

## 8

# Interchanging Double Cloths

In the introduction to the previous chapter it has been stated that double cloths could be joined together by interchanging fabric layers. Each interchange represents in effect a stitch and when such interchanges are frequent the cloths are very firmly united but if the intervals between the changes are considerable then the two layers remain separate over a large area which may give rise to puckering or other forms of cloth distortion. It may also lead to undue wear as the separate cloth 'pockets' between the interchange points would be free to 'ride' one upon another thus creating interlayer rubbing. In such circumstances it may be advisable to stitch such areas together additionally by one or the other method of self-stitching obeying the normal and well established rules explained previously.

The interchanging of the threads means that the series which actually alternates between the face and back of the cloth can no longer be designated as the face or the back yarn because in effect it will occasionally be the one and occasionally the other and should be best identified by the colour or by the position which it occupies, i.e., say, odd or even. It will be appreciated from the principles of double-cloth construction established previously that the face cloth is brought to the top by means of the separating lifts. Thus in a cloth in which the ends and the picks are both arranged in an alternate 1 black, 1 white order the black cloth will form the face when, irrespective of its weave, all the black ends are raised on all the white picks, and, by converse, a white cloth will occupy the top position when all the white ends are raised on all the black picks. The separating lifts do not prejudice the interweaving of the threads within their own cloths but merely ensure that given layers occupy either the top or the bottom positions in the composite structure.

### INTERCHANGING DOUBLE PLAIN CLOTHS

These fabrics are produced in a variety of materials for suitings, over-coatings and furnishings in designs consisting of stripes, checks, spots and more elaborate figured effects. In the simple design ranges the effects can be achieved by two different methods: (a) By retaining a constant and 1-and-1 colour arrangement in the warp and in the weft whilst changing the position of the separating lifts; (b) by retaining the same weave and changing the colour pattern. The former

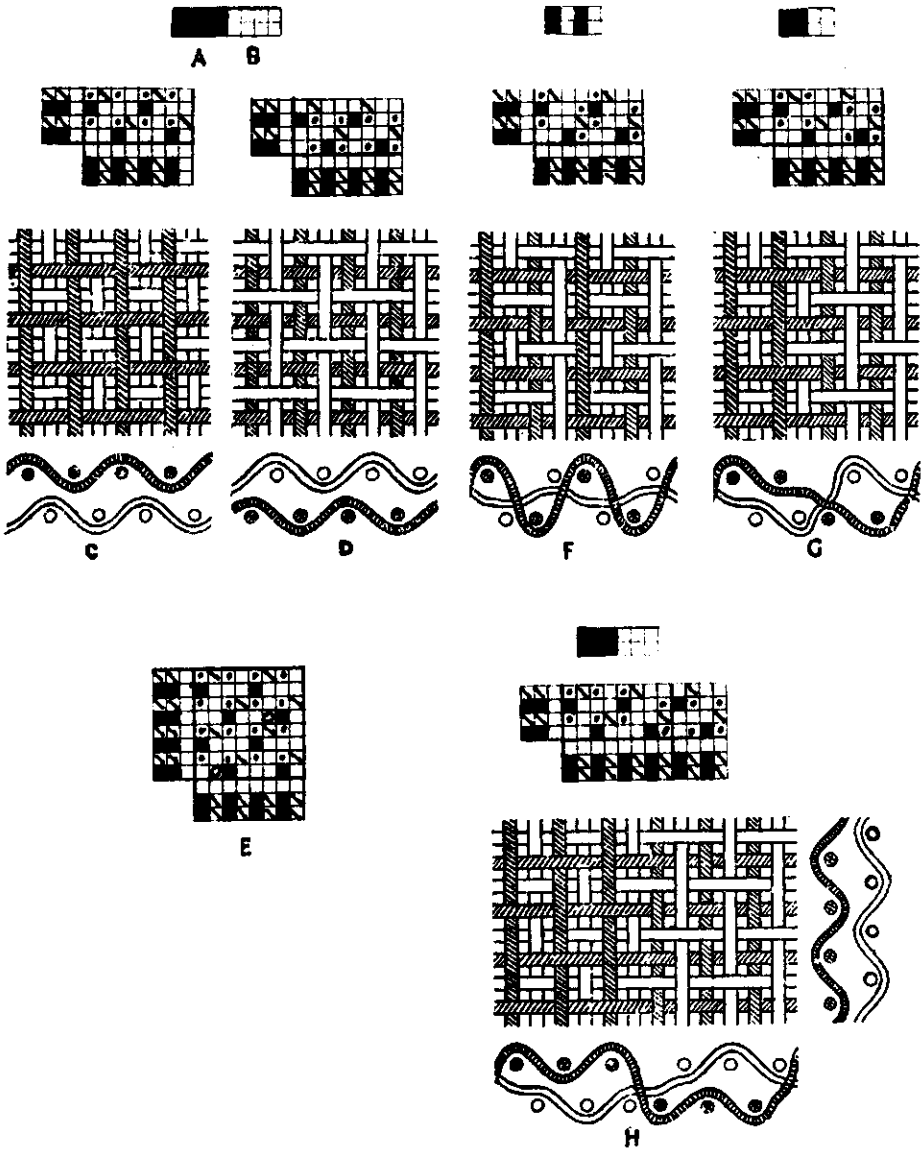
method is more common because it is capable of greater versatility of effect, the latter being mainly confined to the production of stripe patterns. Whichever method is employed it is preferable to commence the design by constructing first a simplified and condensed motif to indicate which colours of the threads are going to appear on the face and which on the back at any given area of the design. The degree of condensation in the motif is by two in each direction so that one square of the motif represents two ends, 1 dark and 1 light, and two picks. Each fully worked-out design in the examples which follow is preceded by such a motif which shows clearly the intended disposition of the two differently coloured layers within a repeat.

*Effects due to changes in the position of separating lifts with continuous 1-and-1 colour arrangements.*

The motif A and B in *Figure 8.1* indicates a stripe design in which at A four dark ends together with the dark picks work on the surface whilst at the same time the light ends and picks form the back cloth, and at B the reverse takes place with the next four light ends forming the face and the corresponding four dark ends producing the back cloth. The fully worked-out designs and interlacing diagrams are given separately at C to correspond with the portion A and at D for the portion B of the motif. The colour arrangement of 1 dark, denoted by the solid marks, and 1 light, denoted by the diagonal marks, is shown on the margins of the fully worked-out designs and this notation is retained throughout this chapter. In the actual fully worked-out designs the solid squares indicate the weave of the dark threads, the diagonal marks the weave of the light threads, and the dots the separating lifts using the normal convention in which a mark equals warp up. Comparing the design C with D it will be noted that the weave marks in both are identical, the only difference being in the placement of the separating lifts. In the design C these lifts cause all dark ends to be raised on all light picks and in the design D result in all light ends being lifted on all dark picks thus achieving the exactly opposite disposition of the two cloths clearly indicated by the interlacing diagrams C and D and by the sections underneath them which show the interlacing of the first dark and the first light pick in each case.

When the two weaves are combined in stripe formation a compact structure results due to the interchange of the dark and the light weft between the face and the back. If however, a broader stripe is required the interchange which in effect stitches the two layers together may not be sufficiently frequent to provide the necessary degree of interlayer cohesion and in such circumstances it may be necessary to self-stitch the two cloths which is usually done by lifting some back ends on face picks at infrequent intervals as shown by the design E in *Figure 8.1* in which the circles denote the stitching lifts. In the case of design E the light threads form the back cloth and, therefore, the light ends are raised for tying on the dark picks when, however, the layer positions are reversed and the dark threads form the back cloth then the dark ends would be raised for stitching on the light picks. As in a plain weave where adjacent floats do not exist it is difficult in some constructions to provide perfect concealment for the stitch points. For this reason the interchanging plain cloths are self-stitched only when this is deemed absolutely essential.

