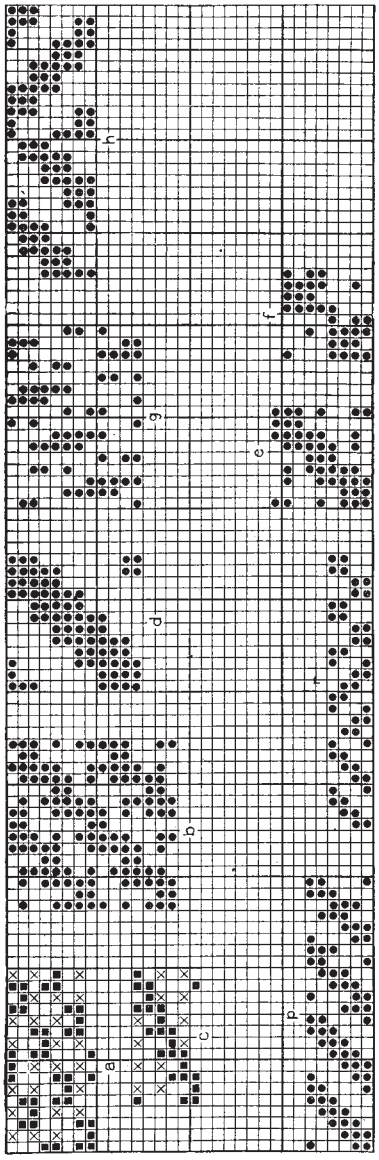
Warp and Weft { No. 1 Ground $\frac{3}{3\frac{1}{8}}$ White — 1 1 1 1 } = 24
{ No. 2 Color $\frac{1}{16^{s}}$ Light Blue — 1 1 1 1 }



6

EXERCISES FOR PRACTICE.

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



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

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

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

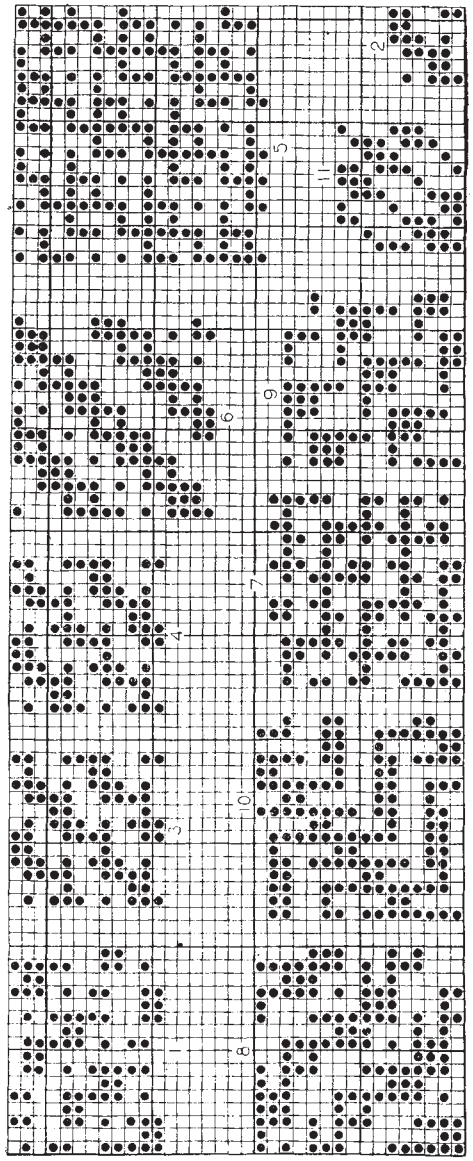
5. Point out any defects in the designs 1 to 7 for double cloths, and correct.

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

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

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

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


1
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11

THREE-PLY OR TRIPLE CLOTHS.

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

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

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

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

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

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

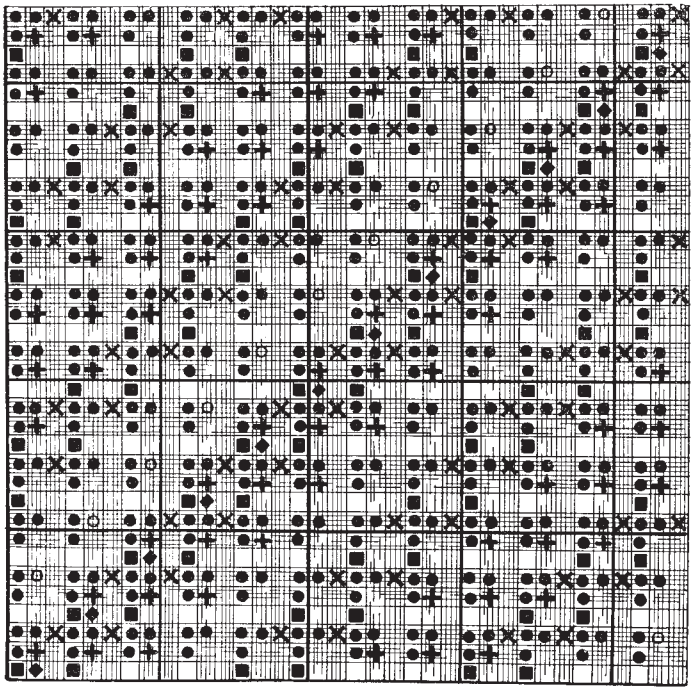


Fig. 213.

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

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

The least common multiple of 4, the face and back weaves, 6, the middle weave, and 12, the binding motive, is 12, and as it is a three-ply cloth, multiplying by 3 will give 36 threads and picks, the dimensions of the complete design. Having found the dimensions required, the design paper may be shaded to indicate the different sets of threads and picks, as was done with double cloths; but, as in this case there are three different sets of threads, two different kinds of shading must be used, one for middle and one for back, the face being left unshaded. For the middle a light wash of yellow may be used, and for the back a light wash of blue; or the middle may be shaded with broken fine lines, and the back with unbroken fine lines, as shown in Fig. 213. By the use of either of these methods confusion is avoided.

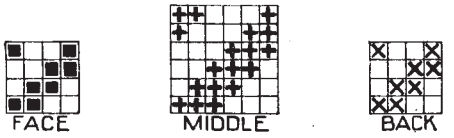


Fig. 214.

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

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

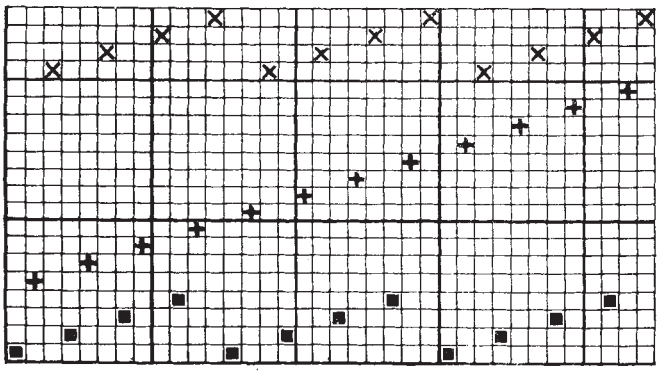


Fig. 215.

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

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

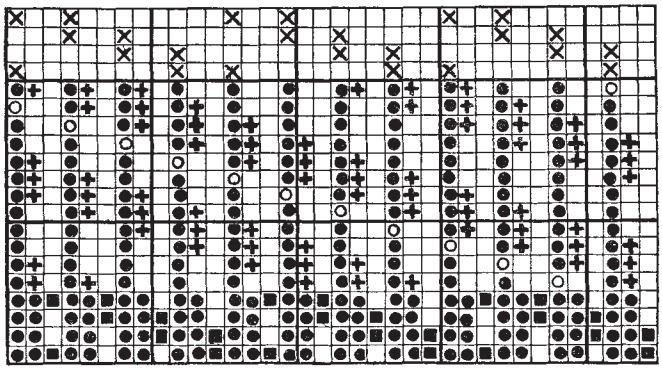


Fig. 216.

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

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

The drawing-in draft for the above design is given at Fig. 215, with the chain-draft at Fig. 216, and a cut section of the first three picks at Fig. 217. Fig. 218 is a design composed of the same three foundation weaves as before, and is like Fig. 213 in every way but the binding. In this case the binding is done by lifting a middle thread over a face pick to bind the middle and face together, and by lifting a back thread over a middle pick. The binding motive is a twelve-harness twill $\frac{1}{11}$ and the binding is indicated in the design by the diamond-shaped marks, Fig. 218. The threads are numbered underneath the design in the order of the drawing-in draft, and as this design would require twenty-eight harnesses as compared with twenty for the previous example, it shows clearly the advantage of doing all the

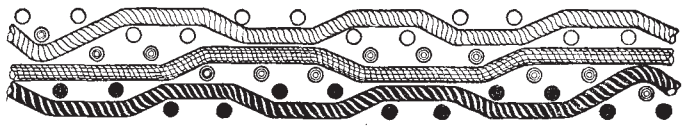


Fig. 217.

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

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

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

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

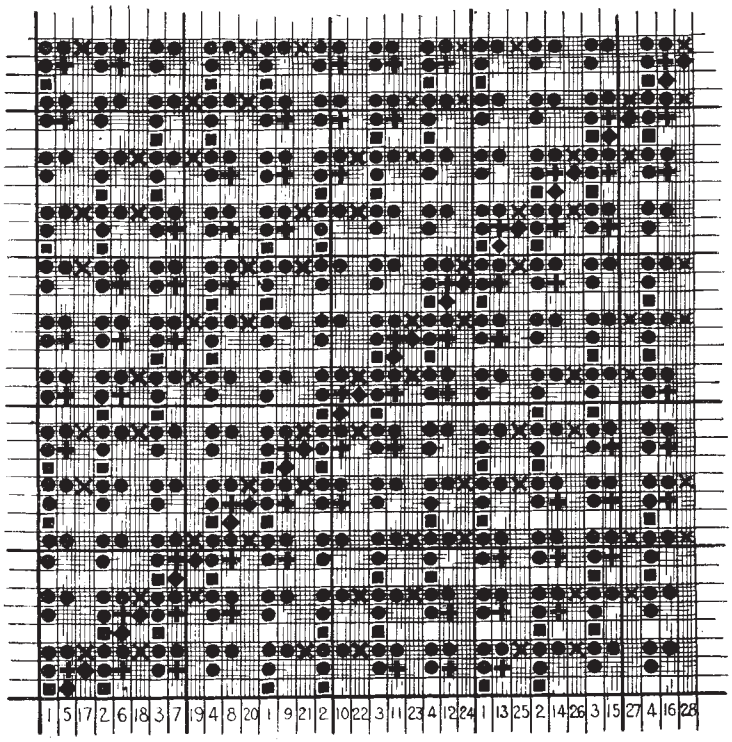


Fig. 218.

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

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

over the face picks, and by the circles where they are sunk under the back picks.

Other multiple cloths may be made in the same manner as those already described, in varying proportions, as two warps with two or three fillings; three warps with two, three or four fillings; four warps with three, four or five fillings, etc. For fabrics used for clothing anything over three-ply is rarely made, but as a matter of experiment, fabrics have been woven up to eight-ply.

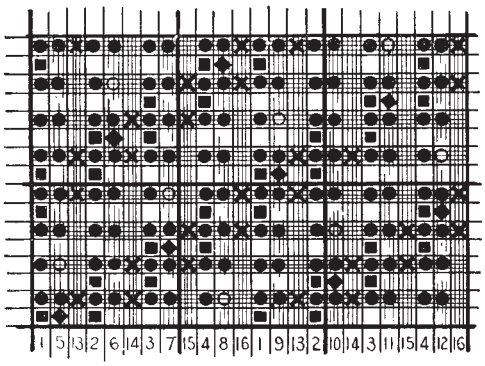


Fig. 219.

TO LAY OUT A TRIPLE CLOTH DESIGN.

First: Obtain complete dimensions and mark off.

Second: Shade the middle threads and picks with light wash of yellow.

