

the foundation will be the proper shade, but in order to get a rich bloom in the pile this is followed by a process which more resembles printing. The pile side of the cloth is passed in contact with the upper edge of a finely engraved roller which revolves partly immersed in the dye solution. The amount carried up by the roller is regulated by a doctor knife. The colour is transferred to the pile, and as the cloth passes forward it is acted upon by revolving brushes which spread the dye over the surface. After drying, brushing again follows, and in some cases, the cloth is also briskly rubbed by hand with an emery covered piece of wood.

The fabrics are usually classified as plain velveteen and corded velveteen which are mostly made of cotton yarns. When the pile is very long, however, the term weft plush is used, and in this type the pile is frequently developed in woollen or worsted yarns.

PLAIN VELVETEENS

This class of velveteen has a perfectly uniform surface, the foundation texture being entirely covered by a short pile in which the projecting fibres are of equal length. In constructing designs for the fabrics the chief points to note are:— (1) The weaves that are used for the ground and pile respectively; and (2) the ratio of pile picks to ground picks. These factors, together with the ends and picks per inch of the cloth, influence the length, density, and fastness of the pile.

The foundation weaves mostly used are plain, 1-and-2 twill, and 2-and-2 twill, the last weave being employed for very heavy structures. The interlacing of the pile is almost invariably based either on the plain weave, a simple twill, a sateen, or a sateen derivative. The pile and ground picks may be arranged in any reasonable proportion, but generally a particular ratio is most suitable for a given weave.

Tabby or Plain-back Velveteens.—Examples A, B, C, D, and E in Fig. 383 are designs for standard velveteens, with the plain foundation weave. The latter is represented by the crosses, and the base weaves for the pile interlacings are shown at the left of the plans. In each design the number of pile picks to each ground pick is equal to the number of picks in the repeat of the pile base weave. This is a convenient ratio, but other proportions of pile to ground picks are quite easily arranged in the same weave.

A distinct feature to be noted in the designs is that the pile base weaves are indicated only on alternate ends; thus each plan is on twice as many ends as the base weave. Design A is arranged two pile picks to one ground pick, and the pile weave is based on the plain weave which yields a weft float of three. In a finely set cloth the pile from this design is short and poor, but if there are not many ends per inch, a fairly good result is obtained.

In design B, the pile weave is based on the 1-and-2 twill which yields a weft float of five, and there are three pile picks to each ground pick. This design produces a fine and rich effect, and is very extensively employed. Designs C and D are each arranged four pile picks to one ground pick, but whereas in design C the pile interlacing is based on the 1-and-3 twill, in design D it is based on the 4-sateen weave. Both of these yield a float of seven, and produce exactly similar results in the finished cloth. Design E is arranged five pile to one ground, and the base for the pile interlacing is 1-and-4 sateen, which gives a float of nine.

In order to produce a dense pile, a very large number of picks per inch are required to be inserted, the number varying from about 300 in 40's cotton weft for the design B in Fig. 383 to about 500 in 60's weft for the design E. There are two reasons why it is possible to insert such a large number of picks. First, the warp is held under great tension, and the ends lie almost straight in the cloth, which causes the picks to do most of the bending. This results in the foundation texture being formed on the weft rib principle, hence a comparatively large number of ground picks can be inserted. Second, the system in which the pile interlacing is arranged enables the pile picks to be beaten over one another, so that each row occupies not more than the space of one ground pick. Also, in the plain-back structures, all the pile picks go into the same shed as the first ground pick, but are in the opposite shed to the second ground pick. Therefore, so far as regards the space occupied by the picks, the structural effect of each design A to E in Fig. 383, is somewhat as represented at F—that is, the total number of picks in the repeat of each design go into the space of four picks, of which three are in the same shed.

The diagrams given in Fig. 384, in which design G is similar to the plan B in Fig. 383, will enable various features of the velveteen structures to be noted. The flat view given at H, which corresponds with G, will serve to show somewhat how the pile picks crowd over each other in the cloth. This, however, is only a convenient representation of the structure, as in the actual fabric the ground picks are entirely concealed by the floating pile picks.

The purpose of binding in the pile picks only by the alternate ends (lettered A in H, Fig. 384) is to enable the cutting to be more easily and more quickly accomplished. This will be understood from an examination of the cross-sectional drawing given at I in Fig. 384, which represents how the picks 2, 3, 4, and 5 in the plan G interweave. Each pile float stands out furthest from the foundation cloth at its centre, and the guide of the cutting knife is so adjusted that only those floats are engaged whose centres are in line with the longitudinal movement of the knife. The method of binding the pile picks causes the centres of the floats (indicated by the arrows above diagram I) to occur only on alternate ends, therefore, only half as many longitudinal traverses of the knife are required as would be the case if the pile picks were bound in by every end.

An important feature, moreover, is that the alternate binding causes regular courses or races to be formed in the foundation texture, which are readily followed by the knife guide. The latter is so fine and flexible that when once its point is inserted in a race it will not readily leave it even though the operative's hand has a zig-zag movement along the surface of the cloth.

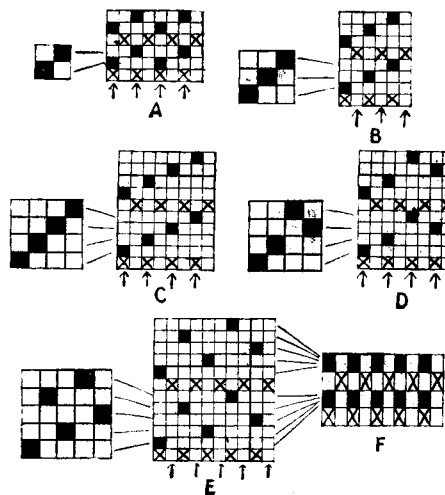


Fig. 383.

Arrows are indicated below the designs in Fig. 383 to show where the cutting races occur.

After the cutting process, the twist runs out of the free ends of the weft threads which then project vertically from the foundation in the form of tufts of fibres, in the manner represented at J in Fig. 384. Each repeat of the pile weave produces one horizontal row of tufts, and in the plans A to E in Fig. 383 a complete row of tufts is formed to each ground pick.