It will be appreciated that the cloth layers can be combined in a variety of ways to produce coloured stripes of different widths. Smart single, double, or

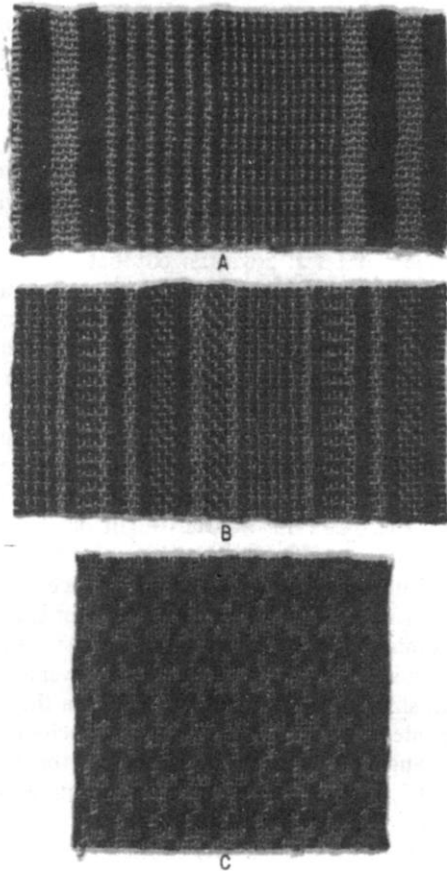


*Figure 8.1*

treble hairlines are most favoured but wider stripe combinations are also produced. The motifs, designs and interlacing diagrams given at F, G, and H in *Figure 8.1* illustrate respectively the construction of the single, double, and treble hair-line effects. It will be noted that in each example the thread colours is 1 dark,

1 light in the warp and in the weft and the occurrence of the alternate stripes is due to the appropriate placement of the separating lifts. The warp cross-sections underneath the interlacing diagrams at F, G and H show that the stripe effect is due to the order of interchange of the weft yarns while the warp ends in each stripe remain continuously either in the top layer or in the bottom as decreed by the separating lifts. This is shown by the weft cross-section to the right of H which illustrates the interlacing of the first dark and the first light end. The appearance of a cloth in which stripes of varying width are combined together is illustrated by the sample A in *Figure 8.2*.

In order to ensure that correct junctions are obtained at each interchange it is necessary to retain exactly the same weave relationship between the dark and the light cloth. It will be clear from the examination of the designs and interlacing diagrams A to H in *Figure 8.1* that such a relationship has been maintained. Thus, on the odd picks of each cloth the even ends are raised and on the



*Figure 8.2*

even picks the odd ends of each layer form the top shed. The disturbance of this relationship is liable to result in unwanted cut marks and floats which disfigure the clean appearance of these constructions.

In addition to vertical stripe designs the technique of the displacement of separating lifts can be used to produce horizontal hairlines as shown at I in *Figure 8.3*. Normally, however, the horizontal hairlines are combined with vertical stripes to form checks or designs similar to the one illustrated in the motif J and the corresponding fully worked-out structure in *Figure 8.3*. The same type of design is also shown in the cloth sample B, *Figure 8.2*, incorporated within a more elaborate stripe effect.

Another method of adding variety of effect is to produce a mixed colour stripe in which the dark warp is made to weave plain with the light weft in the top cloth whilst the light warp weaves plain with the dark weft in the bottom cloth. In this way an intermingled stripe is obtained in which the resultant hue, due to the close juxtaposition of the two colours, is midway between the one and the other. Such a stripe is illustrated in the sample B in *Figure 8.2* and is also shown in the motif K in *Figure 8.3* and in the accompanying fully worked-out design and diagrams. In the motif the mixed colour stripe is indicated by the shaded squares whilst in the full design the plain weave lifts of the dark ends are indicated by the crosses and similar lifts of the light ends by the circles to make identification of this portion of the design easier.

In the foregoing solid stripe designs it will be noted that 2 face or 2 back ends are invariably brought together where the change from one colour to the other is made. This tends to create a crack in the surface and it is sometimes possible, with the same order of colour, to avoid it by arranging the weaves in a special manner as indicated at L in *Figure 8.3*. In this case each stripe section contains an odd number of ends, so arranged that the two ends which are brought together where the interchange takes place are face ends. This, unavoidably, causes more ends to appear on the face than on the back, although the picks are equal on both sides. The interlacing diagram at L and the section below it show that with this form of arrangement the cloth is no longer reversible, the pattern formed on the surface of the cloth being 3 dark, 3 light, and on the back 2 light, 2 dark. Thus, in this form of arrangement each stripe section contains one back end less than the number of face ends and the method could be extended to achieve similar effects with a pattern of, say, 2 dark, 2 light on the face, and 1 light, 1 dark on the back, or, 4 dark, 4 light on the face, and 3 light, 3 dark on the back, etc. One necessary precaution which must be taken when this system is used is to ensure that the same number of face ends is sleyed through each split of the reed. It will be noted that in the case of this structure no motif has been given—the omission is deliberate because the motif is applicable to reversible effects only in which it is assumed that the reverse of the effect shown on the face is equal in size but opposite in colouring. In the structure given at L the size of the reverse side effect is different from that achieved on the face.

So far, the interchanging double plain weave has been shown capable of producing attractive stripe effects in solid and intermingled colourings. It is, however, equally suitable for the production of check, spot and figured effects. The elaborately figured constructions are considered in Chapter 10; at this point two simple examples are shown to indicate the manner in which both the thread elements, i.e., the warp and the weft can be made to interchange. M in *Figure 8.4* represents the motif and the fully worked-out design for a popular counterchange effect. It will be noted from the design that the same weave relationship is retained throughout the repeat and the effect is due, as before,

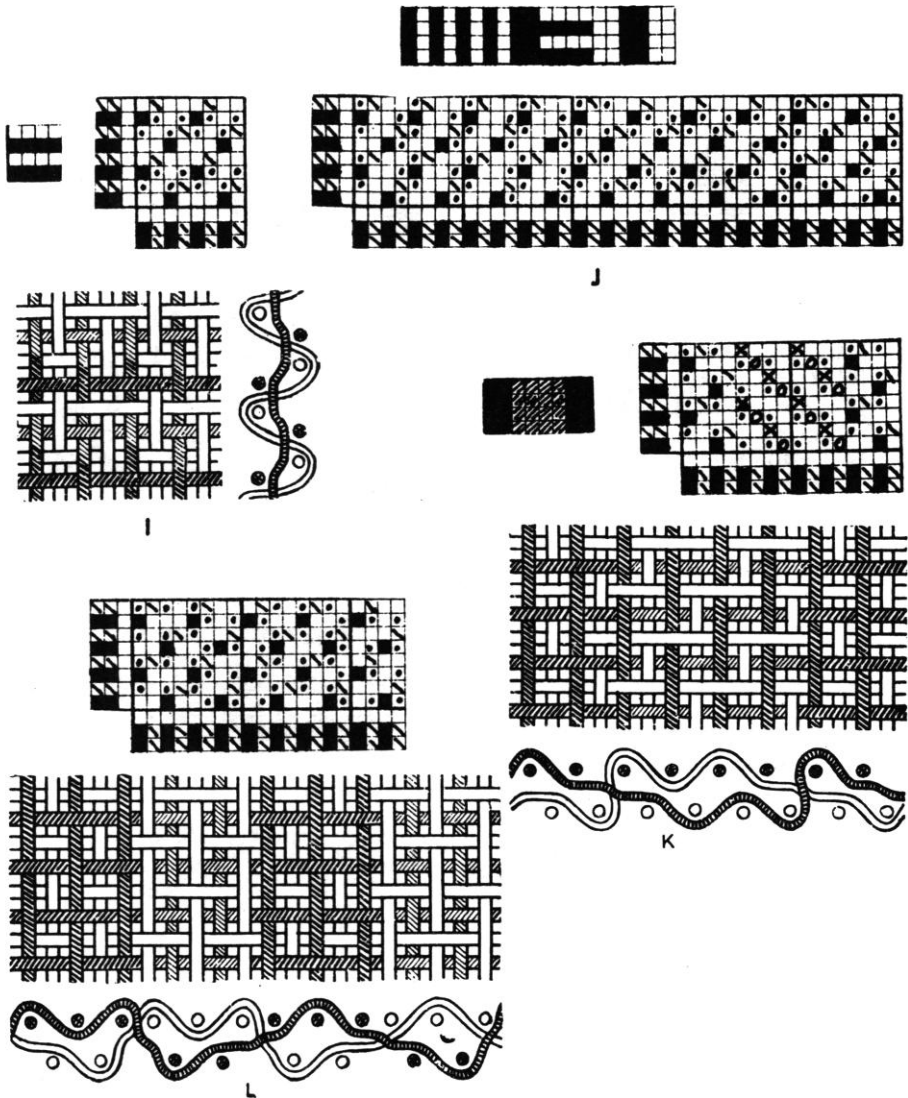
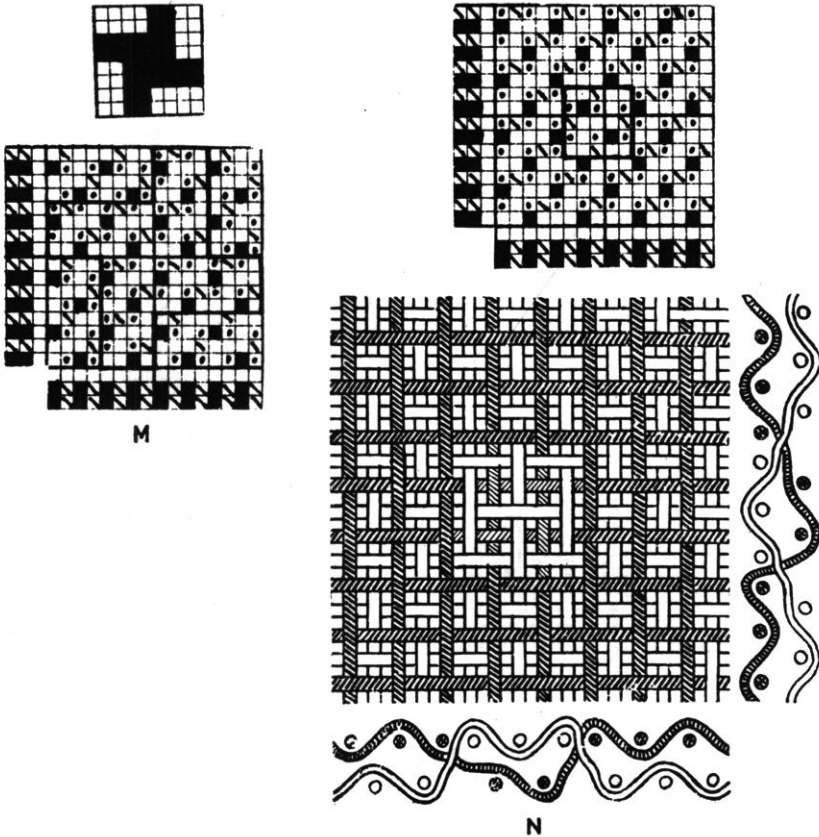