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

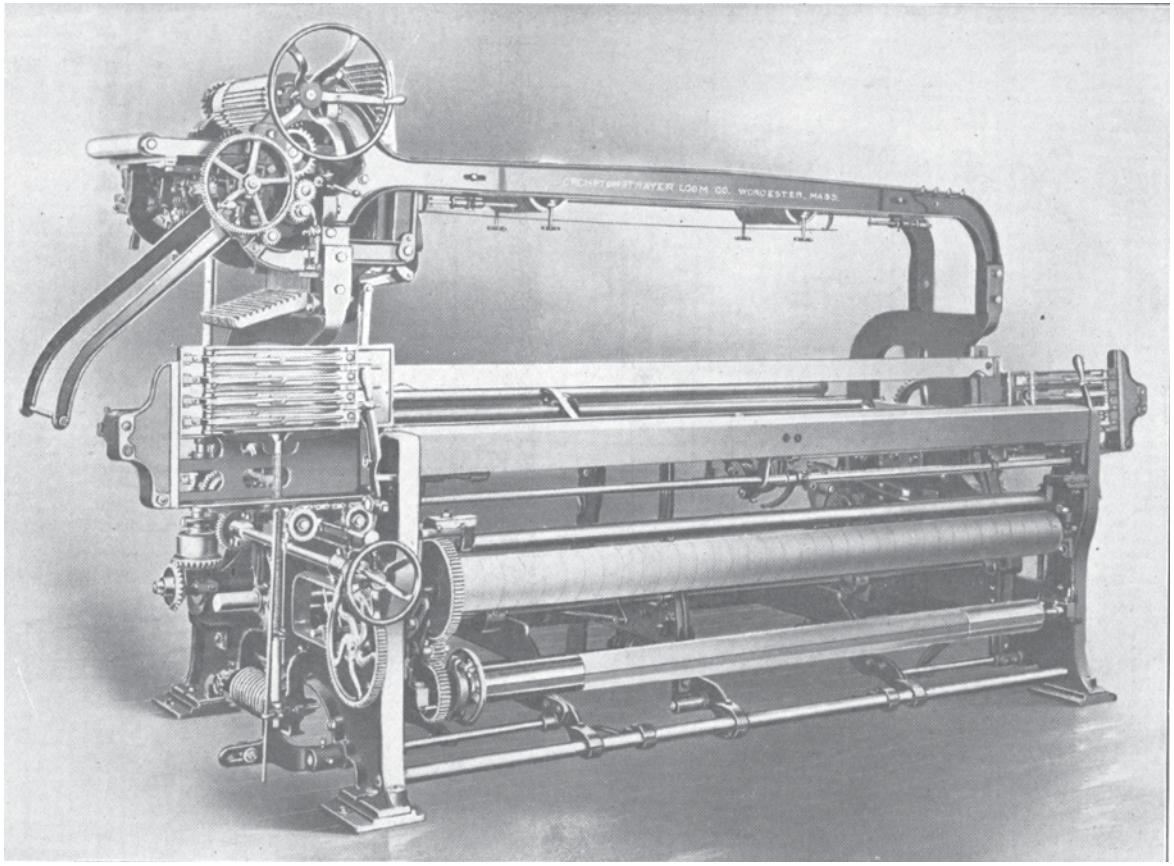
Fourth: Place the face weave on the face threads and picks with black.

Fifth: Place the middle weave on the middle threads and picks with blue.

Sixth: Place the back weave on the back threads and picks with red.

Seventh: Raise all the face threads on the middle picks, and all the face threads on the back picks, with green.

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



HEAVY WORSTED LOOM WITH 82-INCH REED SPACE
Crompton-Thayer Loom Co.

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

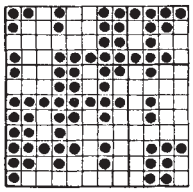
Tenth: In some triple cloths where an extra heavy middle cloth is used to gain weight, the back thread should be lifted right through to the face to prevent any possibility of the stitching showing, as would be likely if the middle warp were used for that purpose.

EXERCISES FOR PRACTICE.

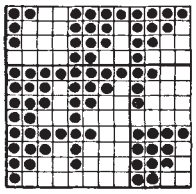
1. Make a design for a three-fold cloth with a 2 and 2 twill for face and hopsack back.

2. Make a design for a cloth with 4 warps and 3 wefts, with a prunelle twill for face and back.

3. Analyze the design A, giving diagram of a section of the cloth weft way.



A

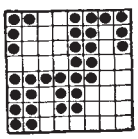


B

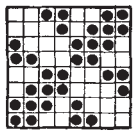
4. Describe the construction of the designs B and C, and mark the ends in the plan which you would put on the same beam.

5. Make a design for a double 3 and 3 twill, same face as back, with a third warp in the middle, having half the number of threads of the face warp.

6. Make plans for 3-fold cloths with designs D and E for face and back, and with a plain cloth in the middle.



C



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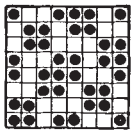
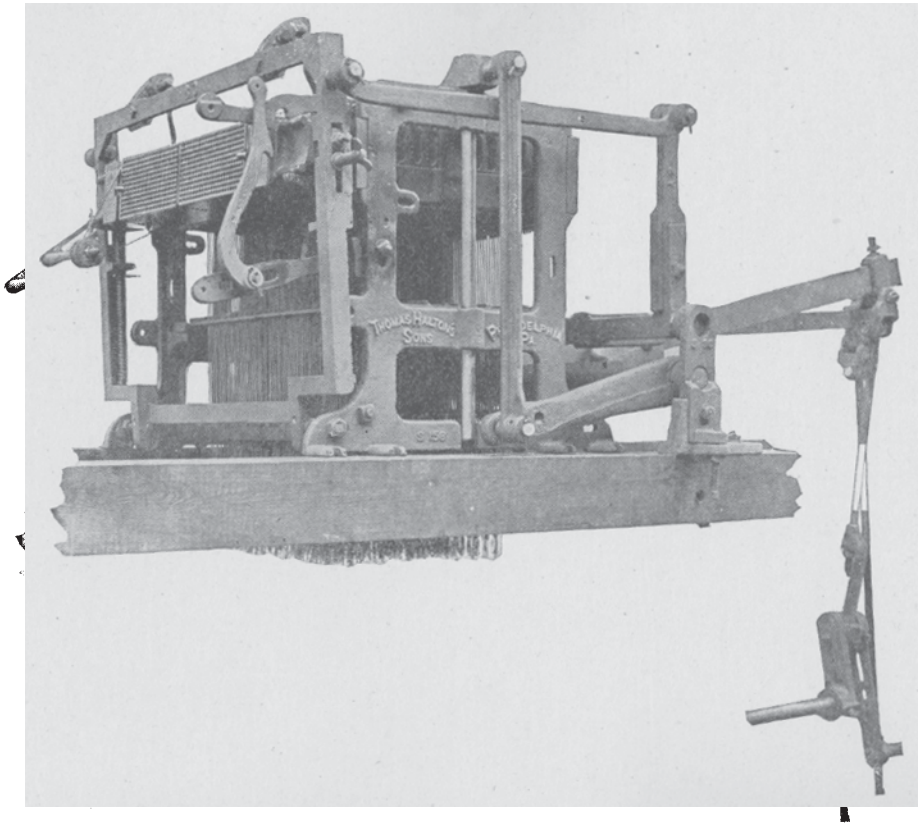


E



THE INDEPENDENT BATON CYLINDER MOTION WITH 624 SINGLE LIFT MACHINE

Thomas Halton's Sons

TEXTILE DESIGN

PART IV

DOUBLE PLAIN

"Double plain," as the name implies, means a double fabric composed of two warps and two fillings, the face warp and filling weaving plain, and the back warp and filling weaving plain. This class of weaves is chiefly used to produce fancy effects by combining or interchanging the single cloths. If one color of yarn is used for both face and back cloths, two fabrics of the same color and construction will be produced; while if the odd-numbered threads and picks are one color and the even-numbered threads and picks are a second color, two separate cloths of different colors will result. Assuming that the first color is black and the second color is red, the fabric will have a black face with a red back or lining.

It will not be difficult to understand that if the face and back cloths are interchanged; *i. e.*, if the black face yarn is woven on the back, and the red back yarn is woven on the face, at predetermined intervals, a variety of stripes and figures may be formed. It is on this principle that the characteristic double plain patterns are made.

Construction. Designs of this class differ from the usual double and triple cloth designs chiefly in the manner of binding the cloths. Where a twill, hopsack, or some other weave with floats of two or more threads, is used for the face cloth, it is a very simple matter to produce perfect binding by lowering a face thread under a back pick, or by raising a back thread over a face pick. These methods are impracticable in constructing double plain designs, because the plain weave, one up, one down, does not contain floats of two threads, consequently the plan of binding would be plainly visible on the face of the fabric. This would be especially true when different colors of yarns were used for the face and back cloths. However, the manner of stitching the cloth is of secondary consideration, for when the face and back fabrics are interchanged, they are, of course, bound together.

The first step in laying out a design is to shade the back threads and picks, then placing the face and back weaves on their respective threads, and raising the face threads on the back picks. This is plainly shown in Fig. 219, which gives the successive steps in laying

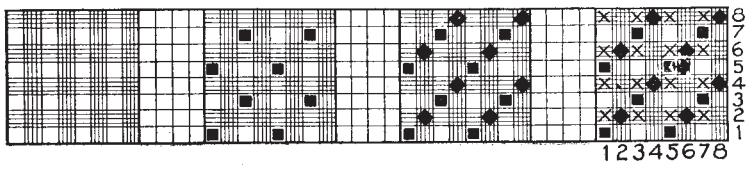


Fig. 219.

out a simple double plain design. If this design were woven with one shuttle, two separate cloths bound only at the selvedges would be woven. If two shuttles were used, two cloths, independent of each other in every way, would be produced.

The diagram, Fig. 220, shows the threads interlaced in regular plain order and gives the relative positions of the face and back cloths. It also emphasizes the statement made above to the effect that a double plain design does not permit of perfect binding by the methods used on the usual ply fabrics. By careful attention to Fig. 221 it will be seen that the face and back cloths may readily be woven in solid colors without interfering with each other in any way. This figure shows a cut section of the first four picks, and represents two plain cloths one over the other.

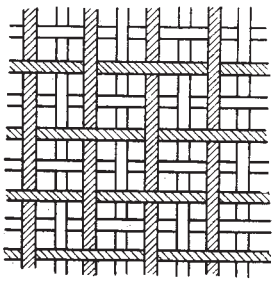


Fig. 220.

The foregoing explains the principle of double plain construction, but, excepting in the manufacture of seamless bags and pockets, it is not used to any extent. It is used here to illustrate the possibilities of double plain designs and the impossibility of obtaining good results by attempting to bind them by ordinary stitching. With these points clearly understood, those that follow will present few difficulties.

The simplest pattern that may be produced is the "Hairline" or very fine stripe effect in solid colors, the effect being produced by the face and back cloths interchanging. To explain how this is done, it will be best to select a pattern and illustrate the successive steps

necessary for its production. For example, assume that a pattern must be made with alternate stripes of black and red on the face, the black stripe to be six threads wide and the red stripe to occupy two threads. When the cloth is turned over, the color effect will be reversed, showing six threads of red and two threads of black.

Referring to Fig. 222, it will be noted that 16 x 8 squares have been marked off, and the first twelve threads shaded in the usual way to produce double plain cloth. These threads give the black stripe on

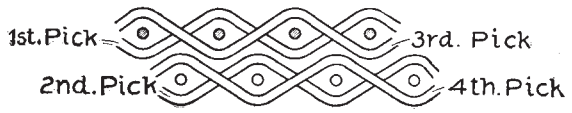


Fig 221.

the face of the cloth and the red stripe on the back. So far no change has been made from the method pursued in Fig. 219, but it is evident that something must be done to reverse this order and make the red stripe appear on the face. This is accomplished as follows:

Those picks and threads that were shaded for the back cloth are now used for face, and *vice versa*. The warp being dressed one black, one red, the opposite color will be raised to the face. The even numbered threads and picks are now the face threads and face picks, and therefore a solid red stripe is formed at this section of the design.