Length of the Pile.—The length of the pile varies according to the ends per inch of the cloth and the number of ends over which the pile weft floats. An increased length of pile is obtained either by reducing the ends per inch or by increasing the number of ends over which the pile weft passes; and

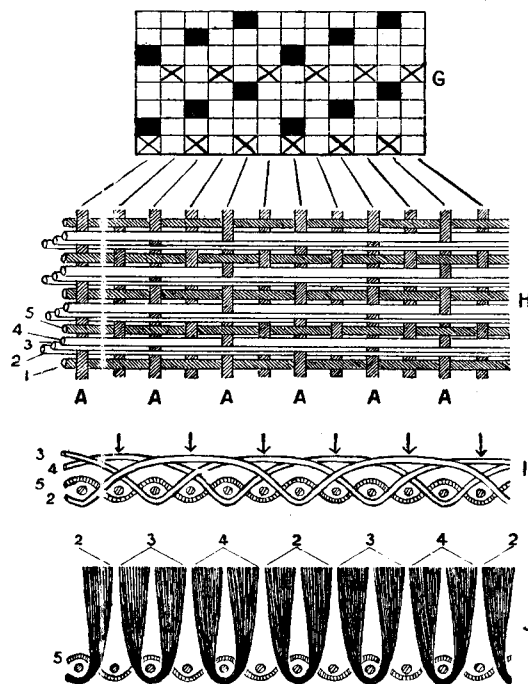


Fig. 384.

A long pile causes the surface of the cloth to be better covered, and thus gives a denser appearance and handle than a short pile. The greater the length of the pile is, however, the fewer are the number of tufts formed by each pile pick, and with the same number of pile picks per inch, an increase in density, due to increased length, will be counteracted by a reduction in the number of tufts. It is, therefore, customary for an increase in the length of the pile weft float to be accompanied by an increase in the number of pile picks per inch.

In each of the plans in Fig. 383, the same number of tufts per square inch will result by employing the same number of ground picks per inch. Assuming that the warp is 2/60's cotton with 72 ends per inch, and the weft is 50's cotton,

conversely, a decreased length results from increasing the ends per inch or from reducing the pile float. With the same number of ends per inch the designs A, B, C or D, and E in Fig. 383 give successively an increased length of pile. For example, with 72 ends per inch in the cloth the approximate lengths are respectively $\frac{1}{48}$ inch, $\frac{1}{36}$ inch, $\frac{1}{24}$ inch, and $\frac{1}{18}$ inch. The length of pile produced by the design A, with 30 ends per inch, is about the same as is produced by the plans C and D with 72 ends per inch.

Density of the Pile.—The density of the pile varies according to the thickness of the weft, the length of the pile, and the number of tufts in a given space. An increase in the thickness of the weft tends to make the pile coarser, but other things being equal the density is increased.

80 ground picks per inch will be suitable, which will give the following number of pile picks and total picks per inch for the designs.

Design A.—160 pile picks and 240 total picks per inch.

Design B.—240 pile picks and 320 total picks per inch.

Designs C and D.—320 pile picks and 400 total picks per inch.

Design E.—400 pile picks and 480 total picks per inch.

Comparisons of the number of tufts in different structures can be made by means of the following formula, which give the number of tufts to the square inch :—

$$\frac{\text{Ends per inch} \times \text{pile picks per inch}}{\text{Ends in repeat of pile weave}}$$

For example, with the foregoing particulars, the design B will produce—

$$\frac{72 \times 240}{6} = 2,880 \text{ tufts per square inch.}$$

It will be found in the same manner that the other designs with the particulars indicated will give exactly the same number of tufts to the square inch.

Changing the Density of the Pile.

There are different ways of changing the density of the pile, and in the same design and sett, alterations are frequently made simply by varying the number of picks per inch, or the thickness of the weft. In another method the design is changed in order to obtain a different proportion of pile to ground picks. This is illustrated in Fig. 385 where the design K has the same base weave as B in Fig. 383, but there are six pile picks, instead of three, to each ground pick. L and M are similar to C in Fig. 383 except that they have six and five pile picks respectively instead of four to each ground pick. In the same manner the designs N and O correspond with D, but have respectively five and three pile picks to each ground pick; while the design P is similar to E except that there are four instead of five pile picks to each ground pick.

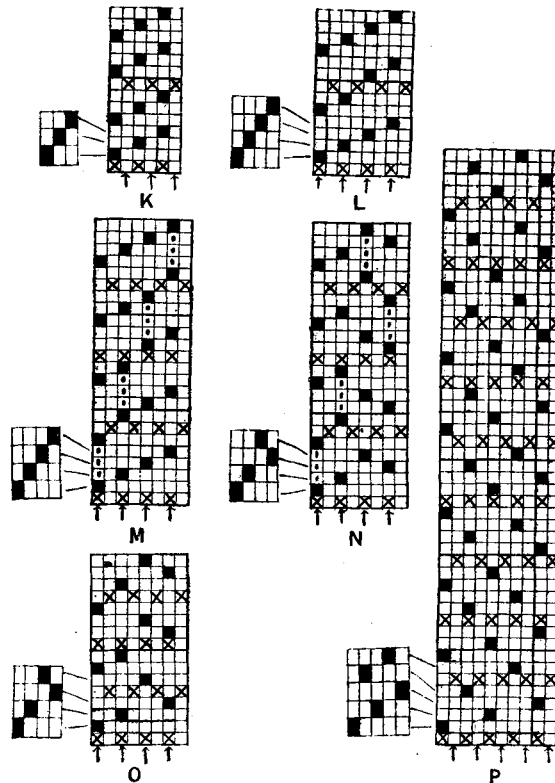


Fig. 385.

The pile is most evenly distributed when, between each pair of ground picks, every binding end holds the same number of tufts, as shown at K in Fig. 385. When the modified arrangement makes it necessary for the pile weave to be extended over two or more repeats of the ground weave, a sateen base is better for the pile interlacing than a twill base. The reason for this will be understood from a comparison of the plans M and N, both of which are arranged on a 4-thread base with five pile to one ground pick. Between each pair of pile picks two tufts occur on one end in the positions where the dots connect the full squares. In the plan M on account of the pile interlacing being based on a twill weave, these positions run in twill order, which may result in a slight twilled effect appearing in the finished cloth. In N, however, the positions occur in sateen order, because a sateen pile base weave is employed, and the liability of twill lines being formed is avoided. Also, in the designs O and P, between each pair of ground picks, there is one end on which there are no tufts, and if these positions were to run in twill order there would be a similar liability of twill lines being formed in the cloth. This may be avoided by using a sateen base for the pile interlacing, as shown in the two examples.