Figure 8.3

to the positioning of the separating lifts. Thus, where the dark cloth is required on the surface the dark ends are raised on the light picks and where the light coloured cloth is displayed on the face the light ends are raised on the dark picks. The cloth is perfectly reversible and the effect is illustrated in the sample C in Figure 8.2.

A light coloured spot on a dark ground given at N in Figure 8.4 is constructed in a different way. The effect is slightly dissimilar on each side because due to the special arrangement of the separating lifts the light spot on the face is produced by three light ends and picks but the corresponding dark spot on the back

comprises only two dark ends and picks the method being similar to the one adopted in producing the stripe design L in *Figure 8.3*. The spot produced in this manner appears more solid on the face and is not separated from the dark



*Figure 8.4*

ground by the distinct cuts or cracks which are liable to develop at each interchange when the method illustrated at M in *Figure 8.4* is employed. The interlacing diagram and the design N in *Figure 8.4* show clearly this method of construction and the warp and weft sections below and alongside the interlacing diagram which respectively indicate the interweaving of the picks 6 and 7, and the ends 6 and 7, illustrate the manner in which both the warp and weft threads change from one cloth layer to the other.

#### *Effects due to changes in the colour arrangement*

In this method of producing stripe and check effects the position of the separating lifts is constant and the different colours are brought to the surface by changing the relationship or the order of the dark and light threads. Thus, if it is the odd ends that are raised on the back picks and the odd ends in one stripe

happen to be dark then a dark stripe will result; if, on the other hand, they happen to be light then a light coloured stripe will be produced. It follows, therefore, that if the odd ends be designated the face ends and the even ends the back ends then to obtain the necessary colour change in the stripe in one section the ends will be arranged 1 dark, 1 light, whilst in the next section the arrangement will have to be 1 light, 1 dark. The picks are usually arranged in a continuous 1 dark, 1 light order as, apart from the check effects which will be dealt with later, there is no benefit to be derived from changing the wefting order.

The method of construction is demonstrated by the designs, interlacing diagrams and sections at A, B, C and D in *Figure 8.5*. The simplified motifs above the designs show that at A and C a dark coloured cloth is on the face whilst in B and D the light coloured threads form the face fabric. Previously used notation is employed, i.e. the weave lifts of the dark ends are shown solid, those of the light ends by the diagonal marks and the separating lifts by the dots. The colour arrangement is denoted by the solid squares for the dark ends and picks and the diagonal marks for the light ends and picks around the margins of each fully worked-out design as before.

It will be noted that identical face effects are formed in A and C, and also in B and D. The only difference between the two pairs of similar effects is the relationship of the back weave to the face weave, a different tabby of the plain weave being used between A and C, and again between B and D. The arrangement A or C may be equally well combined with either B or D so that greater latitude is available in joining the weaves in this than in the previous system. Other advantages of this system are that a more even cloth results because the bringing of two face or two back ends together at the point of interchange is avoided,

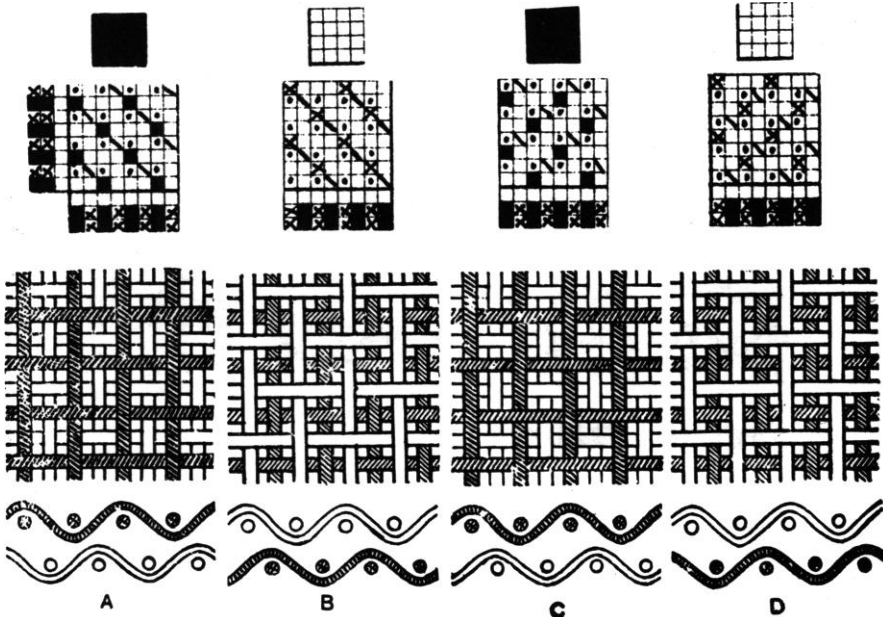


Figure 8.5



and if required, the weaves at the interchange can be made to cut. For worsted cloths cutting of the weave is frequently preferred as the pattern in clear finished cloths is thus brought out smartly and definitely. However, cutting in small sections and several times in succession should be avoided as it tends to produce a ribbed cloth with an unnecessarily harsh handle.