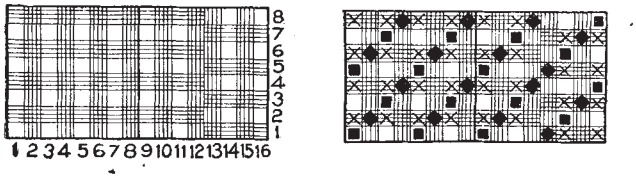


Fig. 222.

The complete design also is shown in Fig. 222. After the threads are shaded, the design is completed by putting the plain weave on both face and back ends and picks, and raising the face warp on the back picks in the usual manner.

The cut section in Fig. 223 shows the first four picks. It will be noted that the odd picks, which are black, interlace only with the odd-numbered threads, while the even-numbered picks, which are red, interlace only with the same color of warp. The cloths are bound together at the point where the interchanging takes place, which in

this design is at threads 11, 12, 13, and 14. If the design were carried out one more repeat, it would, of course, be bound at threads 1, 2, 15, and 16, as the black face cloth returns to its normal position.

For a further example of double plain stripe patterns, refer to Fig. 224. The warp for this design is dressed one black, one red; and the filling pattern also is one black, one red. When woven, the face

Fig. 223.

pattern of the cloth will be six black, two red, two black, two red. Of course, the under surface of the cloth will be the reverse, or six red, two black, two red, two black. The chief object of this design is to show how the face cloth is returned to the face of the fabric after weaving on the back.

Examples of stripe patterns formed on this principle could be multiplied, but the principle is the same in all. The important points to be remembered are to shade the threads and picks as in the case of double cloth, interchanging the cloths by bringing two back or two face threads together.

Check patterns are made by extending the principles used in the production of stripe effects. This is illustrated by the shaded design paper shown at Fig. 225. It will be noted that not only do two face and two back threads come together, as at BB and FF, but two face

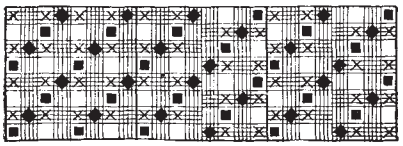


Fig. 224.

and two back picks adjoin as at *bb* and *ff*, reversing the cloths at these points which, of course, are the binding points of the fabric. To better explain the construction of check patterns it will be best to work out from the beginning a design of this class.

The first step is to select a suitable pattern, which in this case is a black and white checkerboard effect to repeat on twenty-four threads

and twenty-four picks. The warp will be dressed one black, and one white, and the filling will be woven one black, one white. After determining the area the design is to occupy the ends must be shaded and the face weave placed on the face threads and picks. This is shown at Fig. 226. The plain weave must now be placed on the back threads and picks, and risers be filled in to lift the face warp over the back picks. The complete design is shown at Fig. 227, and if woven the effect would be alternate squares of black and white, each square occupying six threads and six picks.

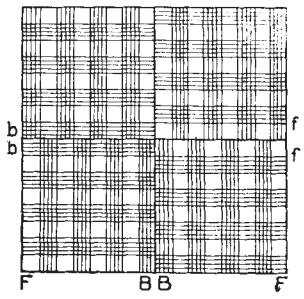


Fig. 225.

Spot effects or floral designs may be produced upon the same principle by allowing the back cloth to weave on the face to form the required spot or floral effect.

SPOT WEAVES

This class of weaves is used to a large extent in manufacturing cotton and worsted fabrics, as the nature of spot weaves makes them

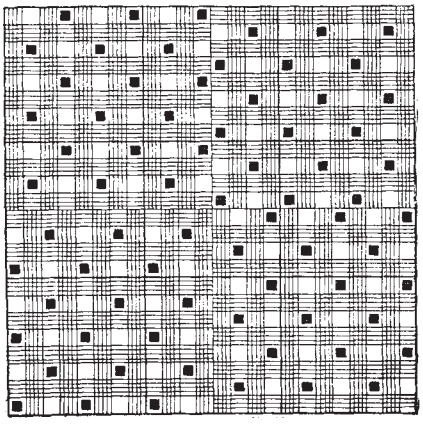


Fig. 226.

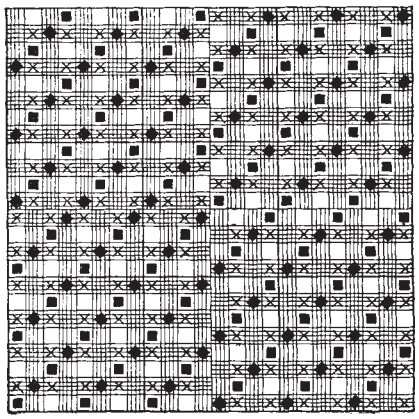


Fig. 227.

especially adapted to the production of large varieties of neat effects.

It will be readily understood that it is necessary to have some of the yarn float on the face of the cloth where it is desired to form a spot;

also that the manner in which the yarn is allowed to float determines the shape and appearance of the figure.

Spot effects may be produced in three ways; *first*, by forming the spot of the same yarn that forms the body or ground work of the cloth; *second*, by employing an extra warp which does not in any way affect the ground weave, but is brought to the face at regular intervals to form the figure; *third*, by the use of an extra filling which, like the extra warp, floats on the back of the cloth when not weaving on the face to make the pattern. The first method limits the pattern to the colors used in the ground, while the second and third methods permit the use of different material of any color desired.

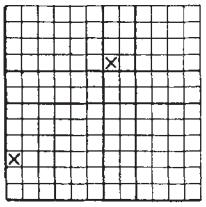


Fig. 228.

It is unnecessary to take up the first method very fully as it is similar to many of the simple weaves already explained, and also because it is taken up on a larger scale under the heading "Jacquard Designing." It will be sufficient to state that spots formed by the yarn that composes the body of the cloth are produced by introducing, at the point where a spot is desired, a second method of interlacing

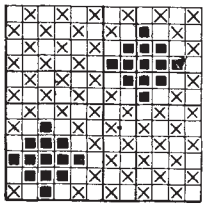


Fig. 229.

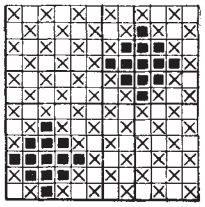


Fig. 230.

the threads. For instance assume that a diamond spot is required on a plain ground (that is, the ground to be woven with a plain weave), the spots to be arranged in plain order, and the full design to repeat on twelve threads and twelve picks.

The first step is to mark off the extent of the design or the area it is to occupy, and as the spots are to be arranged in plain order, to divide it into four equal parts, each containing six threads and six picks. This is shown at Fig. 228. As the spots must have the same relative position it will be helpful to mark one of the small squares that the

spots may be filled in with relation to these squares. This also is shown at Fig. 228.

The next step is to fill in the spots and place the ground weave around them as shown at Fig. 229. Careful attention must be given to the arrangement of the figures and the manner of filling in the ground weave, otherwise the effect shown at Fig. 230 will be produced.

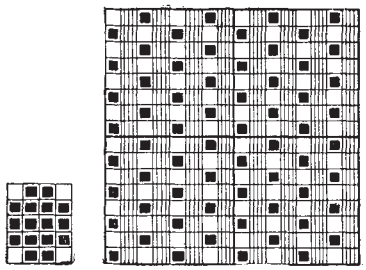


Fig. 231.

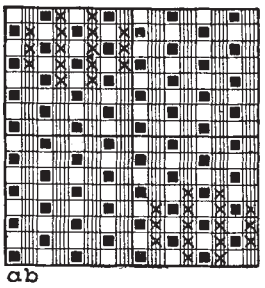


Fig. 232.

A careful study of Fig. 230 in connection with Fig. 229 will emphasize the value of a careful disposition of the spots with regard to facilitating the work of adding the ground weave. Note how the clear cut appearance produced by Fig. 229 is destroyed by the ground weave being run into the figure as at Fig. 230.

The second method of making spot designs, *i. e.*, by the use of extra warp threads to form the figure, presents no difficult features to those who have mastered warp-backed cloth designs for it is similar in every detail. Assume that a design is being laid out for back cloth,

Fig. 233.

but that the backing threads are silk or fine quality cotton or worsted, and instead of being carefully stitched so that they will not show on the face they are floated on the face to form spots. This clearly explains the construction of spot designs by this method.

Attention must be given to the disposition of the spots, as regards the distance they are placed from each other, and the order in which they are arranged, such as plain, sateen, etc. For an example of this method see Figs. 231 and 232. The small figure in Fig. 231 represents

the spot which is to be superimposed upon a plain ground. The first operation is to shade the extra threads, or those which represent the extra warp threads, and fill in the plain weave on the ground threads. This is shown at Fig. 231. The figure must now be placed on the shaded threads and the design is complete as shown at Fig. 232. Fig. 233 shows a cut section of the first and second threads interlacing with the filling.

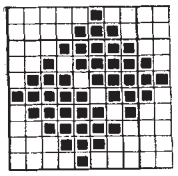


Fig. 234.

This pattern, when woven, will not have the appearance suggested by Fig. 232 as the ground threads will, of course, close over the spaces which represent the extra threads and they will be entirely hidden from view.

It must not be supposed that the ground effect is limited to the plain weave for any of the simple weaves such as twill, sateen, etc., may be used. These figures are not given because of their value as designs but to illustrate the principles on which these effects are laid out.

As a further example of the spot effect produced by extra warp, and one which is of a more practical nature, refer to Figs. 234 and 235.

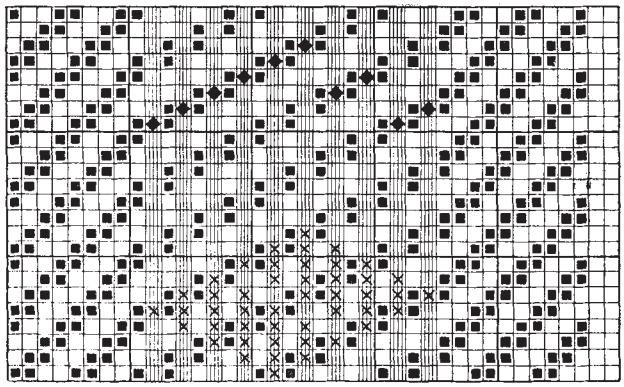


Fig. 235.

Fig. 234 represents a spot which must be produced on a cassimere twill ground, once every twenty-four picks. The ground warp and filling are red and the extra warp is white mercerized cotton. The ground cloth counts forty threads to the inch and there must be one-half inch between the rows of spots.

As in the previous example the extra threads are shaded and the ground weave, which in this case is the cassimere twill, is placed on the ground threads. The next step is to place the figure on the extra threads. Apparently the design is now complete, and in fact it would produce good cloth. However, a designer should seek means to produce the best that is possible and in this case something more may be done to improve the design. The first and last extra threads are interlaced once in twenty-four picks, or in the full repeat of the design. This means that they will float on the back of the cloth for twenty-three consecutive picks if some method is not devised to prevent it. For this reason the extra threads are stitched at convenient places as shown in Fig. 235.

As the ground yarn is red and the spot or extra threads are white, it must be understood that care should be exercised in the selection of binding places or the stitch will spoil the face effect. The rule given

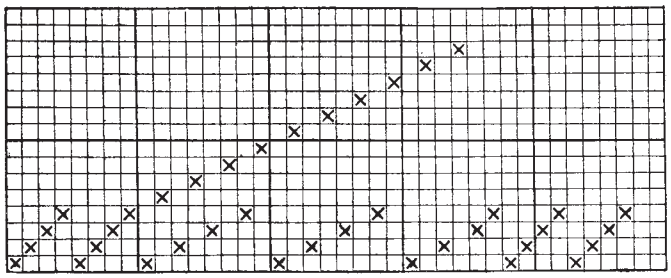


Fig. 236.

for stitching backed fabrics applies equally well here and is as follows: The extra thread must be raised over a pick of the face filling at a point where the threads on each side of it are raised.