In changing the proportion of pile picks to ground picks in a design the effect of the alteration should be considered in relation to the number of picks that it is proposed to insert under the new conditions. The alteration may be for the purpose of changing the density of the pile while retaining exactly the same total number of picks per inch as the original structure; or of changing the density while retaining a similar ground structure; or the idea may be to obtain exactly the same density as before, but with a different ground structure. The following list shows the result which will occur under the different conditions named, assuming that the weave D in Fig. 383—which has four pile picks to one ground pick—is changed to five and three pile picks respectively to each ground pick, as shown at N and O in Fig. 385. The total picks of the original

	Design.	Ratio of pile picks to ground picks.	Ground picks per inch.	Pile picks per inch.	Total picks per inch.	Tufts per square inch.	Remarks.
Original structure,	D	4 to 1	80	320	400	2,880	Original structure.
To retain same total picks as original structure,	N	5 to 1	66	334	400	3,906	Density of pile increased. Ground texture less firm.
	O	3 to 1	100	300	400	2,700	Density of pile reduced. Ground texture firmer.
To retain same density of pile as original structure,	N	5 to 1	64	320	384	2,880	Total picks reduced. Ground texture less firm.
	O	3 to 1	106	320	426	2,880	Total picks increased. Ground texture firmer.
To retain same ground texture as original structure,	N	5 to 1	80	400	480	3,600	Density of pile increased. Total picks increased.
	O	3 to 1	80	240	320	2,160	Density of pile reduced. Total picks reduced.

structure are taken as 400 per inch, giving 80 ground and 320 pile picks per inch; and the tufts per square inch are based on the cloth having 72 ends per inch.

Fastness of the Pile.—A very important feature in these fabrics is the proper securing of the pile to the foundation cloth so that there will be no liability of the tufts fraying out. In the examples given in Figs. 383, 384, and 385, the tufts are bound in by one end only at a place, and the fastness of the pile is chiefly dependant upon the pressure of the picks upon one another. It is therefore necessary, particularly in the longer piles, for a very large number of picks to be inserted in order to keep the pile firm. If it is desired to introduce fewer picks per inch, or to make a very long pile, the necessary firmness can be secured by interweaving the pile picks more frequently, making what is termed a "fast" or "lashed" pile. The examples Q, R, and S, given in Fig. 386, respectively show how the plans C, D, and E in Fig. 383 may be made firmer. The section, shown at T, illustrates how the tufts, formed by the picks five and six of the design S, are bound in. By comparing the designs given in Figs. 383 and 386 it will be seen that with the same number of ends per inch Q and R will each produce the same length of pile as B, and S, as C or D. The firmer interweaving renders it more difficult to insert a large amount of weft, and it is generally recognized that in a fast pile the richness of the cloth will suffer, but there is the advantage that the greater firmness gives the cloth better wearing qualities.

A plan for a very thin pile structure is given at U in Fig. 386, in which the arrangement is two plain ground picks to two "fast" pile picks. The idea in this case is for the pile to be developed—say in black weft—upon a coloured foundation of a tartan character, which will show through the thin pile covering. The presence of the pile tends to make the foundation colours appear deeper and richer.

Twill-back Velveteens.—Examples of velveteens with a twill foundation are given in Fig. 387, A, B, and C having a 1-and-2 twill or "Genoa" back, while the ground weave of D and E is 2-and-2 twill. A twill foundation weave is looser than a plain, and, therefore, not only permits, but, in order to maintain the same firmness of pile, requires a large number of ground picks to be inserted. Hence, with the same ratio of pile to ground picks, more pile picks can be put in and a denser pile formed. Also, a cloth with a twill ground is softer and more flexible than a similar cloth with plain ground; the latter ground, when very heavily wefted, tending to make the cloth handle somewhat hard and stiff.

In A, B, and C in Fig. 387, the pile weave is based on 1-and-2 twill which,

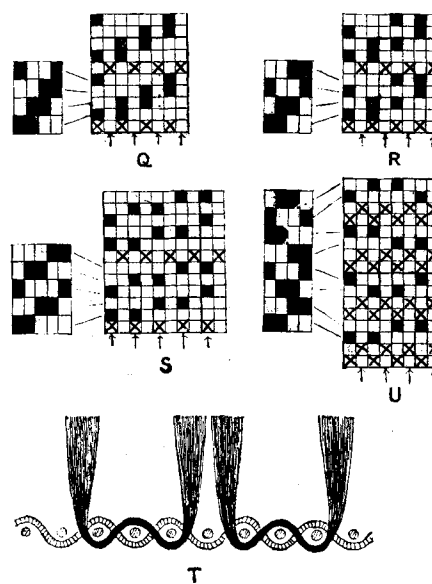


Fig. 386.

as before, is marked on alternate ends ; the pile picks are arranged in the proportion respectively of two, three, and four to each ground pick. The 1-and-2 twill foundation weave of these designs is invariably made with the weft float on the under side of the cloth. This provides a better surface than a warp twill back for binding in the pile picks and covering them on the underside. Also, the 2-and-1 weft surface is suitable for the application of a raised or flannelette finish to the back if such is required.

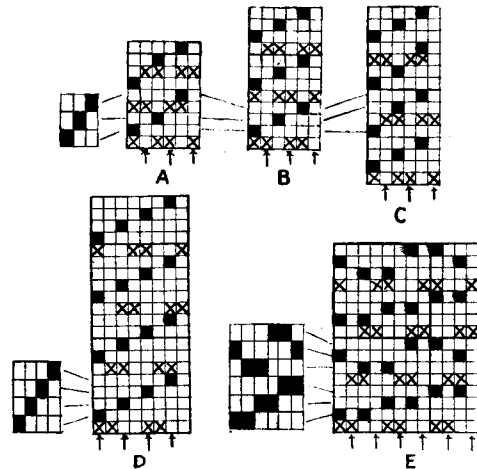


Fig. 387.

In the design D, Fig. 387, the pile weave is based upon 1-and-3 twill, and there are four pile picks to each ground pick, while in E, a six-thread sateen pile base weave is employed with the pile made fast, and there are three pile picks to each ground pick.

Designs which Simplify the Cutting Operation.—The designs given in Fig. 388 illustrate a method of arranging the pile interlacing that is sometimes employed

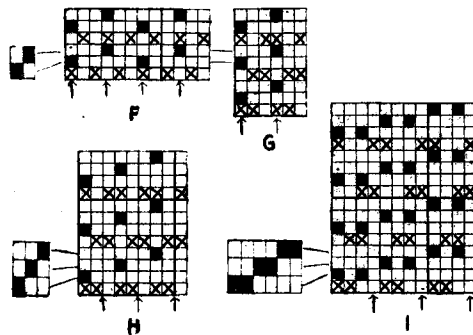


Fig. 388.

with the object of reducing the time occupied in the pile cutting. In F, G, and H, the pile base weaves are indicated only on every third end, therefore, only one-third as many longitudinal traverses of the cutting knife are required, as there are ends in the width of the cloth to be cut over. Compared with the examples in which the binding of the pile picks occurs on alternate ends, the number of cutting races is reduced by one-third. The distribution of the pile, however, is not so perfect, and the surface of the cloth has a coarser appearance. I in Fig. 388 shows a fast pile effect in which the pile interlacing is based on a 1-and-2 twill weave doubled ; and as indicated by the arrows below the design, the cutting races occur only on every fourth end.