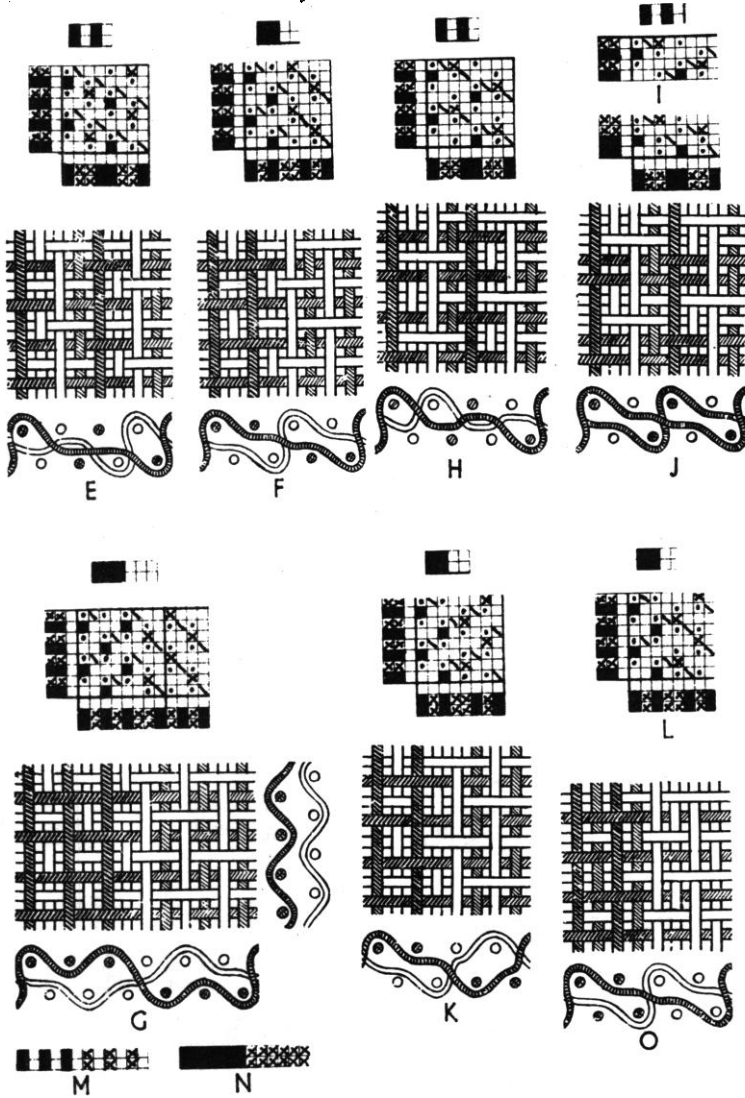


Figure 8.6

In E, F, and G in *Figure 8.6*, the weaves are arranged to cut at each change of the pattern, as is shown in the designs. In each case, however, the weaves may be arranged without the cutting, or to cut at one change and not at another. Thus, H shows how the vertical hairline may be obtained with the weaves cutting every 4 ends, instead of every 2, as in the design E; while I shows how the same effect

may be formed without the weaves cutting. The most common method of producing the single-thread vertical hairline, with the weaves cutting every four ends, is illustrated by the design J in *Figure 8.6*, and the corresponding diagrams. In this case, while the arrangement of the warp colouring is the same as that for the designs E, H, and I, the threads interlace in the same order as in the design F. The wefting, however, is changed to 2 dark, 2 light, hence the pattern may be produced in looms with changing boxes at one side only. Design K in *Figure 8.6* shows how the 2-thread stripe pattern may be formed with the weaves cutting every eight ends and L without the weaves cutting, the colour effect in each case being the same as that produced by the design F.

If the plans E to L in *Figure 8.6* are carefully analysed and compared with the corresponding interlacing diagrams, it will be seen that each colour of weft interweaves only with its own colour of warp, and solid lines of colour are formed on both sides of the cloth. It will also be seen that with the warp colours arranged on the principle indicated below the designs E to L, the pattern on the underside of the cloth is exactly the reverse of that on the face, which in many cases is a distinct advantage. If, however, the colour pattern on the underside is of little or no importance, the back ends may be in either dark or light, or practically any colour, since these ends remain on the back all the time, while the face ends are continuously on the face, as shown in the section alongside the interlacing diagram given at G in *Figure 8.6*. In such a case, therefore, so long as the face ends are arranged as to colour in accordance with the form of pattern which is required on the surface, the order of warping may be materially simplified by colouring the back warp in sections to conform with the face order of colouring. For example, the design given at G in *Figure 8.6* will produce the pattern 3 dark, 3 light on the surface, if the face ends are arranged in the order of 3 dark, 3 light, as shown at M. So far as regards the face of the cloth, the complete warping plan may therefore be 6 dark, 6 light, as shown at N, which is a simpler arrangement than the warping order which is necessary in order that the face and back will be alike. In the same manner, of course, the warping plan for the 2-dark, 2-light stripe produced by the design F may be 4 dark, 4 light. The back warp may also be in a different colour from either of the face warp colours, and it may be different in thickness. The weft, however, should be in the same colours as the face warp, and similar in thickness, and it is usually an advantage to insert more picks than ends per cm, as greater solidity of colouring is thereby obtained. The interlacing diagram of the design F, with the warp colours arranged 4 dark, 4 light, is given at O in *Figure 8.6*, while the section shows the interweaving of the picks 1 and 2. If the diagram given at F is compared with O, it will be noted that on the face the patterns are respectively the same, the change in the warping plan simply affecting the underside, where an intermingled colour effect is produced.

The method of constructing a specific stripe design is illustrated at P to T in *Figure 8.7*. It is assumed that the ends are arranged 1 face, 1 back, the picks 1 dark, 1 light, and that the pattern to be formed on the surface of the cloth is 3 dark, 2 light. 3 dark, 1 light, 2 dark, 1 light (shown in the motif above P). The position of the back ends, the order of wefting at the side, and the face warping plan below the ends, are first indicated, as shown at P. The complete order of colouring the ends may afterwards be arranged, as described with reference to

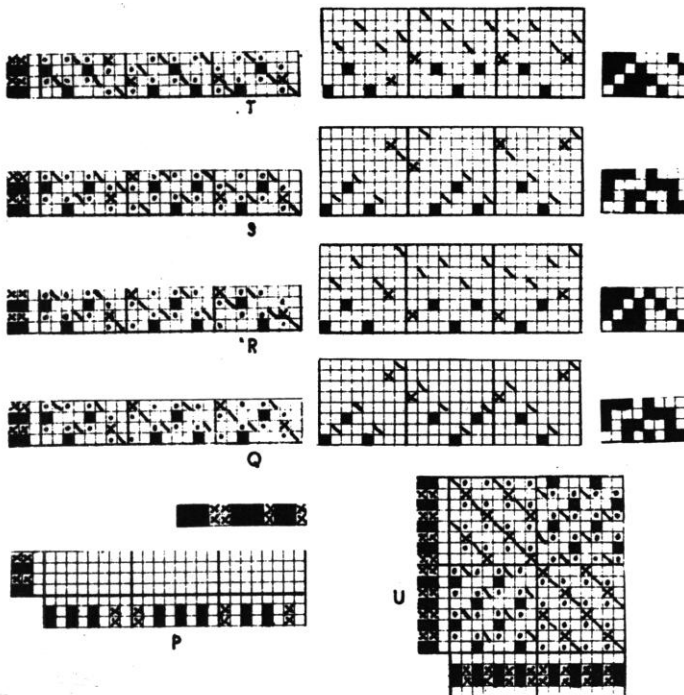


Figure 8.7

the weave G, *Figure 8.6*, according to the effect which is required on the underside. Each colour of weft is arranged to interweave on the face only with its own colour of warp; and if the weave A or C, *Figure 8.5*, is inserted in the dark sections, and the weave B or D on the light, the required colour pattern will be formed on the surface of the cloth, although, as has already been shown, the weaves may be combined in many different ways. Q shows the weaves arranged to cut at each change of the pattern, while in R a cut is made only at each side of the 3's of dark colour. S shows another arrangement with weaves cutting at each change, and T with the cutting as at R. Other combinations may be made which will produce the same colour pattern on the surface, but one of the chief objects to note in arranging the weaves is the simplification of the drafting.

The respective drafts are given alongside the design Q, R, S, and T, and the lifting plans on the right of the drafts. Two sets of four healds each, are required in each case but while in the drafts for Q and S the front four healds produce the dark sections of the pattern, and the back four healds the light sections, the drafts for R and T are arranged with the face threads drawn on the front four healds and the back threads on the back four healds. The draft for Q is the simplest arrangement, because not only are the mails per unit space of the healds in each set the same, but the order in which the threads are drawn in can be readily followed. The order of drafting is 1, 2, 3, 4, throughout, a change from one set of healds to the other being made at each change of colour. In the draft for the design R a definite system is also employed for the simplification of the drawing-in. Thus, the dark face ends are on the odd healds, and the light face

ends on the even healds of the front set. The first heald of the front set is followed by the first heald of the back set, the second by the second, and so on. Further, in the case of tappet shedding, the design and the draft may, with care, be made to conform with any given lifting plan. For example, if the threads 19 to 22 of the draft for the design Q are drafted 1, 2, 3, 4, instead of 3, 4, 1, 2, the lifting plan for Q will produce the design R. The design S may be taken to illustrate a defective combination of the weaves to fit a given lifting plan. In this case with the lifting plan the same as for Q the draft is unsatisfactory, because not only is it difficult to follow, but there is an extreme variation in the setts of the healds.