The drawing in draft and harness chain for Fig. 235 are given at Figs. 236 and 237. These are made in the manner common to backed and ply-cloths, the ground threads being drawn in on the front harnesses as they are so greatly in excess of the extra threads. This facilitates the operation of weaving the cloth as, there being so many more ground threads, there will be more breakage among them and they may be more readily tied up if drawn in on the front harnesses.

The formation of spot designs by the use of extra filling is the third and last method in our classification. It is exactly the reverse of the second method and the principles involved are very similar to

those employed when constructing filling backed fabrics. It is not difficult to understand that the blank squares on the shaded picks in Fig. 238 will make a filling spot of the same character as the small figure at the left of the design. Of course, the crosses represent that the other threads will be raised so that the extra pick, which may be of a radically different color from the ground, will not show on that part of the cloth. If the distance between the figure is so great that the extra filling will float loosely on the back of the cloth, it may be stitched in the same manner that the back filling is fastened to the face cloth in a filling backed design, *i. e.*, by lowering a ground thread under it between the two floats of the ground filling.

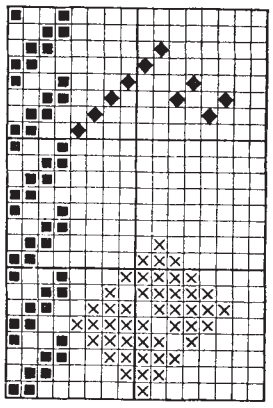


Fig. 237.

To explain the meaning of arranging spots in sateen order Figs. 239 and 240 have been prepared. It should be understood that although this design is of the extra filling class the arrangement of spots secured may be obtained equally well on both the other methods.

The small figure at the left of Fig. 239 represents the spot which it is desired to produce in five harness sateen order on a three harness twill ground, the spots to be placed as close together as practicable. Fig. 239 shows the design laid out with the spot figure arranged on the extra filling picks, and Fig. 240 shows the design complete, with the ground weave filled in on the ground picks. Fig. 241 shows a cut section of the first and second picks interlacing with the warp.

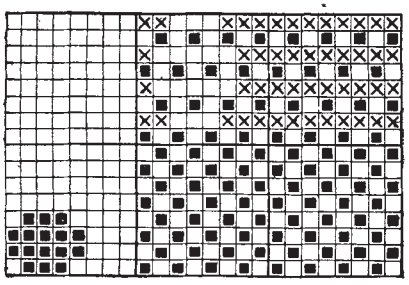


Fig. 238

In all spot designs the ground weave must repeat on the extent of the design, or the arrangement of the figures must be changed to occupy a number of threads and picks which is a multiple of the

threads and picks occupied by the weaves. Take for example Fig. 240 which repeats on fifteen threads. If the plain weave were used for the ground in this design, the first and fifteenth threads would be the same,

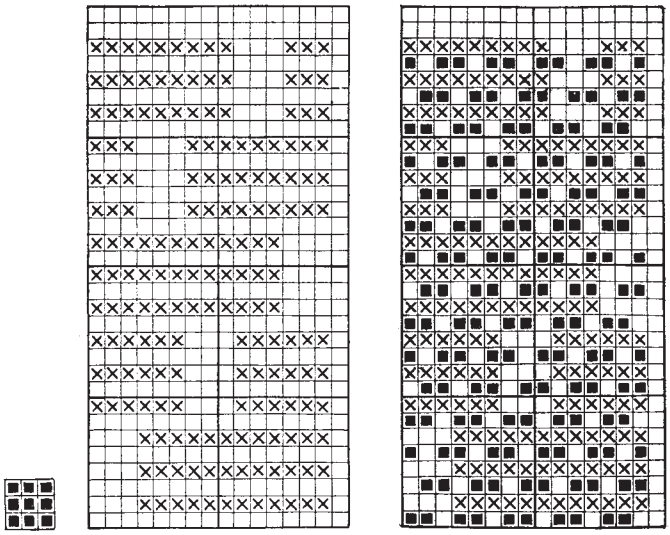


Fig. 239. Fig. 240.

and when the design is repeated would come together to form a double thread. This would be a serious defect, and would make the design practically valueless.

PILE OR PLUSH

Fabrics made by this class of weaves differ both in structure and appearance from all others as their surface presents a series of short threads which issue from the body of the cloth. These loops formed by the yarn are termed pile.

Plushes may be divided into two classes, *i. e.*, *warp pile* and *filling pile.* The former is cloth in which the loop is formed by the

Fig. 241.

warp, while in the latter the loop is formed by the filling These two classes may be subdivided into cut and uncut, or cut and loop pile.

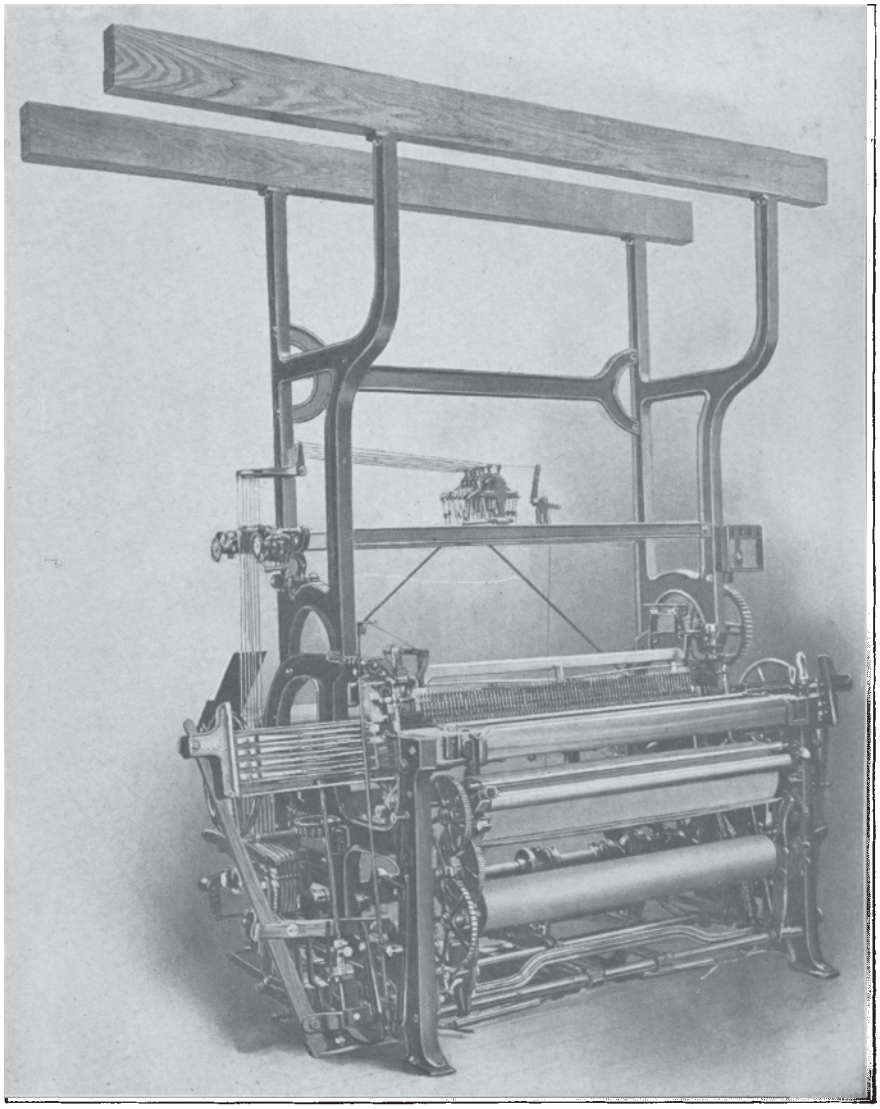
Filling Plush. This is the simplest of all pile fabrics. As suggested by the name, the cloth is formed by a series of filling threads floating on the surface. The operation consists of weaving a ground cloth, plain or otherwise, and weaving a filling floating loosely over the surface and bound into the ground at certain regular intervals. This surface filling is then cut as nearly as possible in the center of the float, and stands up from the body of the cloth, thus forming a cut pile.

The diagram shown at Fig. 242, is a cut section of a common velveteen, the weave being shown at Fig. 243. Two picks are shown in the diagram, one of ground and one of pile. The ground filling, B, in conjunction with the warp forms quite a plain fabric, while the pile filling, A, passes under one warp thread and over five. The letter C shows the pile filling cut at one of the floats. An examination of Fig. 243, will show that the ground weave is plain while the pile picks are bound down once every six threads, there being three picks of pile filling to one pick of ground. The pile picks are marked P, and the ground picks are marked G.

The structure of the cloth must be carefully considered in order to determine the best method of binding the pile into the cloth, and also the best distribution of the pile over the surface of the fabrics. If the pile is not firmly bound it will not permit of its being cut, and if it were cut the yarn would constantly be pulling out in wearing as there would be no power to resist friction.

The firmness of the binding is dependent upon the compactness of the fabric and the manner in which the pile filling is interwoven with the ground, and in the case of Fig. 243, where the pile filling passes around but one warp thread, it makes little difference how the binding point is distributed, because it will have to depend entirely upon the pressure of the ground picks on each side to secure it firmly in the fabric.

In the design shown in Fig. 244, the pile filling interweaves with three warp threads, which, of course, increases the holding power of the ground cloth. The ground picks are marked G and the pile picks are marked P. As in Fig. 243, there are three picks of pile filling to one pick of ground, however, in this design the pile filling floats over nine consecutive threads, making a longer loop. The diagram at Fig. 245 shows a cut section of two picks in this pattern and has been prepared



EMBROIDERY LOOM DESIGNED TO WEAVE A RAISED FIGURE OF ANY DESIRED PATTERN

Crompton & Knowles Loom Works

to show the increased holding power of this method of binding. The pick marked P interweaves with the fifth, sixth and seventh threads. In this instance the ground filling would not have to be beaten up so firmly to produce a good cloth.

It is sometimes found difficult to obtain the requisite weight of texture in plushes made with a plain ground weave, or sometimes for

Fig. 242.

other reasons the construction must be changed. At such times the ground may be twill instead of plain and the same plan of distribution followed. However, great care must be exercised in arranging the binding, so as to make it firm.

The diagram at Fig. 245 shows a method of binding into more than one thread upon a plain ground. The same rule will apply to twill grounds, but instead of interweaving with three threads it would be necessary to use four or more as shown in Fig. 246.

In all the examples given there have been three picks of pile to one pick of ground. In order that the impression may not be given

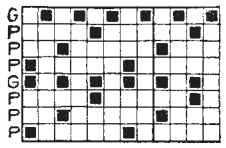


Fig. 243.

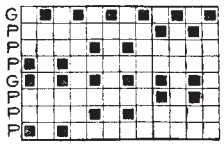


Fig. 244.

that this is the only construction that may be used, Fig. 247 has been prepared with five picks of pile filling to one pick of ground. This of course gives a much denser pile. It will also be noted that in this design every warp thread is used to bind the pile filling, this being necessary where a large number of pile picks are used to give a dense fabric.

Corduroy. In addition to being distributed equally over the face of the cloth, piles are made in stripe or cord form which are termed corduroy when they run in the direction of the warp. The binding differs from that of plushes in that it is confined to a few ends,

the object being to present the appearance of ribbed cloth, the rib to stand out very prominently.

Referring to Fig. 248, and comparing it closely with Figs. 243 and 244, it will be readily noted that there is no difference between velvet-

Fig. 245.

eens and corduroys, except in the manner of binding the pile filling; the object in the former being to distribute it as evenly as possible over the entire surface of the cloth, and in the latter to confine it to a

Fig. 246.

few threads that it may run in lines and thus form cords. There are two picks of pile to one of ground and the binding is done by the first, second, sixth and seventh threads.

Another corduroy weave is shown at Fig. 249. In this plan it will be noted that there are eight warp threads, and the four harness cassimere twill is used for the ground. Of these eight threads only two are interwoven with the pile filling, leaving threads one, two, three, four, seven and eight, to form the space between the pile after the filling is cut. The special feature of this pattern is that but one pick of pile is used for one pick of ground. This is due to the fact that the cassimere twill is used for ground, which allows a much larger number of picks to be beaten in than the plain weave would under similar circumstances.