It may be noted that A in Fig. 387 is the standard design for the moleskin class of fabric, which is usually made in coarse cotton yarns. This is not a pile fabric, as the floating picks are not cut but remain in the condition they are after weaving. The cloth is very strong and leathery, and is eminently suitable for workmen's clothing which is subjected to very hard wear.

A 2-and-2 twill foundation weave enables a very large number of ground picks to be readily inserted, and is therefore used for the heaviest and densest velveteens.

In the design D, Fig. 387, the pile weave is based upon 1-and-3 twill, and there are four pile picks to each ground pick, while in E, a six-thread sateen pile base weave is employed with the pile made fast, and there are three pile picks to each ground pick.

The distribution of the pile, however, is not so perfect, and the surface of the cloth has a coarser appearance. I in Fig. 388 shows a fast pile effect in which the pile interlacing is based on a 1-and-2 twill weave doubled ; and as indicated by the arrows below the design, the cutting races occur only on every fourth end.

CORDED VELVETEENS

In these structures the pile picks are bound in, at intervals, in a straight line. The cutting knife is run right up the centre of the space between the pile binding points, with the result that the tufts of fibres project from the foundation in the form of cords or ribs running lengthwise of the fabric. An illustration of a cloth is given in Fig. 389, which shows in the upper and lower portions respectively, the appearance of a corduroy before and after the operation of cutting.

The finer classes of cords, such as are used for children's clothing and dress fabrics, are largely made in fine yarns with a plain back. The corduroys, used for men's clothing, are made stronger and heavier, and a twill foundation weave is mostly employed. In the heavier cloths thicker weft is used, and consequently fewer pile picks to each ground pick are necessary, usually not more than two being employed.

In the simplest cord designs, the pile picks are bound in in plain order on two consecutive ends. J, K, L, and M in Fig. 390 are examples with a plain back which, in the same sett, yield successively an increased width of cord. Thus, with 72 ends per inch in the finished cloth the number of cords per inch will be J-12, K-9, L-7, and M-6. Designs may be constructed to produce other widths of cords simply by varying the space between the binding ends.

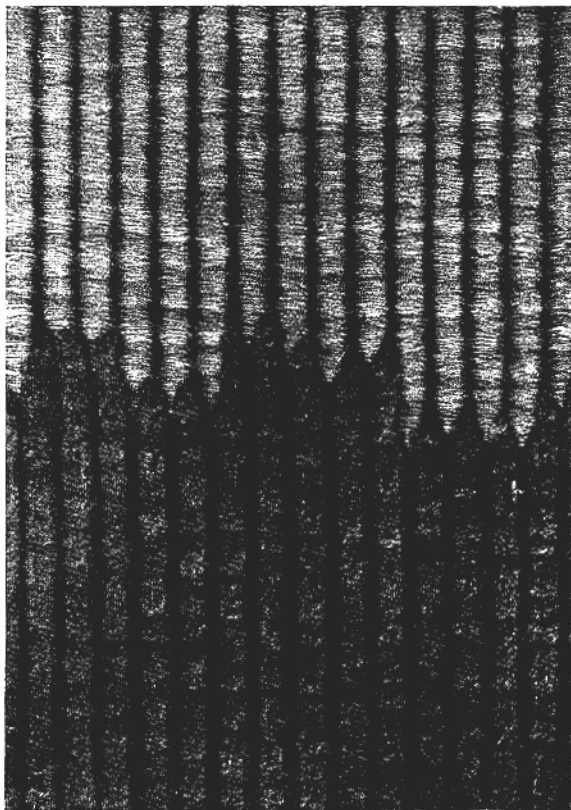


Fig. 389.

The plain binding weave of the pile picks may be reversed in alternate cords, as shown at J, in which case the design extends over the width of two cords, and each pile pick forms alternately a long and a short float. On the other hand, the pile binding may be the same in each cord, as shown at K, and in this case all the pile floats are equal. The result is practically the same whichever method of binding is adopted, because the floats are cut as nearly as possible in the middle of the space between the pile binding points; consequently, in either case, one side of each tuft is longer than the other side. The difference in the lengths causes

the ribs to have a rounded formation, as the long side of the tufts forms the centre, and the short side the outer parts of the cords. This is illustrated by the drawing given at N in Fig. 390, which shows on the left how the picks of the plan K interlace, while on the right the appearance of the cord, after the cutting, is represented. The arrows indicate the position of the cutting races. Similar effects are produced by the designs L and M, but here there are three and four pile picks respectively to each ground pick.

Examples of cords with a 1-and-2 twill back are given at O and P in Fig. 390, and with a 2-and-2 twill back at Q, R, and S. These are arranged two pile picks to each ground pick, and in producing very heavy structures they are woven with comparatively few ends per inch, the number varying from about 28 to 36.

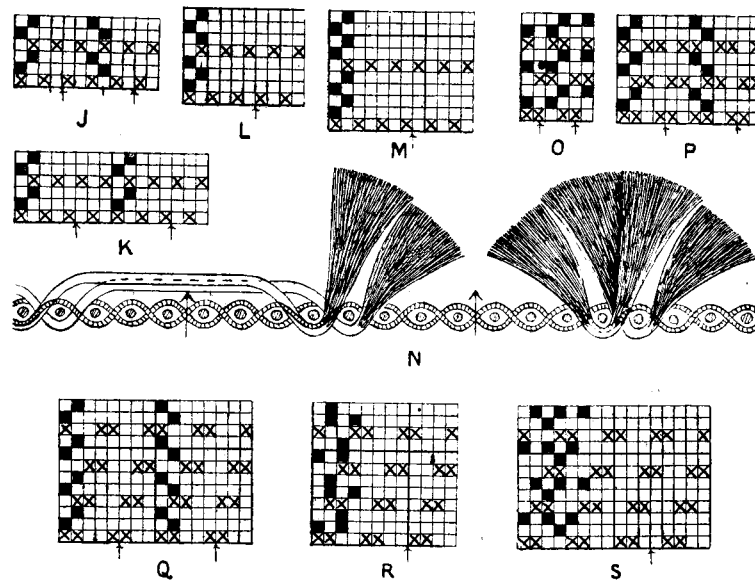


Fig. 390.