The method of arranging the colours and the weaves for producing a *check* pattern in sections of 4 dark, 4 light colouring on both sides of the cloth is illustrated by the design U in *Figure 8.7*. The order of colouring in the weft is the same as that in the warp—viz., 1 dark, 1 light for four times, and 1 light, 1 dark for four times. The pattern is obtained by the interchanging of both the warp and the weft threads.

### *Effects in three and four colours*

As there are only four picks in the repeat of the double plain weave, the limit as to the number of colours which can be introduced is four, if each line on the surface is required to be solid in colour. If one colour is brought to the surface for two consecutive threads, in order to form a plain weave there must be at least two picks of that colour out of the four in the repeat of the wefting plan. Hence, in such a case, the limit as to the number of colours is three, of which two must form single lines of colour.

In the designs given in *Figures 8.8* and *8.9* the differently coloured threads are represented by different marks along the bottom and at the side of each plan. The marks which indicate where the face warp lifts over the face weft correspond with the marks which are used to represent the colours; the diagonal marks indicate the back weave, and the dots the face ends up on the back picks. The motif above each design indicates the surface colour of each section of the pattern.

Interlacing diagrams and sections showing the interweaving of the threads are given of the majority of the designs; and in order that comparisons between them may be readily made, the threads in the diagrams are shaded in different ways to represent the colours. The colours are also indicated by numbers—shade 1 corresponding with the full squares on the design paper, shade 2 with the circles, shade 3 with the crosses and shade 4 with the vertical lines.

The designs A and B in *Figure 8.8* and the corresponding diagrams illustrate the method of producing patterns in four colours in the system of arrangement in which two face or two backing threads are brought together where the weaves interchange. The shades in the warp are arranged in the order of 1, 2, 3, and 4 throughout, and in A the wefting is in the same order. The weave in section 1 of A brings the odd ends and picks in shades 1 and 3 to the surface, while the even ends and picks in shades 2 and 4 pass to the underside. Each face end floats under its own colour of weft and over the other colours, vertical lines in shades 1 and 3 being formed on the face. The weave in section 2 of A brings the even

ends and picks in shades 2 and 4 to the surface, while the odd ends and picks in shades 1 and 3 pass to the underside. Again each face end floats under its own colour of weft and over the other colours, with the result that vertical lines in shades 2 and 4 are formed on the face. The complete pattern produced on the surface by the design A is a single thread stripe with the shades arranged in the order of 1, 3, 1, 3, 2, 4, 2, 4. By combining four threads of section 1 with four threads of section 2, the single thread vertical hairline in four colours is formed.

The design B in *Figure 8.8* is exactly the same as the design A, except that in the weft the shades 2 and 4 are reversed in order that they will occupy different positions in relation to the corresponding shades in the warp. An examination and comparison with the diagrams given at B will show that in section 3 each face pick passes under its own colour of warp and over the other colours, with the result that horizontal lines in shades 2 and 4 are formed on the surface. In the same manner, if the shades 1 and 3 are reversed, section 1 will produce horizontal lines. The complete effect produced on the surface by the design B is a stripe arranged—one of shade 1, one of shade 3, one of shade 1, one of shade 3, and four of the horizontal hairline in shades 2 and 4.

With regard to the underside of the cloth, an examination will show that in A, section 1 produces a horizontal hairline in shades 2 and 4, and section 2 a similar effect in shades 1 and 3; while in B, section 1 produces a vertical hairline in shades 2 and 4, and section 3 a horizontal hairline in shades 1 and 3.

It is evident from the foregoing that with the warp arranged 1-and-1 throughout in four shades there is considerable scope for producing variety of pattern in stripe form by varying the spaces occupied by the weaves and by changing the order of wefting. The weaves may also be arranged and combined to form figured styles in which the pattern is due not only to contrast in colour, but the direction of the lines of colour may be varied as desired. Three-colour effects may be obtained by employing the same shade for all the odd or for all the even threads.

Stripe patterns in three and four colours are usually produced in the system in which the ends are arranged 1 face, 1 back throughout. In the warping plan the chief point to note is that the face ends are coloured according to the form of stripe which is required on the surface, and in the following examples the colouring of these ends only is indicated below the designs.

Examples C, D, E, and F in *Figure 8.8* show different ways of constructing a vertical hairline in three colours. It will be noted that the arrangement of the face warp colours is the same in each case, but in C and D the shades in the weft are in the order of 1, 2, 1, 3, and in E and F in the order of 1, 1, 2, 3. In C and E the weaves do not cut; in D one cut, and in F two cuts are made. The interlacing diagrams and the sections of the weaves C and F represent two repeats of each construction. In the diagrams the back ends are not shaded, because, so far as regards the face of the cloth, they may be in any colour. Thus, the complete warping plan may be two of shade 1, two of shade 2, and two of shade 3, etc. If, however, solid lines of colour are required on the underside, it is necessary for each back end to be in the same colour as the pick over which it is raised. For example, in the design C, the first back end is raised on the pick in shade 3, and the second and third on the picks in shade 1. If, therefore the back ends are coloured to correspond, when the cloth is turned over the shades on the underside will be in the order of 1, 1, 3. The arrangement of the back ends as to colour,

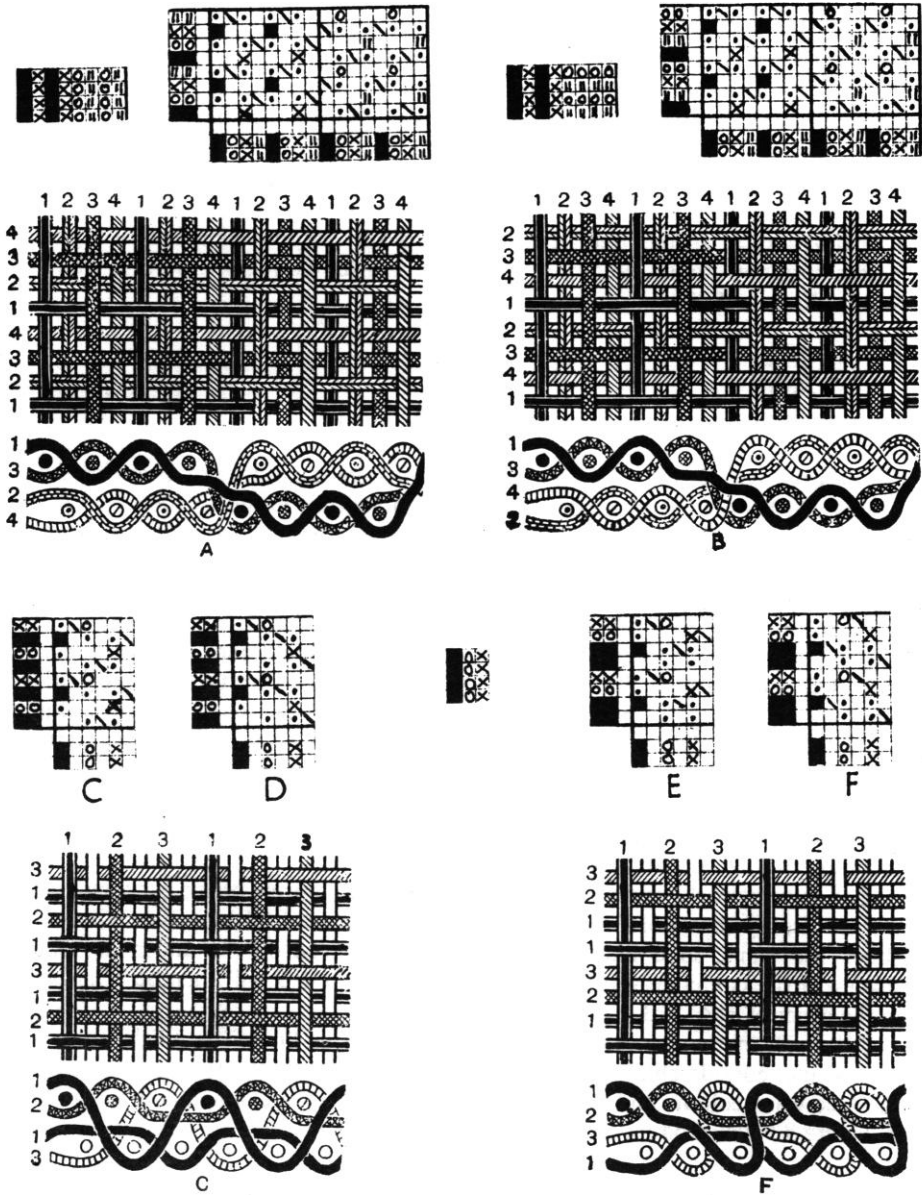


Figure 8.8

which will produce solid lines on the underside, is indicated above each plan. It will be noted that the pattern is not the same as that on the face, except in the design E, for which the shades in the complete warping plan will be in the order of 1, 3, 2, 1, 3, 2.