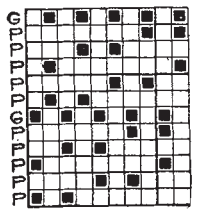


Fig. 247.

Fig. 250 represents still another corduroy weave. The ground weave is a three harness twill, two up, one down, and there are three picks of pile filling to one of ground. The binding is done on the first, second, eighth, and ninth threads.

In all these examples of corduroy weaves, the two loops correspond to two cords in the cloth in each repeat of the pattern. In Fig. 250 the first, third, sixth, ninth, and eleventh picks of pile filling float over seven threads for the first cord, and then over three picks for the

second cord, while at picks two, five, etc., the pile filling floats over five threads for each cord. This, in addition to facilitating the binding, gives a rounded cord which is much desired.

There is very little art in making designs for filling plushes and corduroys. The chief objects to be kept in view are, in the former, to produce a firm binding to fasten the pile to the ground and a proper distribution of the binding positions over the surface, while in the latter the binding must be as firm as possible and must be confined to such threads that it will make a prominent cord. However, very frequently figured patterns are made with filling piles by allowing the filling to float on the surface for the space required to form the figure and then binding it into the cloth after the manner of fancy ordinary weaving.

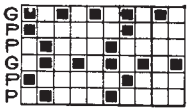


Fig. 248.

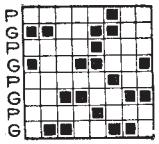


Fig. 249.

Warp Plush. The principles involved in the formation of pile of this description are similar to those in filling pile, yet the treatment and method of constructing the design are different. In the construction of the latter two fillings and one warp are employed, while in the former two warps and one filling are used.

The filling pile is woven in the same manner as an ordinary fabric, and when it is to be cut this operation is performed after the cloth leaves the loom. Warp pile is both woven and cut on the loom. Having defined the similarities and differences of these two fabrics, it will be easy to understand how warp pile is made.

Warp pile fabrics are constructed by raising the pile threads and inserting a wire, then lowering the pile threads and interlacing them with the ground weave.

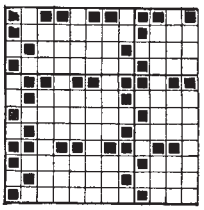


Fig. 250.

The loops formed by the yarn passing over the wire may be cut to form common velvet, or may be left uncut for Terry cloth. If the velvet effect is desired, the wire over which the warp passes, is equipped at one end with a knife which cuts the pile as it is withdrawn. If Terry is desired, a plain wire is used which, when withdrawn, leaves the loops standing. It will be understood that if velvet is to be produced the loops are cut, while if Terry is desired, the

loops are left intact. Fig. 251 represents a weave for a Terry fabric.

Fig. 252 shows a velvet weave and that this principle may be thoroughly understood it will be analyzed in conjunction with the cut section shown at Fig. 253. Referring to Fig. 252, it will be noted that there is one pile thread for every two ground threads and a wire for every two ground picks. One-half of the pile warp is lifted over the first wire that is inserted, the other half being lifted over the second wire, and so on. The object of raising one-half of the pile warp at a time is that if all the warp were raised it would cause rows of pile, which would be visible as lines across the cloth. The object of velvet being to produce a perfectly even face, this, of course, would be a defect.

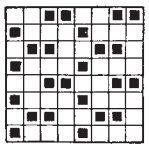


Fig. 251.

As shown in the cut section the pile warp is raised from and returns to the cloth between two ground picks which are in the same shed. It then passes over two picks which are in the same shed (and between which the other half of the pile is raised) and being lowered under the next pick, is again lifted over a wire. This constitutes the principle of weaving warp pile.

When a number of the wires have been woven into the cloth the first one put in is withdrawn (cutting the loops) and inserted again, then the second is withdrawn in the same manner and inserted again. The third follows in like manner and so on, this cycle of movement being continued as long as the loom is operated.

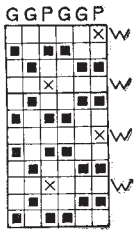


Fig. 252.

In many cases all the pile warp is lifted over one wire as shown in Fig. 254, but as stated above, this to some extent gives the pile the appearance of being in rows which is overcome by raising one-half the pile warp over each wire. The pile must be bound into the ground as firmly as possible. It will be understood that owing to the loops being formed wholly by the pile warp, it takes up much faster than the ground, consequently the pile warp must be woven from a separate beam to which very little tension is applied.

There are other methods of forming pile which are more or less important. One of these is the method of manufacturing Turkish towels, the pile being formed by a cotton warp which is formed into loops on the surface of the cloth. This is done without the assistance

of wires by having a special device attached to the reed, which allows the filling to be beaten up to a point some distance from the cloth for several picks and then beating up these picks over the intervening space to the cloth, thus causing the loose pile warp to rise and form a loop. The distance between the binding picks and the cloth, before they are beaten together, determines the length of the loop.

This kind of pile presents a very irregular appearance; the loops

Fig. 253.

do not stand up well, are of various lengths, and intermixed to a great extent. For these reasons this method cannot be used for better grades of goods.

Another form of pile is the one used in the manufacture of Brussels carpets. In this case the pile warp weaves in the ground when not required on the face to form the pattern, the required color being

Fig. 254.

brought to the surface over wires in the order required to form the pattern. If the pile is cut it forms a Wilton carpet, as Wilton bears the same relation to Brussels that velvet bears to Terry cloth.

CHINCHILLA

This cloth derives its name from a small animal native to South America, whose fur it is supposed to imitate. Chinchilla is a very heavy fabric with a long nap on the surface which is rolled into curls in the finishing operation, by the use of what is known as a chinchilla machine. The cloth is used chiefly for heavy cloaks or overcoats being much too heavy for other articles of clothing.

Construction. There are several grades of chinchilla cloth, the construction depending upon the quality desired. The following constructions are in common use: *a*, one warp and one filling; *b*, one warp and two fillings; *c*, two warps and two fillings; *d*, two warps and three fillings; *e*, two warps and four fillings. When more than one warp is used as at *c*, *d* and *e*, the different threads are designated as

face threads and back threads. When four fillings are used as at *e*, the various sets are designated as pile filling, ground filling, stuffing filling and back filling.

The purpose of the pile filling is to form the face of the goods and it gives the long nap necessary for the chinchilla finish. For this reason it is interwoven with the face warp by means of a weave that will give a long filling float on the face of the goods. The pile filling is generally a soft spun thread of fine stock.

The ground filling is to give the fabric the required firmness. It, of course, interlaces with the face warp by means of a much closer weave than is used for the pile filling.

The stuffing filling, sometimes known as the wadding filling, enters the fabric between the face and back warps, not interweaving with either, its purpose being to add weight and bulk to the fabric.

The back filling interlaces with the back warp by means of weaves

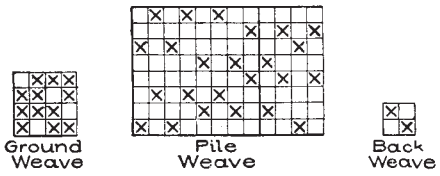


Fig. 255.

which are either even-sided or which present a filling effect on the back.

These facts being understood a chinchilla weave will be constructed, every operation being explained in its turn. As in many other classes of fabrics the principles of double cloth construction are used, being extended or modified as required by the peculiarities of the cloth under consideration. In this instance every step from shading the design paper to binding the cloths together can be easily traced to the double cloth principle, and if looked upon in this light will make the construction of chinchillas very simple indeed.

The three weaves shown at Fig. 255 are to be used in the construction of a chinchilla design. For the purpose of simplifying the explanation they will be termed ground weave, pile weave, and back weave. (Note that the pile weave has long filling floats as explained in the explanation given above.) These weaves are to be used to form a design having two face warp threads to one back warp thread on the

one face, one back, one face system. The filling is to be arranged as follows; one pile, one back, and one ground.

Fig. 256 shows the design paper of the area required, with the pile and back picks and the back warp threads shaded. It also shows the pile weave on the face warp threads and pile picks. At Fig. 257 is given the ground weave on the face threads and ground picks.

A little study at this point will reveal a departure from double cloth principles. In double cloth the face weave is placed on the face threads and the face filling is the only yarn that interweaves with this warp (excepting the binding points). In chinchillas the pile filling is an extra set of threads superimposed upon the ground cloth in much the same manner as the extra filling is added to the back of a filling

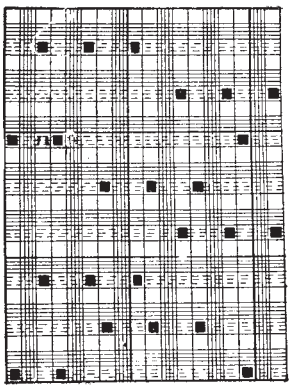


Fig. 256.

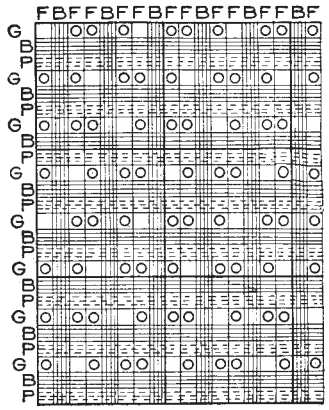


Fig. 257.

backed cloth. For this reason neither the pile nor ground filling is referred to as face filling, for it might cause some confusion, it being much simpler to give them their proper terms. Before proceeding further the relation of the pile and ground picks must be thoroughly understood.

The statement that both weaves are on the same set of warp threads but on different picks explains this fully and Figs. 256 and 257 should be carefully studied until this is firmly fixed in mind.

The design at Fig. 258 shows the back weave placed on the back threads and picks, and Fig. 259 shows Figs. 256, 257 and 258 combined, with the risers added to raise the face warp on the back picks, and the binders to stitch the ground filling to the back warp. The dia-

mond shaped dots represent risers for lifting the face warp over back picks, and the binding places are indicated by the upright crosses. Fig. 260 represents a cut section of the first three picks of Fig. 259 and illustrates very clearly the relative positions of the different sets of threads. It also gives especial prominence to the long filling float of the pile filling. The points marked H show the binding places of the cloth and correspond to the upright crosses on the third pick of Fig. 259.

To explain the use of the stuffing or wadding filling and the method of procedure when the ground filling is omitted another example will be worked out. In this instance a twelve harness double sateen is used for the pile weave, and the back weave is a cassimere

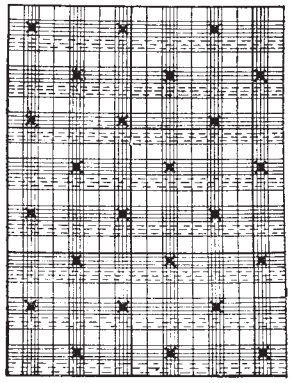


Fig. 258.

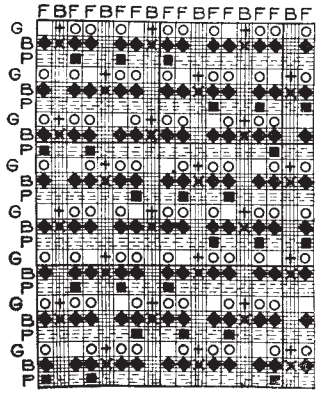


Fig. 259.

twill. The two cloths are to be stitched in twelve harness sateen order. The warp arrangement is one face, one back, and the filling is arranged with one double pick of pile, one stuffing or wadding pick, and one back pick.

It should be stated that in binding chinchilla cloths the same method is pursued as in binding double cloths, that is, by raising a back thread over a ground pick or pile pick, between two risers on the face warp and next to a riser on a back warp. In this particular instance the binding is accomplished by raising a back thread over one of the stuffing picks.