The cords, produced by the design O in Fig. 390, are only three ends wide, and both sides of the tufts are of equal length, therefore, the ribs are not rounded, and a poor and bare structure results. P is similar to J except for the difference in the ground weave, the pile floats being of different sizes, and the complete design extending over the width of two cords. Q is similarly arranged, but in R and S (which are used for specially heavy and wide cords), alternate pile picks are interwoven more frequently with the object of producing greater variety in the length of the tufts, and so cause the rounded formation of the ribs to be more pronounced.

Corded Velveteen Cutting.—The cutting of cord designs, by hand, is much more readily accomplished than in the case of plain velveteens, as only one traverse of the knife is required for each cord. In the lower classes of cords the cutting operation is now largely facilitated by the aid of machinery, of which there are two chief types. In one method, which is the simpler, the two ends of a piece are sewn together and the cloth is passed rapidly under tension through a machine

during which a cord is cut the full length except for a few inches at either end. The knife is similar to the kind used in hand cutting, and at each complete passage of the cloth the machine is stopped while the guide is inserted in the next cord. The cloth makes as many passages through the machine as there are cords to be cut.

In the second type of machine all the cords are cut at the same time by means of circular knives, one to each cord, placed upon a revolving shaft. Each knife rotates within a slot formed in a guide, the pointed end of which is inserted under the pile floats in the centre of a cord. By means of tension rollers the cloth is drawn forward horizontally towards the knives, but at about the point of contact with the latter, it is taken downward over the edge of a transverse bar. The floating pile picks are brought by the guides into the path of the revolving knives and are cut, while the cloth passes downward and is either wound on a beam or is plaited down.

Corded Velveteens from Plain Velveteen Weaves.—In addition to the corded velveteens in which the rib formation is due to the pile picks being bound in in a straight line, as shown in Fig. 390, cord effects are now largely made by hand-cutting from plain velveteen weaves. In the latter system tufts are produced of different

lengths, so as to form rounded cords, simply by the way in which the pile is cut. The width of the cords is not determined by the repeat of the pile weave, and in the same weave different widths of cords may be formed. It is customary, in this system, for the cutting to be performed at two operations: first on a short frame, and then on a long frame. Different forms of knives are used, the blade being supported vertically in cutting certain races, and at an angle in cutting other races. A simple example, to illustrate the principle, is given in Fig. 391, in which A shows an ordinary plain-back velveteen weave

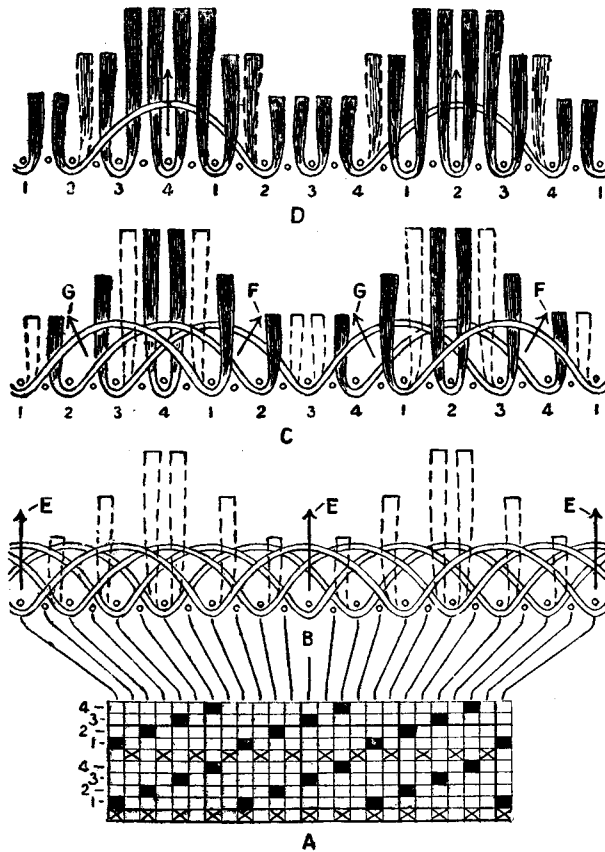


Fig. 391.

repeating on eight ends. Corresponding sections through the warp are given at B, C, and D, which represent in stages how the pile picks are cut. The interlacing of the four picks that constitute a repeat of the pile weave, is indicated at B, the warp threads in which are shown connected by lines with the corresponding vertical spaces of the plan A. The arrows lettered E indicate the position of the first series of cuts which, in the example, occur at intervals of twelve ends. These cuts are made on the short frame system throughout the length of the piece, with the blade supported vertically, and care is taken in starting that the races are the proper distance apart to give the required width of cord. All the floating pile picks, which are in line with the stroke of the knife (three out of every four), are severed, and the free ends then assume the position represented by the dotted lines in B, three different lengths of pile being formed.

After this portion of the cutting has been effected, the cloth is taken to a long frame, and a second series of cuts is made with the blades supported at an angle, as indicated by the arrows F in the drawing C. Then a third series of cuts is made with the blade inclined in the opposite direction, as shown by the arrows G. In each race one pick in every repeat of the pile weave is severed, and the free ends assume the positions shown by the dotted lines in C. The final series of cuts is made in the positions shown by the arrows in the drawing D, and the blade in this case is held vertically.

The numbers below C and D indicate the order in which the pile picks are inserted, and by comparing the drawings, noting the order in which the cuts are made, the gradual evolution of a corded pile effect from a plain velveteen weave will be understood. This system of cutting is more costly than the cutting of proper corduroy, but for ladies' and children's wear it has the advantage that the cloth is softer and more flexible. The two types of cord may be readily distinguished by the feel of the cloth.

Particulars of Weft Pile Fabrics.—The weaving particulars, of a number of the foregoing examples, are given in the accompanying table, and in order that comparisons may be made the width in the reed for 24 inches grey, the calculated grey weight of 100 yards of cloth, 24 inches wide, and the approximate number of tufts to the square inch in the finished cloth are stated. The particulars of A, Fig. 387, are suitable for a moleskin fabric.

A feature to be noted is the great shrinkage in width from the reed to the cloth, which varies from about 12½ per cent. in the lighter velveteens to 20 per cent. in the heavy cords. There is very great tension put on the warp (a positive shedding motion is mostly used), and the shrinkage in length is very slight. For this reason all the warp is usually brought from one warp beam, although some of the ends are much more frequently intersected with the weft than others.