Two standard three-colour hairline arrangements are given at G and H in *Figure 8.9*. In the pattern produced by G the shades on the surface are in the

order of 1, 2, 1, 3, and by H in the order of 1, 1, 2, 3, as indicated by the numbers above the warp threads in the interlacing diagrams. The complete warping plan for G may be two of shade 1, two of shade 2, two of shade 1, and two of shade 3; and for H, four of shade 1, two of shade 2, and two of shade 3; but if the back ends are coloured in the order indicated above the designs, the pattern on the underside will in each be exactly the same as that on the face.

So long as two of the colours are used only to form single-thread stripings, a great variety of stripe effects can be produced by varying the spaces occupied by the third or ground colour. An example is given at 1 in *Figure 8.9*, which will produce the following pattern on the surface:

Shade 1	—	1	.	2	.	3	.	2	.	1	.	1	.
Shade 2	—	.	1	.	1	.	1	.	1	.	.	.	.
Shade 3	—	.	.	.	.	.	.	.	.	.	1	.	1

The designs J, K, and L in *Figure 8.9* show different methods of arranging the weaves and the colour for producing the vertical hairline in four shades, with the ends arranged in the order of 1 face, 1 back. It will be noted that in J the weft colours are in the same order as the warp colours, but in K and L the second pick is in the same colour as the third face end, and the third pick as the second face end. For the reason that each colour of weft must pass over its own colour of warp in producing the vertical hairline, the arrangement shown at J is somewhat defective, because the intersections of the face ends form a twill line. With the double plain weaves combined as in J, the warp-backed 3-and-1 warp twill is really formed. In the same manner K is the warp-backed 4-thread warp satinette weave. In the design L, however, the weaves are purely double plain, arranged to cut every four ends. The interlacing diagrams (showing two repeats) and the sections given at J and L will show that in each case vertical lines of colour in the order of 1, 2, 3, and 4 are formed on the surface.

The same remarks apply with reference to the colouring of the back ends, as in the case of three-colour effects. If they are arranged in the order indicated above the plans, solid lines of colour will be formed on the underside. The shades in the complete warping plan for L, in *Figure 8.9* will then be arranged in the order of 1, 4, 2, 3, 3, 2, 4, 1.

Although in the four-colour effects the pattern is limited to single lines of each shade, considerable variety of effect can be obtained by suitably arranging the face warp colours and the weaves to correspond. For example, the design M in *Figure 8.9* will produce the following single-thread stripe:

Shade 1	—	1	.	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.
Shade 2	—	.	1	.	1	.	1	.	1	.	.	.	1	.	.	.	.	.
Shade 3	—	.	.	.	1	.	.	.	.	1	.	1	.	1	.	1	.	1
Shade 4	—	.	.	.	.	.	.	.	.	.	1	.	1	.	.	1	.	1

In constructing such a style, however, it is necessary to remember that when more than two colours are used, a change of colour may not cause an interchange of the picks to take place. Thus in M no interchange takes place between the shades 1 and 2 and the shades 3 and 4. Care must therefore be taken to group

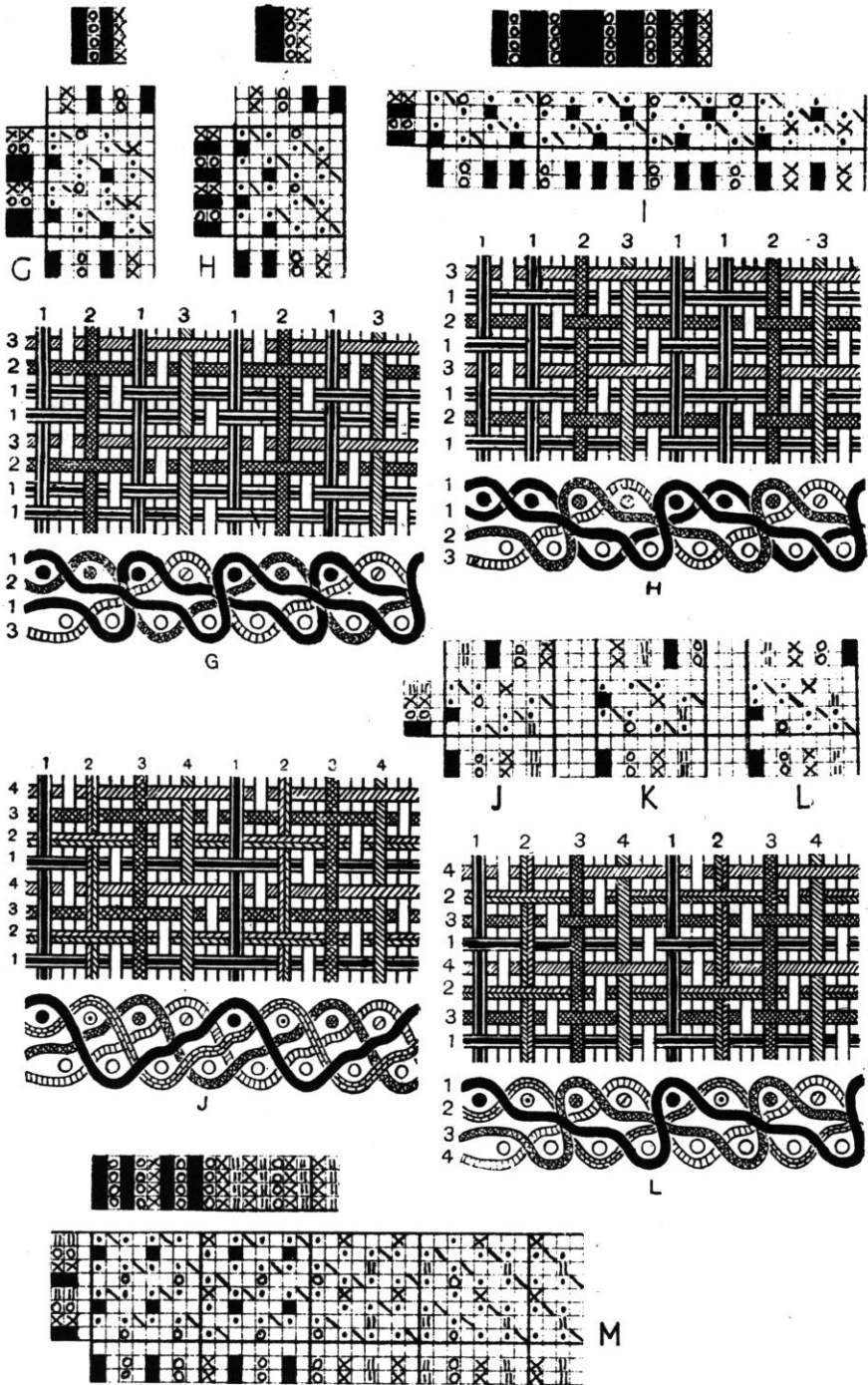


Figure 8.9



the shades in such a manner that the weave in any one section does not occupy too large a space, or the cloth will be liable to cockle. In making a design the weave marks for each pick of weft require first to be related to its own colour of face warp, the marks on the back ends being then added to the best advantage. Experiments may be made in changing the order of wefting and altering the weaves to correspond to find the most satisfactory arrangement.