The weaves to be used are shown at Fig. 261, and it should be noted that the pile weave has the long filling floats as in the previous example. The first step is to shade, on the design paper, every even

numbered warp thread for back, and to shade the picks for two pile, one stuffing, one back. The pile weave is then placed on the face threads and the back weave is placed on the back threads. Fig. 262 shows the operation up to this point. The letters at the left indicate

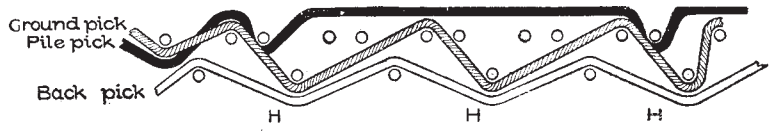


Fig. 260.

to which set each pick belongs, P meaning pile; S, stuffing; and B, back.

In completing the design there is one thing that must be done which was not met in the previous example. Reference is made to the stuffing pick which should be put in the cloth when all the face warp is raised and all the back warp is down, as it is not interwoven in any manner with either set of threads. This is accomplished in exactly the same manner as raising all the face warp when a back pick is placed in the back cloth, except that in the latter instance some of the back warp also is raised, while in the former no interlacing is desired, so every thread of the face warp is raised and every thread of the back warp is down.

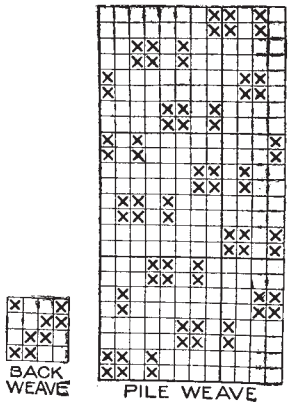


Fig. 261.

The complete design is shown at Fig. 263. The letters at the left of the design are the same as at Fig. 262, being used to designate to which class each pick belongs. The upright crosses, on the first of each pair of stuffing picks, indicate the binding points.

PIQUE

This is a cotton fabric but the principles upon which it is constructed are applicable to Matellasse and other worsted and silk fabrics which require raised patterns. The chief characteristic of this class of cloth is its embossed effect, the pattern being in relief, the stitching forming the outline of the figure.

In all the double cloth fabrics explained heretofore, the necessity

of selecting binding points where the stitching would be invisible on the face of the cloth has been impressed very forcibly upon the mind of the student. This is exactly reversed in the present case for the stitching, or at least the effect of the stitching, must be plainly visible upon the face of the fabric to produce the required effect.

The first cloth produced with patterns in relief was probably the old quilts made by stitching two cloths together by hand, the slightly raised parts between the depressions caused by the stitches forming the patterns. The principle is the same to-day, but the two cloths are woven at the same time and stitched as required by interweaving face and back yarns. In many instances the makers of old hand-made quilts spread a layer of cotton batting between the two cloths to increase the weight and bulk of the quilt. The same thing is done to-day by introducing a stuffing or wadding filling, but the object is to produce a more raised pattern.

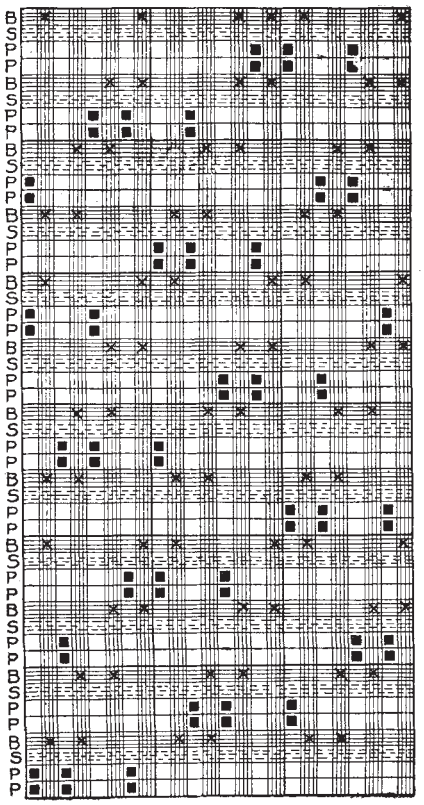


Fig. 262.

Construction. Piqué weaves may be constructed in various ways according to the quality of the cloth, but the common article is woven with face and back warps, and face, back, stuffing, and binder fillings.

The actual operation of making a design is not so formidable as the above would indicate, in fact, most all cloths made with more than one warp and filling are merely variations of double cloth, and if the principles of the latter are thoroughly mastered the former will present few difficulties. The only principle employed in making piqué designs

which has not been exploited in the previous articles is the use of a binder pick. The face and back cloths are made in the usual way, and the stuffing filling is employed in the same manner as explained in the lesson on Chinchillas.

The binder pick is interwoven with both warps. It interlaces with the face warp in the same manner as the face picks, but in addition to this, the back warp is raised over it, which has the effect of depressing the face cloth at this point. This depression is further exaggerated by the stuffing pick elevating the ridge or rib line.

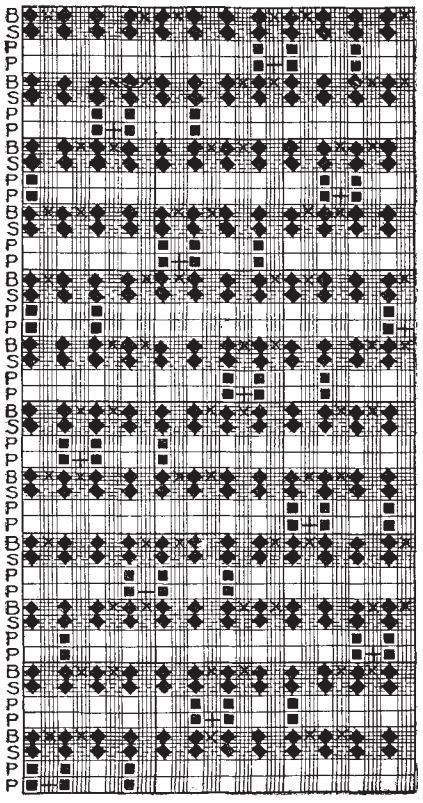


Fig. 263.

The following points should be constantly kept in mind: The face filling always weaves plain with the face warp; the back filling when used, always weaves plain with the back warp; the stuffing filling, when used, enters between the face and back warps; and the binder filling unites the face and back cloths, or the face cloth and back warp according to the construction of the fabric. If a back filling is not used the binder of course unites the back warp with the face cloth.

To illustrate the different classes of piqué three examples will be taken. The first will have face and back warps, face, back, and binder fillings, the warp to be arranged one face, one back, one face, and the filling to be arranged two face, one back, two face, one back, two face, and two binder.

The first step is the one which is common to all cloths containing two or more warps or fillings; *i. e.*, shade that portion of the design

paper that indicates the back threads or picks. The next step is to place the plain weave on the face threads and face and binder picks. (The binder picks are always considered face picks when laying out the face weave, the difference being that they are also used as binders.)

Fig. 264 shows the problem worked to this point and gives two

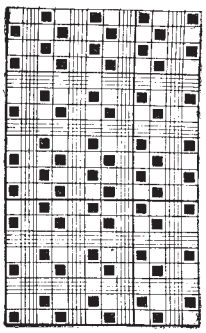


Fig. 264.

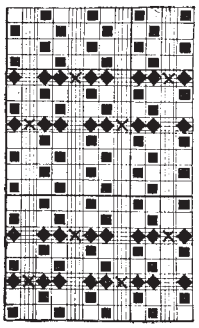


Fig. 265.

repeats each way. The back weave is now put on the back threads and the face warp lifted over the back picks. This is shown at Fig. 265.

Up to this point there has been no deviation from the method of constructing a double plain design excepting that the back cloth is of very loose texture. It is very evident that something must be added or taken away to produce a piqué effect of what is now a double plain design. In this instance something must be added to make the depression or recess which is characteristic of these cloths. The back warp is raised over the two binder picks as indicated by the upright crosses in the complete design at Fig. 266, and as these picks interweave with the face warp in the plain weave order the face cloth is slightly depressed at this point.

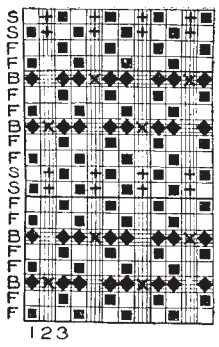


Fig. 266.

The letters at the left of the design show to which class each pick belongs. Those marked F are face picks; B, are back picks; and S, are binder picks. The diagram at Fig. 267 shows a cut section of the first three threads for two repeats of the weave or for the extent of Fig. 266. The end sections of the two binder picks are shown at S. It will be noted

that the back thread, 2, passes over these picks while the face threads, 1 and 3, each pass under one of them, which gives the necessary depression.

The second example will be very similar to the one just explained, but in this case the ridges, caused by the portion of the face weave that is not bound, must be more rounded and more prominent. To produce this result the following arrangement will be used: Warp—

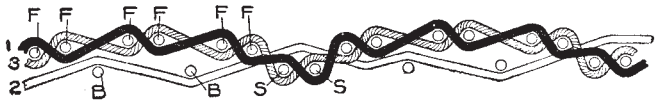


Fig. 267.

one face, one back, one face. Filling—two face, one back, two face, one back, one face, one stuffing or wadding, one face, one back, two face, one back, four face. It will be unnecessary to work out plans showing the various steps in the construction of this design as it is similar to Fig. 266 in every detail excepting the stuffing pick. The complete design is shown at Fig. 268. Note that the only risers on the stuffing pick are to raise the face warp, for this pick lies between the face and back cloths. The system of binding is the same as in the previous example.

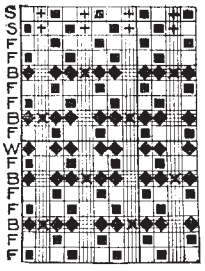


Fig. 268.

It must not be supposed that more than one stuffing pick could not have been put into the design, for one or two more might easily have been included at such places as between the fourth and fifth, and the eleventh and twelfth picks.

The letters at the left of Fig. 268 show to which set each pick belongs, F meaning face, B meaning back, W meaning wadding or stuffing, and S meaning binder.

In manufacturing the cheaper grades of this cloth it is customary to omit the back picks, allowing the back warp to float on the back of the cloth between the binding points. In designs of this class, one or more stuffing picks are generally used. Fig. 269 shows the design paper shaded for a fabric of this construction with the plain weave on the face threads, and face and binder picks. The arrangement is one face, one back, one face, in the warp; and two face, one

wadding, two face, one wadding, two face, two binder, in the filling. The shaded picks in this design are the wadding picks. These are marked W. The face picks are marked F, and the binding picks are marked B.

The complete design is shown at Fig. 270. It will be noted that the face warp is raised on the stuffing pick in the usual manner and

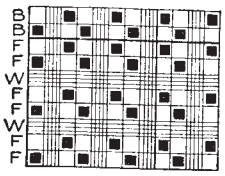


Fig. 269.

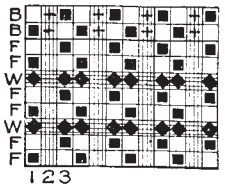


Fig. 270.

that the binding is accomplished by raising the back threads over the binding picks and interweaving the face warp with them in the plain weave order.

When weaving this grade of piqué it is a good policy to have a large amount of tension on the back warp and to use very coarse yarn for the stuffing pick, otherwise the face cloth will not be deflected and the pattern will not be very pronounced. The diagram shown at Fig. 271 represents a cut section of a fabric woven with this design and shows the long float of the back warp.

Figured Pique. The effect of a figured piqué relies chiefly for its value upon the system of binding, all other features being secondary

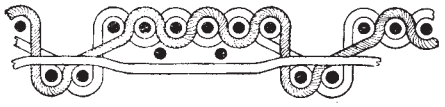


Fig. 271.

to this. In constructing a figured piqué design the principles of double cloth construction are followed very closely, less the use of the stuffing or wadding picks and the method of binding being the only differences. Wadding filling is not indispensible, but as previously explained it makes a more raised pattern.

The first step in making these designs is a departure from the primary operations of other cloths. In this case it is necessary to make a motive which determines the extent of the design. This

motive is nothing more than a system of binding. For instance, if one of these designs were bound in twill order or with twelve harness sateen, the twill or sateen would be termed the motive. It should be kept in mind that the motive shows the plan of binding and as the binding forms the outline of the figures, the motive represents the effect.