In any design the weight of the cloth can be varied extremely by varying the ends per inch and the thickness of the weft. Reducing the sett of the warp enables more weft to be put in, and the excessive weight of the heavy cords is obtained by employing a loose foundation weave with few ends per inch. A very good quality of cotton is required for the warp, because of the great strain put upon it, and in the best cloths the finest fibred cottons are used for the weft. The finer the fibres are, the more are required in forming a given size of thread, and the more are contained in each pile tuft.

Design.	Counts of cotton warp.	Counts of cotton weft.	Ends per inch in reed.	Ends per inch in cloth.	Ground picks per inch.	Pile picks per inch.	Total picks per inch.	Length of warp 100 yards cloth.	Width in reed for 24 in. grey.	Calculation weight of 100 yds. 24 in. wide.	Tufts per square inch.
B, Fig. 383, .	2/60s	40s	72	81	75	225	300	104	27"	32 lbs.	3,200
C and D, Fig. 383,	2/70s	60s	72	83	88	352	440	103	27 $\frac{3}{4}$ "	31 lbs.	3,700
E, Fig. 383, .	2/80s	70s	76	88	90	450	540	103	28	32 lbs.	4,800
A, Fig. 387, .	2/20s	16s	38	44	80	160	240	102 $\frac{1}{2}$	28	63 lbs.	4,500
B, Fig. 387, .	2/80s	70s	72	84	108	324	432	102 $\frac{1}{2}$	28	26.7 lbs.	4,600
C, Fig. 387, .	2/70s	60s	72	84	104	416	520	102 $\frac{1}{2}$	28	35.8 lbs.	5,900
L, Fig. 390, .	2/60s	50s	72	87	92	276	368	104	29	34 lbs.	2,350
O, Fig. 390, .	2/16s	22s	28	34	90	180	270	102 $\frac{1}{2}$	29	54.7 lbs.	1,040
P, Fig. 390, .	2/20s	18s	30	37	140	280	420	102 $\frac{1}{2}$	29 $\frac{1}{2}$	82.7 lbs.	1,760
Q, Fig. 390, .	2/18s	18s	32	39	170	340	510	102 $\frac{1}{2}$	29 $\frac{1}{2}$	112 lbs.	1,680
R, Fig. 390, .	2/16s	18s	32	40	144	288	432	102 $\frac{1}{2}$	30	100 lbs.	980

WEFT PLUSHES

The designs for these fabrics are constructed on exactly the same principle as plain velveteens, but the pile floats are longer and more firmly bound in, while the cloths are frequently very heavy. In the plan A in Fig. 392, the pile interlacing is based on a 4-sateen weave, and there are four pile picks to each ground pick. With the following particulars a long pile is produced which is developed in mohair worsted weft:—Warp, 2/30's cotton, 44 ends per inch; weft, 1 pick 20 skeins woollen, 2 picks 8's mohair, 144 picks per inch. This design is used for weft pile Astrakhan structures, the mohair weft, previous to weaving, being boiled while wound round a spindle or twisted tightly in the hank. This treatment causes the mohair when slack to curl up, hence after the pile-cutting operation, the free ends of the tufts form curls on the surface, and give the cloth the characteristic Astrakhan appearance.

In the plain-back velveteen structures previously given, all the pile picks go into the same shed as one ground pick, and in the opposite shed to the other ground pick. This causes a slight irregularity in the lower picked cloths, which, however, is quite imperceptible in the finer fabrics when finished. In some of the long and coarse weft pile structures, the irregularity is got over in the manner illustrated by the design B in Fig. 392, in which the plain ground texture is modified, so that each group of two pile picks is in the same shed as the preceding ground pick, and in the opposite shed to the ground pick that follows. Suitable weaving particulars for the design are:—Warp, 2/32's cotton, 50 ends per inch; weft, 1 pick 26 skeins woollen, 2 picks 16's mohair, 150 picks per inch.

The design C in Fig. 392 is arranged two ground to one pile pick, and the pile interlacing is based on an irregular 8-sateen weave. This design is used for a heavy

type of weft plush termed "dogskin," in which a long mohair pile is developed with the following weaving particulars:—Warp, 2/24's cotton, 40 ends per inch; weft, 2 picks, 2/20's cotton, 1 pick, 3's mohair, 60 picks per inch.

In the design D in Fig. 392 the pile interlacing is based on a 5-sateen weave, and to each ground pick there are two pile picks. One pile pick, however, has a longer float than the other, so that two different lengths of pile are formed in

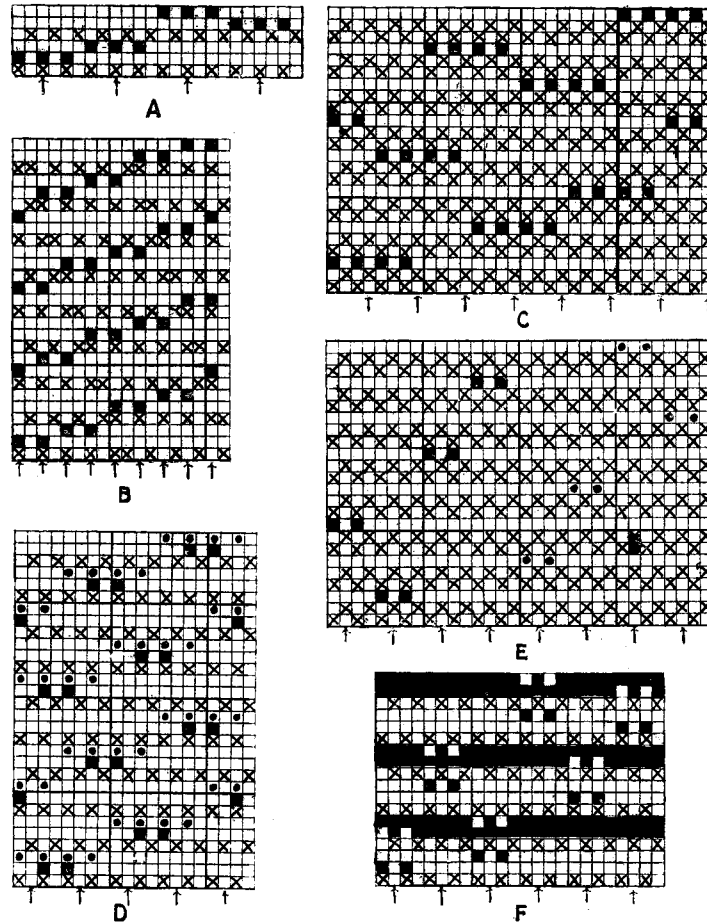


Fig. 392.

the cloth. Variety of effect can also be obtained by having the pile picks alternately in different colours or different materials. The following are suitable weaving particulars:—Warp, 2/40's cotton, 48 ends per inch; weft, 1 pick 24's cotton, 1 pick 28's mohair (shade 1), 1 pick 28's mohair (shade 2), 216 picks per inch.