#### INTERCHANGING DOUBLE TWILL AND SATEEN STRIPE DESIGNS

While the double plain, owing to the neat appearance, firmness, and good wearing quality of the cloth, is the standard weave used in the production of patterns in which each section requires to be in solid colour, similar effects may be obtained by using other double weaves. These also enable a larger number of colours to be introduced. Thus the double 3-thread twill permits the use of six colours, the double 4-thread twill and the 4-thread sateen the use of eight colours; while with the double 5-thread sateen any number of colours up to 10 may be employed. In addition, if the pattern is required in large sections, firmness of structure may be obtained by tying the weaves on the self-stitching principle. In small patterns, however, the interchanging of the threads where the weaves are combined gives sufficient firmness.

Numerous examples might be given to illustrate the various ways in which patterns may be formed; but as the principles involved are the same as in the construction of the double-plain effects, the examples N to Z in *Figure 8.10* will be sufficient for the purpose. N and O are the opposite double 3-thread warp-faced twill weaves, arranged on the system in which two face or two backing ends are brought together where the weaves are combined. In N the odd threads are on the surface and even threads on the back, while in O the even threads are on the surface, and the odd threads on the back. Various schemes of colouring, each necessarily repeating on six threads, are indicated above and alongside the plans, each shade being represented by a different kind of mark. At P the order of colouring in warp and weft is 1-and-1 throughout; and assuming that six threads of each weave are combined in stripe form, as shown in *Figure 8.10*, the pattern formed on the surface will be three threads of shade 1 and three threads of shade 2, as shown by the motif to the left of the warping plan P. Q will produce a solid coloured stripe pattern in three shades, arranged on the surface in the order of 1, 1, 2, 2, 3, 3. R is a four-colour arrangement, the shades being brought up in the order of 1, 1, 3, 2, 2, 4. S is in five shades, the order on the face being 1, 1, 2, 3, 4, 5; while T produces an effect in six shades in the order of 1, 2, 3, 4, 5, 6. The surface arrangement of the threads is clearly indicated by the motifs on the left of each warping plan. It will be noted in the designs that each face end passes under its own colour of weft and over the other colours, while each back end is raised over its own colour and passes below the other colours. Solid vertical lines of colour are thus formed on both sides of the cloth. The double 3-thread weft-faced twill weave may be arranged in the same manner to form horizontal lines.

Although the list is by no means complete, the foregoing examples illustrate the diversity of effect which can be obtained in one design by varying the arrangement of the threads as to colour. In any of the schemes of colouring,

however, still further diversity can be produced by varying the spaces occupied by the weaves. In addition, the weaves may be combined as in the interchanging double plains to form check and figured patterns in two or more colours.

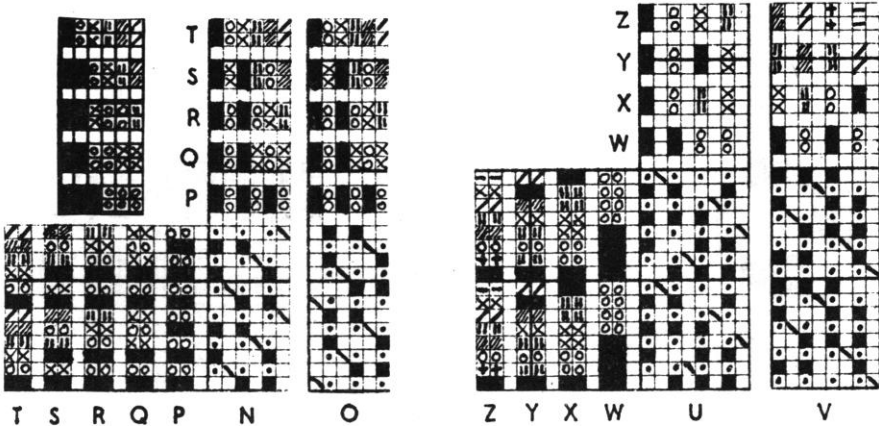


Figure 8.10

The plans given at U and V in *Figure 8.10* are the opposite double 4-thread warp satinette weaves constructed on the system in which the ends are arranged 1 face, 1 back throughout. Four different colour plans for the face ends are given above the designs at W, X, Y, and Z, and the corresponding weft colour plans, similarly lettered, are shown alongside. It is assumed that eight threads of each weave are combined in stripe form, although, as will be understood, the space occupied by each may be varied as desired. The face warping plans indicate the colour patterns which will be formed on the surface, while the chief point to note in arranging the weft colours is that each pick passes over its own colour of warp. W is a two-colour pattern, the shades on the surface being in the order of 1, 1, 2, 2, 1, 2, 1, 2. X is in four shades in the order of 1, 2, 4, 3, 3, 4, 2, 1; Y in six shades in the order of 1, 2, 1, 3, 4, 5, 4, 6; while Z shows how a single-thread stripe in eight shades may be arranged. The colour of the back ends is not indicated, but if solid lines are required on the underside, each must be in the same colour as the pick over which it is raised.

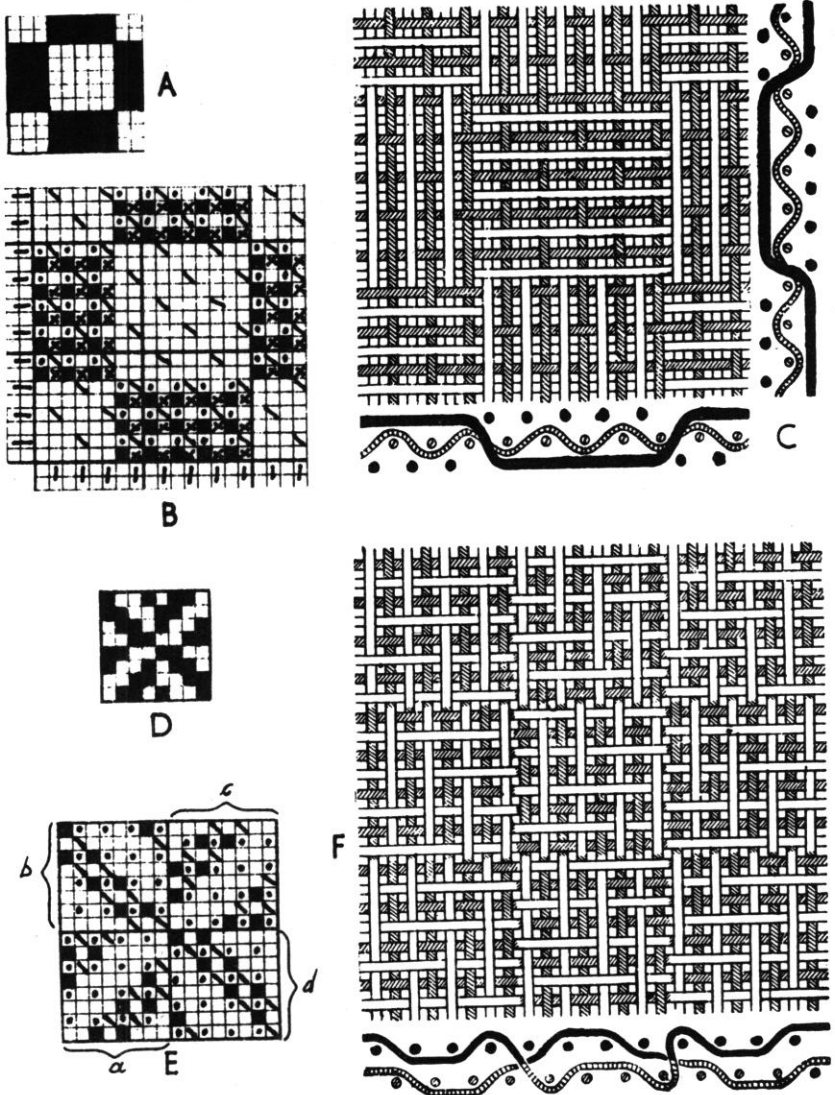
### CUT EFFECTS IN INTERCHANGING DOUBLE CLOTHS

It has been demonstrated in the preceding sections of this chapter that distinct cut marks, similar to those obtained in ordinary herringbone and diaper constructions (see *Watson's Textile Design and Colour*), could be obtained in double plain cloths by selective use of the cloth interchange principle. The same techniques could be extended to double twill and other weaves if required.