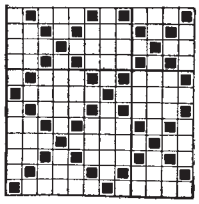


Fig. 272.

For example suppose a cloth is desired with small squares running diagonally across the cloth. The first step is to make a motive that will give this effect. Fig. 272 is the result. Having obtained the motive, it is now necessary to make the design. As each binding point spreads over three picks, the design must cover three times the area covered by the motive or 36 x 36 squares. If stuffing or wadding picks were used in the design the extent in the filling direction would of course

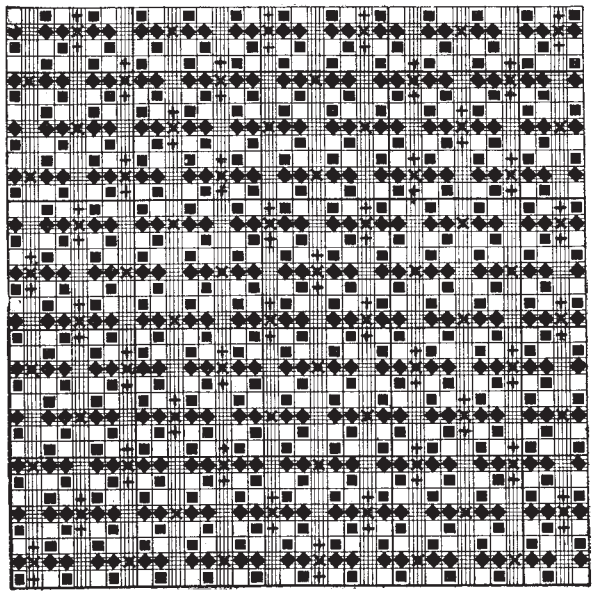


Fig. 273.

be a trifle larger, or to be exact, as much larger as the number of wadding picks. The design paper is shaded in the regular manner for one face, one back, one face, in both warp and filling and the plain

weave put on both systems of threads. The risers are now put in to lift the face warp on back picks.

All that has been done so far would be done in the same manner on several other kinds of cloth, but the next step is peculiar to this class of fabrics. Reference is met to the binding from a motive. The rule which applies in this case is as follows: Raise a back warp thread over a face pick on each side of the backing pick and next to a riser on the back warp.

The upright crosses in Fig. 273 show this rule put into effect. In this example a wadding pick is not used but one could be inserted between any of the two face picks, and the same principles would apply as in making plain piqué.

JACQUARD DESIGNING

In all the classes of designing explained up to this point it has been necessary to limit the designs to those that could be woven on the ordinary shedding or harness motion. In almost every instance, they repeat on from two to twenty-four or thirty threads, and when they exceed this number a drawing-in draft can be arranged to weave them on a practical number of harnesses. Jacquard designing includes those designs which are too large to be woven on the ordinary harness motion.

Before attempting to make jacquard designs, it is necessary to form a clear idea of the principles on which the jacquard machine operates. Figure 274 represents a section of a jacquard machine, showing the mechanism for lifting the warp threads. To each of the upright hooks A is attached a neck cord, which takes the place of the harness in an ordinary loom, and from each neck cord are suspended the harness cords through which the warp threads are drawn. A weight is attached to the bottom of the harness cord for the purpose of bringing the harness cord, and thus the neck cord and hook A, to its original position after being lifted.

The position of the hooks (whether raised or lowered) on each pick is determined by the action of the cards upon the needles or wires B. As this is the fundamental principle of jacquard weaving, it should be thoroughly mastered. To make this principle clear, Figs. 275 and 276 have been prepared. Fig. 275 shows a card

on which one pick of the design is cut, just as one pick of an ordinary design is placed on one bar of the harness chain. This card passes over the cylinder, shown in Fig. 276, in much the same manner as a bar in the ordinary harness chain passes over the chain barrel.

The cylinder has a reciprocating movement, coming in con-

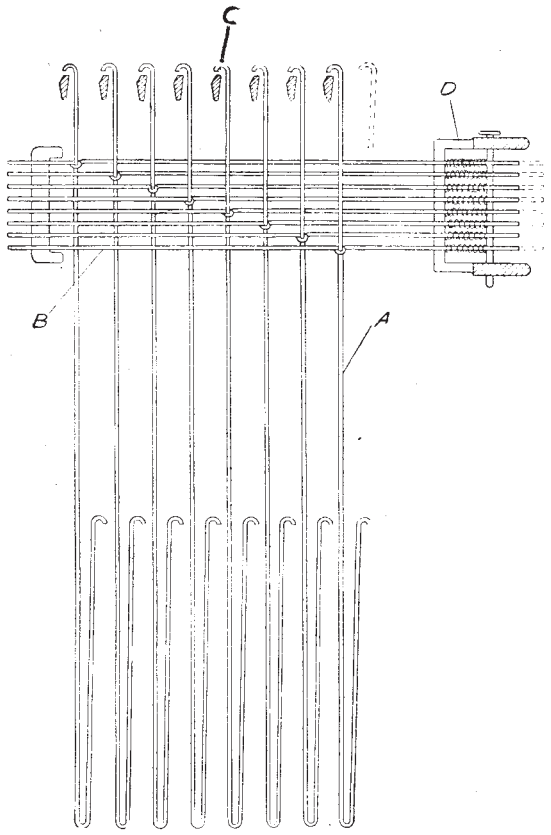
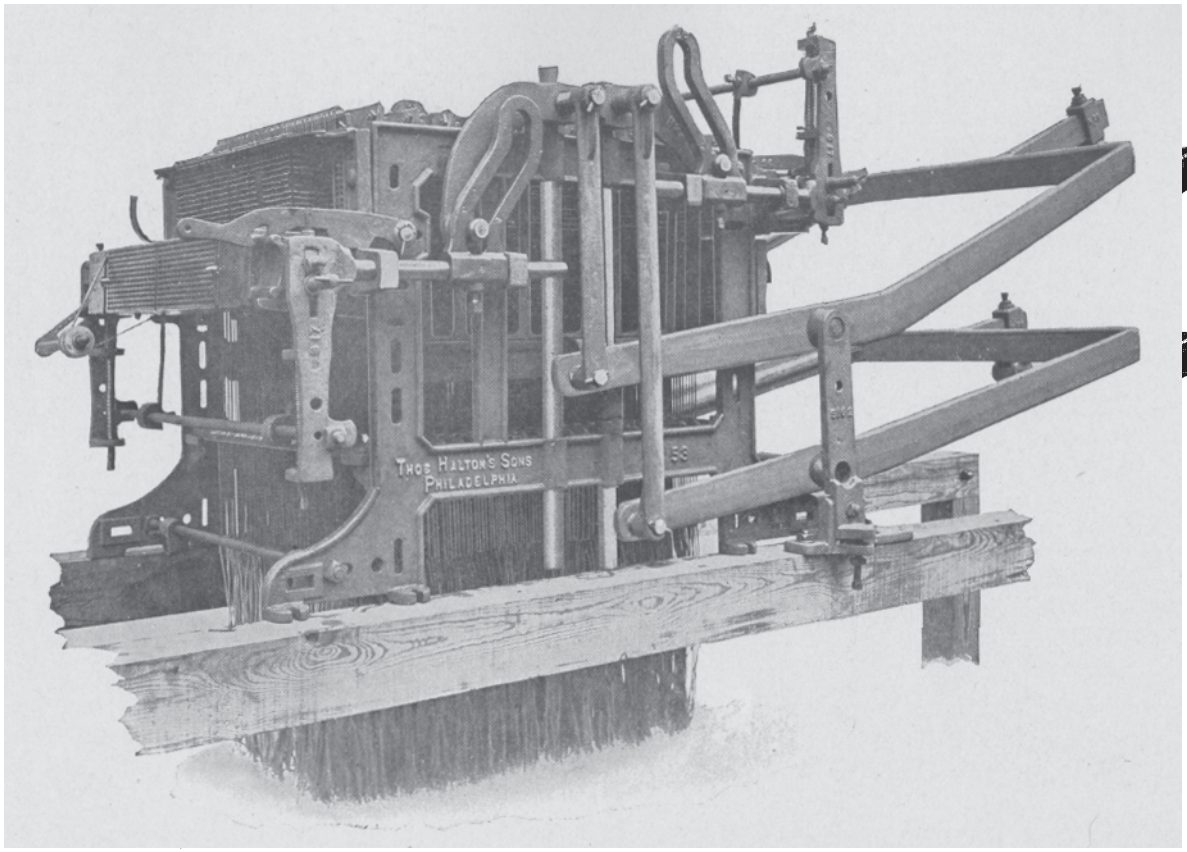


Fig. 274.

tact with the ends of the needles B; the ends of the needles entering the holes in the cylinder. Now, if a blank card is placed on the cylinder, the holes will be covered and all the needles will be pressed back, carrying their upright hooks out of the path of the



DOUBLE LIFT DOUBLE CYLINDER JACQUARD MACHINE

Thomas Halton's Sons

griffe C, as shown by the dotted line in Fig. 274. The griffe consists of a number of iron bars which have a vertical reciprocating movement and are the direct means of forming the shed.

If a card on which the pattern has been cut, such as the one shown at Fig. 275, is placed on the cylinder, those needles which correspond with the holes in the card, will not be pressed back, and the griffe in its upward movement will lift the upright hooks.

The springs D force the needles and hooks back to their original position after the pressure of the cylinder is removed.

The above are the principles of jacquard machines. A hole in the card always represents a *riser*, as its corresponding hook will be raised and, through the connections, will raise the warp thread. The usual practice in tying up the harnesses is to take

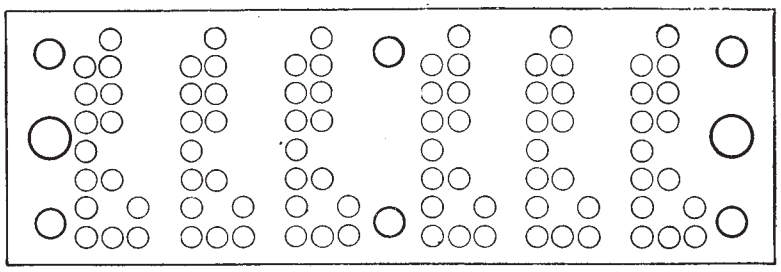


Fig. 275.

the first hook in the row nearest the cylinder head and count that the first hook in the machine. The other hooks in the same row will be counted as the second, third, fourth, fifth, sixth, seventh, and eighth hooks. The next row follows on consecutively; the first hook being counted the ninth. This is continued until the full extent of the machine is reached.

This arrangement of the machine necessitates, for the convenience of the card cutter, as well as for the designer, a special arrangement of the design paper. Each small square of the design paper represents one of the upright hooks (A in Fig. 274) and consequently the warp threads which are actuated by that hook. These small squares are divided by a heavier line, according to the number of hooks in one row of the machine. Thus, the number of small squares contained in each large square represents the number of hooks in each row.

A thorough understanding of the above is very essential to ensure a knowledge in the use of the design paper. As an example, take a machine that has eight hooks in a row (and so is necessarily tied up in rows of eight) and design paper which has eight small squares in each direction between the large squares; in other words 8 x 8 paper. Beginning at the left, the first small square represents the first hook, the next square represents the second hook, and so on to the extent of the eight hooks which form the first row of the cylinder and the first eight squares of the design paper. A heavy line follows the eighth small square, and is in turn followed by eight more small squares in a horizontal line; these represent the second row of hooks in the machine. The small squares between the third and fourth heavy lines represent the third row of needles, and so on till the full extent of the

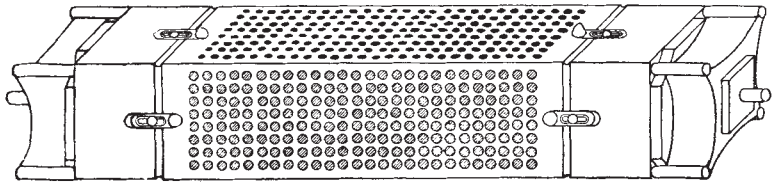


Fig. 276.

machine is reached.