The design E in Fig. 392 illustrates an effective method of developing the pile in different materials or colours. The pile interlacing is based on an irregular 8-sateen weave, but the binding of the odd pile picks, shown by the full squares, occurs on one-half of the plan, while that of the even pile picks, represented by

the dots, occurs on the other half. By arranging the pile picks alternately in different colours or materials, stripes of pile are formed on the surface.

The design F in Fig. 392 shows the arrangement of a reversible weft plush, a structure that is sometimes used for carriage rugs. The cloth has a plain centre, and the pile binding places are arranged in 6-sateen order on both sides. The following weaving particulars are suitable:—Warp, 2/30's cotton, 48 ends per inch; weft, 1 pick 30 skeins woollen, 2 picks 12's mohair (face), 1 pick 30 skeins woollen, 2 picks 12's mohair (back), 144 picks per inch. The pile on the back may be developed in a different colour from that on the face.

FIGURED WEFT PILE FABRICS

Plain woven velveteen cloths are sometimes figured by printing or embossing in the manner described in reference to warp pile textures (p. 405). In true weft pile figuring the ground of the design is produced by throwing the pile picks to the back of the cloth, so that the foundation shows on the surface and forms a background to the figure. The ground is bare and dull in appearance compared with the pile surface, and for this reason, and in order to make the best use of the large quantity of weft that is put into the cloth, the most suitable designs are those in which the pile figure is massive, and covers nearly the whole of the face of the fabric.

Figured Velveteens. —

Fig. 393 represents a figured velveteen fabric in which the design is typical of the kind that is mostly employed; it will be seen that the ground is shown chiefly in order to separate the parts of the ornament.

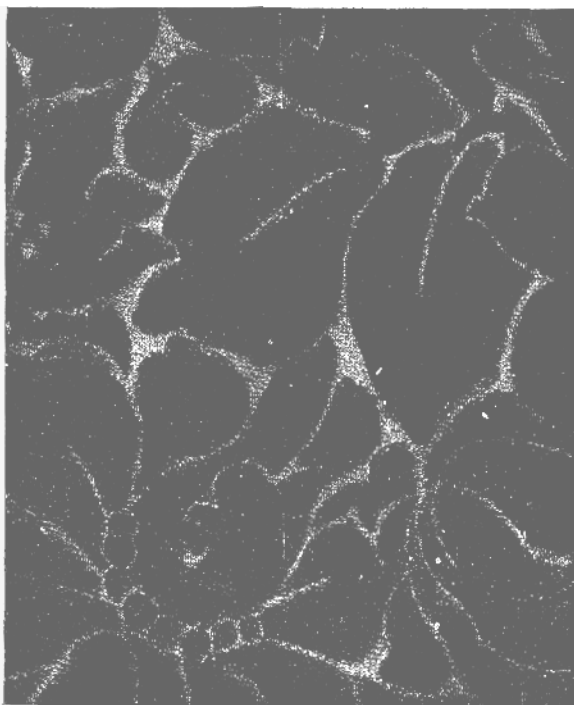


Fig. 393.

Practically any velveteen weave can be used for the figure, but in the ground the structure is varied according to the method in which the pile weft is prevented from showing on the surface. There are two chief methods of disposing of the surplus weft in the ground:—(1) It is bound in on the underside in the same manner as on the face. (2) It is floated loosely on the back of the foundation texture, and after the cutting operation is brushed away as waste. In the latter method, if

very long floats are formed on the underside, sometimes a series of extra ends is introduced which interweave only with the pile picks on the back. A coarse cloth is thus formed on the underside, which, after the cutting operation, is pulled away leaving the ground clear of the pile weft.

The velveteen weaves that are chiefly used for the pile figure are given at A and C in Fig. 394. If the pile picks are bound in on the back, corresponding methods of interlacing, as shown at B and D respectively, are employed in the

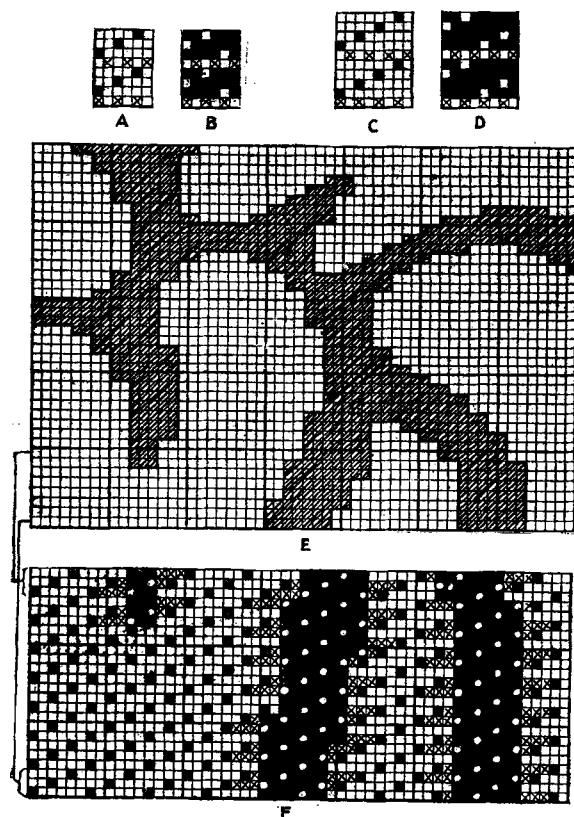


Fig. 394.

weave given at A is employed, and the cloth in the finished state contains 80 ends and 320 picks per inch, the counts of the design paper is in the proportion of 80 to $(320 \div 4) = 8 \times 8$. As the figure nearly covers the surface of the cloth it is convenient to paint the ground of the design, as shown at E in Fig. 394.

The complete card-cutting plan is constructed from the reduced design in the method illustrated at F in Fig. 394, in which the figure is formed in the weave given at A, and the ground in that shown at B. Each horizontal space of E corresponds to three spaces of F, the ground picks not being included in F, because they are all plain, and can be cut independently of the design.