In the following, several other methods are shown which further emphasise the structural versatility of the interchanging double cloths.

*Cut effects produced by interchanging the threads*

The effect indicated by the motif A, the fully worked-out design B and the interlacing diagram and sections given at C in *Figure 8.11*, represents a simple structure which is used to produce a reversible cloth with a soft handle due to loosely interlaced threads which are displayed on the face and on the back. The surface appearance of this structure is similar to a 10-thread hopsack weave as shown by the motif. This is achieved by floating, alternately, on the surface and on the underside of a plain ground cloth extra warp and weft threads which are



*Figure 8.11*

considerably thicker than those used for the ground fabric and which, therefore, cover it completely. The fine, even numbered ends and picks weave plain, as indicated at B by the diagonal marks, and form the firm centre structure through which the odd yarn elements interchange.

Where the odd ends are on the face, which corresponds to the solid portions of the motif A, the odd picks are on the underside of the ground cloth. This is obtained by lifting the odd ends on all the picks, as represented by the solid marks and the dots at B and by lifting the even ends on odd picks, as indicated by the crosses at B.

When the odd picks are displayed on the surface, which corresponds to the blank portions of the motif, the odd ends are on the back of the plain ground cloth. This is achieved by dropping all the ends on odd picks and the odd ends also on the even picks.

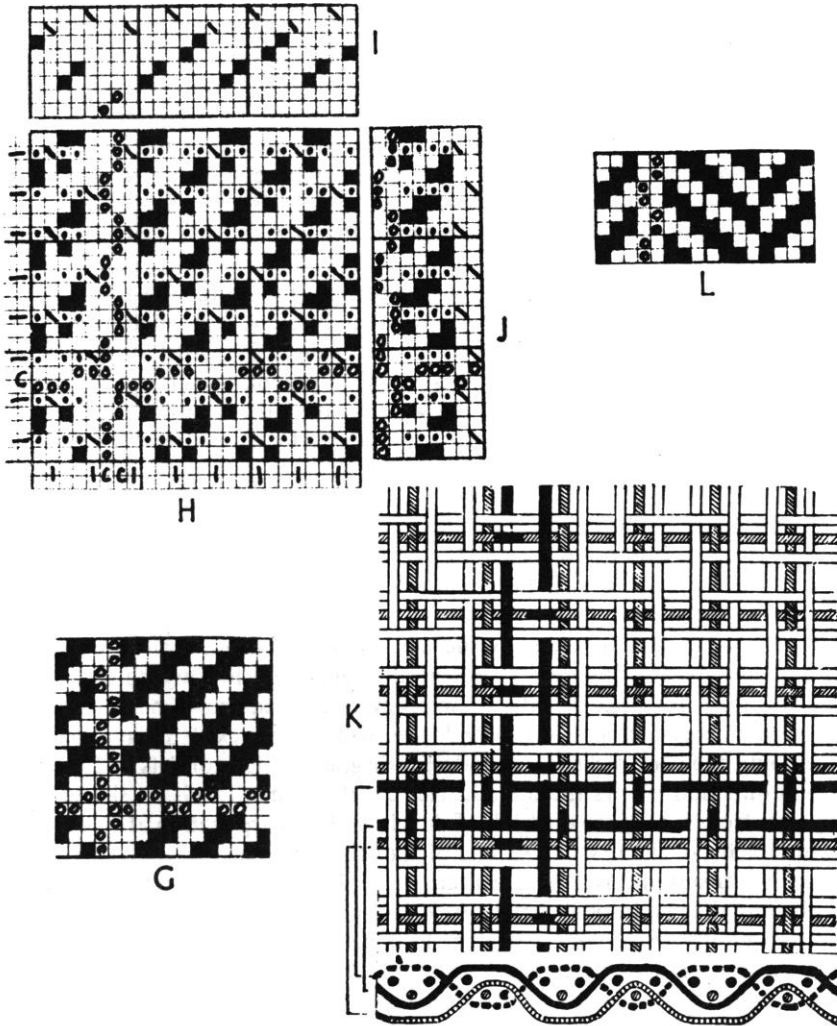
The interchanges are shown clearly by the interlacing diagram and the sections at C in *Figure 8.11* from which it will be also apparent that structurally this fabric may be classified as a continuous extra warp and extra weft cloth. It is included here because it defines the principle of the thread interchange particularly well. The cut lines in this cloth run both vertically and horizontally, and occur at each point at which the warp float is opposed to the weft float; they are particularly distinct because each cut mark also represents the point at which the floating threads alternate between the face and the back of the plain ground structure.

D, E and F in *Figure 8.11* indicate respectively the motif, the fully worked-out design and the interlacing diagram of a different construction in which distinct cuts are produced by the thread interchange. The motif shows a typical diaper arrangement in which cut marks would be produced even in a single cloth structure due to the opposition of the warp float by the weft float at the boundary of each section. In this construction the effect is more clearly defined because at the boundaries of the sections certain ends or picks are also made to interchange between the face and the back cloth. Thus, in section *a*, odd ends and picks form the face cloth, in section *b*, the face is formed by even ends and odd picks, in section *c*, by even ends and even picks, and in section *d*, by odd ends and even picks, whilst the opposite sets of threads in each respective section produce the back cloth. In the fully worked-out design E the weave lifts of the odd ends are represented by the solid marks and those of the even ends by the diagonal marks. The dots represent the separating lifts which in an interchanging cloth indicate the lifts of whichever ends happen to be, at any given part of the construction, the face ends over whichever picks happen to be at the same point, the back picks. The interlacing diagram, which consists of  $1\frac{1}{2}$  repeats in each direction, shows the interchanges clearly as the threads are shaded when they pass from the face to the back of the cloth. The warp section at C represents the interlacing of the first and second pick of the construction.

As the threads in this structure alternate between the face and the back it will be obvious that additional variety of effect may be obtained by arranging the threads in different colour patterns. For example, with odd ends and picks coloured dark and even ends and picks coloured light, section *a*, forms a solid dark area, section *c*, a solid light area, whilst a mixed colour effect results in sections *b* and *d*.

*Cut effects produced by the use of special cutting threads*

This is the more common method of producing the cut or sunk effect, and it is usually employed in cloths in which the threads are arranged in the proportion of 2 face to 1 back in warp and weft. In this system both the face and the back threads assist in forming the line, and it is necessary for the weaves to be arranged in precise order in relation to the threads to obtain the best results. In the first place at each cut two cutting threads between a pair of back threads are arranged to weave in 2-and-2 order with the face picks, and to oppose each other with their floats, as shown by the circles on the fourth and fifth ends and picks of the face plan given at G in *Figure 8.12*. Also each face float of two is arranged to include a face end or pick on each side of a back end or pick. The face weave is



*Figure 8.12*

then placed, as far as possible, to support the cutting threads. Thus in G the float of one cutting thread is a continuation of the twill, while the other duplicates the float of the face weave. If the face weave is placed so as to oppose the cutting threads, as shown at L in *Figure 8.12*, which illustrates a defective plan, the line is made more open and not so distinct.

In constructing the complete design, which is given at H, the back thread between each face float of two is given a corresponding float, the cutting threads thus interweaving in 3-and-3 order, as shown by the circles on the sixth and seventh ends and picks of H. Each float passes under, or over, 1 face thread, 1 back thread, and 1 face thread. The plain weave also requires to be placed to support the cutting threads, as shown by the diagonal marks which are inserted to coincide with the centre of each float. In some cases, in order to increase the sunk effect, the cutting ends are woven as tightly as possible from a separate beam, in most circumstances, however, these ends weave tighter than the rest, and will create a distinct cut line even when placed on the same beam as the normal face ends. The draft for H on the lowest possible number of healds, is given at I, and the lifting plan at J.

The flat view given in the upper portion of K in *Figure 8.12* shows the interweaving of the ends and picks 1 to 18 of the weave H, the threads which assist in forming the cut being indicated in solid black. The solid line in the section given in the lower portion of K shows the interweaving of the first face cutting pick, the dotted line of the second, and the shaded line of the back pick which precedes them. The method of interweaving not only forms the sunk effect between the face cutting threads, but the face and back fabrics are tied very firmly together along the cuts.