It will be understood that each division of the horizontal lines and small squares represents one row of upright hooks in the jacquard machine, and the number of small squares between the heavy dividing lines correspond with the number of upright hooks in each row. This arrangement is for the benefit of the card cutter, each division representing a row of holes on the card and the keys in the cutting machine. To make this clearer, an explanation of card cutting is given.

Card Cutting. In designing jacquard designs, the same condition is necessary which is common to all branches of textile designing, *i. e.*, the design must join correctly on all four sides, so that, when repeated, the pattern will be continuous and perfect. But in this instance, there is one essential condition which is not necessary in designing for harness looms. That is, the pattern must be repeated a sufficient number of times to begin and end

with full squares. This is primarily for the convenience of the card cutter.

In Fig. 277 is shown a design which occupies one full square and six extra threads. It will be inconvenient and very impracticable to work from this.

It has been explained that the reason for dividing the paper by means of heavy lines, is to make each division of squares correspond with a row of hooks in the jacquard machine, and the holes in the cylinder, therefore, it is apparent that when working on a machine that has eight hooks in a row, the card cutter, after cutting the first row in Fig. 277, would read for the second row and find only six threads, or two less than the number required. This would necessitate taking two threads from the beginning of the design to complete the second row, consequently, there would be four threads short on completing the fourth row; and so on. This would result in a great deal of confusion and perhaps a large number of mistakes. To obviate this difficulty, the design is carried out until it repeats on even sets of eight threads, as shown at Fig. 278.

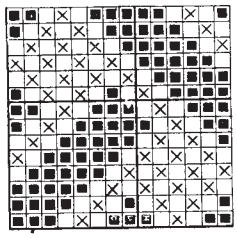


Fig. 277.

The rule for determining the number of squares on which a design will repeat evenly is as follows: Find the least common mul-

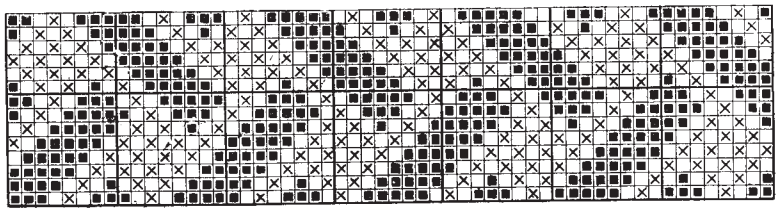


Fig. 278.

tiple of the number of threads occupied by the design and the number of hooks in each row on the cylinder; (or the number of squares in each division of the design paper.)

It is not necessary to carry out the design in the direction of the filling until it repeats on even squares, and in the case under

discussion, there would be only fourteen cards required, as there are but fourteen picks in one repeat of the design.

Another example of this nature is shown at Fig. 279. One repeat of the design occupies eighteen threads and eighteen picks. This, of course, must be extended until it repeats on even squares of 8 x 8 paper, as the machine on which it is to be woven has eight hooks in a row. The completed design, as shown at Fig. 280, occupies seventy-two threads, this number being the least common multiple of eight and eighteen.

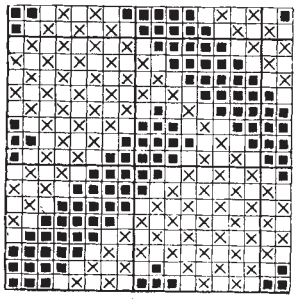


Fig. 279.

Another point in connection with design paper that should be thoroughly mastered is the proportion the number of squares in one direction bears to the number of squares in the other direction, and its influence upon the fabric. If the design is made upon paper which is ruled square, that is, 8 x 8, or 12 x 12, the cloth should have the same proportion of warp and filling. But suppose that it is necessary to change the construction of the cloth so that the filling is reduced in the proportion of eight warp threads to six filling threads, and the design for this construction is placed on 8 x 8 paper. It would, of course,

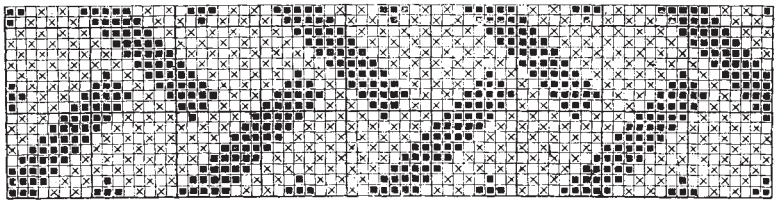


Fig. 280.

be out of proportion, the figure being elongated by the reduction in the number of picks per inch.

If the original design on 8 x 8 paper occupied eighty threads in each direction, and the cloth contained that number of threads and picks per inch, the design would be one inch square; but if the same cloth were constructed with eighty threads and sixty picks

per inch, the design would be one inch wide and $1\frac{1}{3}$ inches long. To overcome this difficulty, the design must be drawn disproportionately, or the design paper must be ruled similar to the construction of the cloth. The latter alternative is the better.

In the instance mentioned above, where eighty warp threads and sixty picks are used per inch, the heavy lines would be ruled square, but instead of eight small squares being ruled in each direction, there would be eight squares in a horizontal direction and six squares arranged vertically. This is shown at Fig. 281.

It is sometimes necessary to construct a cloth with a larger number of picks than warp threads. In this instance, it will be necessary to have more squares in the direction of the filling, or vertically. If the proportion is ten to eight, or one hundred picks to eighty warp threads, the design paper would be ruled as shown at Fig. 282.

EXAMPLES FOR PRACTICE

1. Continue Fig. 283 on 8 x 8 design paper until it repeats on even squares.

2. Determine a method of calculating the number of squares on which a design would be complete.

3. What design paper would you use for a cloth constructed with seventy-two threads per inch and fifty-four picks per inch, if the design were to be woven on a jacquard machine which has eight hooks in a row?

4. What design paper would you use if the above cloth were woven on a jacquard machine which had twelve hooks in a row?

5. When it is decided to raise a thread on a specified pick, how is this brought about?

Casting Out. Casting out means omitting some of the hooks and harness cords from the calculations, when arranging a pattern to be woven on the jacquard machine. The hooks are not actually cast out of the machine, and in fact, the harness cords hang from these hooks the same as if they were in use, but no warp is drawn through them.

To make this condition clear, assume that a loom is weaving a pattern on eighteen harnesses, and it is desired to weave a pattern on sixteen harnesses. Ordinarily the two extra harnesses would

be removed. But suppose these two harnesses are fixtures in the loom and cannot be removed. The only thing that can be done in such a case is to withdraw the warp from the heddles, allowing the harnesses to hang idle in the loom. The foregoing is exactly parallel to the condition found in the jacquard machine when some of the hooks are not used, or "*cast out.*"

As previously explained, the hooks in the jacquard machine represent a number of harnesses or their equivalent, and from the nature of the machine the hooks which are not required cannot be removed. However, the presence of hooks and harness cords does

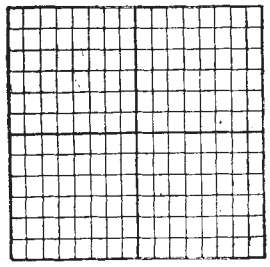


Fig. 281.

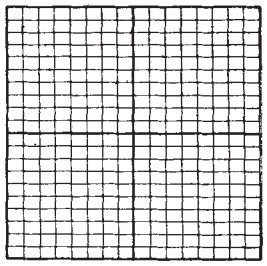


Fig. 282.

not make it necessary to use them, any more than the presence of the two extra harnesses in the ordinary loom makes it necessary to draw in the warp on them. In both cases the extra hooks or the extra harnesses are treated as having no existence.

The necessity for casting out, or leaving a portion of the machine idle, may be brought about by two causes. If the number of threads occupied by the pattern is one which will not divide into the number of hooks which the machine contains, without a remainder, a number of hooks as large as the remainder must be cast out or left idle.

What is known as the "*three hundred*" jacquard machine contains three hundred four hooks, or thirty-eight rows with eight hooks in each row. The "*four hundred*" jacquard machine contains four hundred eight hooks. The "*six hundred*" jacquard machine contains six hundred eight, or six hundred twelve hooks, according to whether there are eight or twelve hooks in each row. In the former there are seventy-six rows and in the latter fifty-one rows,

which make this machine equal to two "three hundred" jacquards.

When one of these machines is tied up to its full capacity (that is, every hook having neck and harness cords attached) and the pattern designed to be woven occupies twenty threads, some of the hooks would have to be cast out, as twenty will not divide evenly into the total number of hooks. If the machine contained three hundred four hooks, there would be four hooks cast out, as three hundred four divided by twenty equals fifteen with four remaining. ($304 \div 20 = 15\frac{4}{20}$.) If the four hundred eight machine were used, eight hooks would be cast out; and so on.

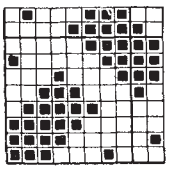


Fig. 283.

In many cases, however, the number to be cast out would not be so small as four or eight hooks. The pattern may occupy eighteen threads and have to be woven on a machine that has three hundred four hooks In this instance, it would be necessary to cast out sixteen hooks. If these hooks were not cast out an imperfect pattern would be formed at every division of the harness; or at every three hundred four threads. If the eighteen thread pattern had to be woven on a four hundred machine, there would be twelve threads left over. It will be understood that only complete patterns, or as many hooks as will work a number of complete patterns, must be employed.

There is another object in casting out, in addition to adapting a machine to weave complete repeats of a design. When a jacquard machine is tied up; *i. e.*, when the harness cords are arranged in the machine; it is arranged for a certain number of threads per inch. When all the hooks are employed the number of threads cannot be increased, but it may be reduced by having some of the hooks remain idle. To make this clear, assume that a loom is working with four ordinary harnesses on each of which there are fifteen heddles per inch, or a total of sixty heddles per inch for the four harnesses. If only fifty-two threads per inch were required, two heddles per inch on each harness would be taken off. If it were impossible to remove the extra heddles, the same result could be obtained by not drawing the warp threads through them. The latter method is the one adopted on the jacquard

machines. The cords hang idle in the loom, no warp thread being drawn through them, consequently the "*sett*" or number of threads per inch is reduced.

The whole matter may be readily summarized as follows: If the full number of hooks contained in the machine are not employed, the number of threads per inch is reduced, but there is a consequent limitation of the pattern producing power, in extent, of the machine.

Casting out is resorted to for two purposes: *first*, when the number of threads occupied by the pattern cannot be divided evenly

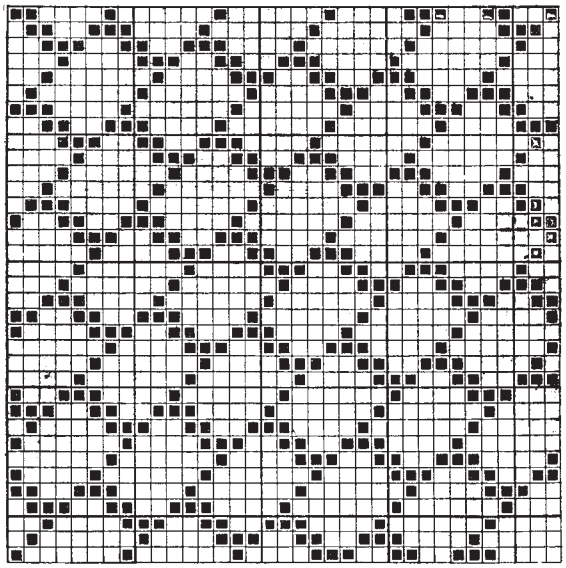


Fig. 284.

into the machine, and, *second*, when it is desired to reduce the sett or number of threads per inch carried by the harnesses. The first has the disadvantage of reducing the sett when this may not be necessary nor advisable. The second has the disadvantage of reducing the pattern producing power of the machine. However, these difficulties are part of jacquard designing and must be overcome, as it is impracticable to tie up the machine every time a new pattern is made.

To calculate the effect of casting out and thus enable the designer