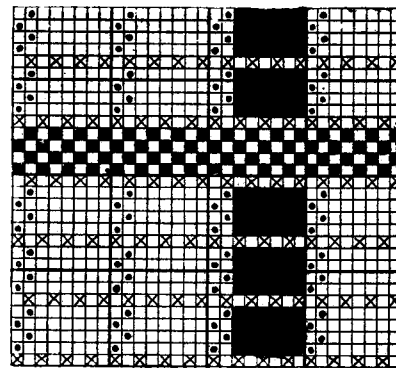
ground, but the pile binding points are placed in different relative positions to the face binding points.

In drafting a design upon point-paper, the pattern may be drawn and painted out in full from the original motive; but on account of the great preponderance in number of the picks over the ends it is advisable to adopt a method which will simplify the work. In one method the design is first drafted to a reduced scale, as shown at E in Fig. 394, in which each vertical space represents an end, and each horizontal space a ground pick and as many pile picks as are inserted to each ground pick. This proportion is convenient for the subsequent process of drafting, and it enables suitable design paper for the reduced plan to be readily selected, as the counts of the paper is in the same ratio as the ends are to the ground picks per unit space.

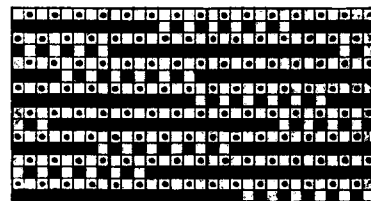
Thus, assuming that the pile

Figured velveteens are more difficult to cut than plain velveteens on account of the liability of the knife guide leaving the races between the separate parts of the figure. It has been found by experiment that the best results, as regards the pile cutting, are secured, first, by painting the outer edges of the ground portions on the bound ends; and, second, by making each pile weft float pass over at least five ends at the edges of the figure. It will be seen in E, Fig. 394, that the edges of the ground effect are indicated on the odd ends which are shown bound in the plan F, while the outline steps in pairs of ends. The crosses in F illustrate the method of taking out all pile floats of less than five at the edges of the figure. The marks in the plan F are cut.

The method of indicating a design, shown at F, may be employed when the pile weft is not bound in in the ground, except that no binding marks are indicated in the ground portion of the design. It has to be taken into account, however, that the removal of the surplus weft from the underside causes a half tuft formed by each pile pick to be drawn away on both sides of every portion of figure. The latter method, as compared with the former, therefore increases the ground space, and if care is not taken in indicating the cutting marks of a design, a narrow portion of figure may be eliminated. In order to preserve the full mass of the figure, instead of throwing all the small floats to the back, as shown by the crosses in F, the three floats may be extended to floats of five on the surface by taking out marks in the ground.



G



H

Fig. 395.

Figured Cords.— Any standard cord weave may be employed as the basis of the structure in producing a figured velveteen cord, but as it is necessary for the outline of the figure to fit with the vertical cord lines, more elaborate ornamentation can be produced in narrow than in broad cord effects. In any case the steppy character of the lines makes it necessary for the designs to be simple and massive, and, as a general rule, the styles are limited to simple geometrical figures. The ground effect is produced by floating the pile weft on the back between the binding ends, but there is the exception that in check patterns the horizontal lines can be formed simply by discontinuing the pile weave and inserting the required number of ground picks consecutively.

In the plan shown in Fig. 395 the solid marks illustrate the formation of ground lines in a corded velveteen structure, the vertical series of marks indicating the usual way in which the pile picks are thrown to the back in forming the ground of an effect, and the horizontal series, the method of producing a horizontal line of ground in a corded check.

IMITATION OF WEFT PILE FABRICS

A form of weft curl pile is produced by combining a shrinking with a non-shrinking weft, and submitting the cloth to very great contraction in the finishing processes. Woollen and mohair wefts may be used, inserted one or two picks of each alternately, and a cotton warp. The woollen weft is interwoven in perfectly plain order with the warp, while the mohair weft is interwoven in plain order for a number of threads, and is then floated loosely on the surface. The method is illustrated by the plan given at H in Fig. 395, in which the dots represent the woollen picks, and the solid marks the mohair picks. The cloth is heavily milled, and shrinks excessively in width, but the mohair floats do not contract, and are, therefore, caused to form loops or curls on the surface.

In another form of imitation weft pile a fabric is produced with a fibrous surface which, to some extent, resembles various skin and plush textures. The cloth is woven with cotton warp, and a weft that consists of a mixture of cow's or calf's hair and a low quality of wool. The weave is usually an ordinary four- or five-thread weft-sateen, but sometimes a reversible weft-face weave (as shown in Fig. 7, p. 8) is used in order that the cloth will be the same on both sides. The pile effect is produced in the finishing operation by submitting the cloth to very severe processes of milling and raising. In the dyed or printed condition the fabrics are used for such purposes as curtains, upholsteries, and carriage rugs.

CHAPTER XVII

TURKISH TOWELLING FABRICS

Formation of the Pile—Turkish Towelling Weaves—Methods of Drafting and Denting—Terry Motions. *Terry Ornamentation*—Stripe and Check Dobby Patterns—Figured Terry Pile Fabrics—Mixed Colour Effects.

THE Turkish towelling structure forms a class of warp pile—termed “terry” pile—in which certain warp threads form loops or curls on the face of the cloth. Only one kind of weft may be used, but two series of warp threads, placed on separate beams, are necessary for the production of the cloths—viz., ground threads and pile threads. The former produce with the weft a foundation texture from which the loops, formed by the pile threads, project.

The distinguishing feature of this class of pile, as compared with true warp pile, is that the looped structure is produced, not by the aid of wires, but by employing a special reed motion and warp easing arrangement which enable the loops to be formed on the upper or lower, or both upper and lower, surface of the cloth. Turkish towels may be made in either linen or cotton yarns, and in cotton yarns the structure is applied, in addition to towels, to such fabrics as counterpanes, mats, dressing gowns, and toilettings. The principle has also been employed in the manufacture of cheap mantle cloths in which the pile is developed in yarns made from wool.

Formation of the Pile.—In forming the looped pile without the aid of wires, many different kinds of terry motions are used, but in every case the object is

to cause two succeeding picks of weft to be left a short distance from the fell of the cloth, and then to beat up these two picks along with the following pick.

In Fig. 396 a longitudinal cross-section of a double-face plain pile fabric is given, which shows the weft threads in relation to the ground and pile warp threads. The dotted vertical lines R R, S S, and T T divide the picks 1, 2, and 3 into repeating groups of three, line T T indicating the position of the fell of the cloth. On the right of the diagram, a group of three picks, which compose a repeat, is represented previous to being beaten up to the fell of the cloth. The ground threads G, G¹, and the face and back pile threads F and B are shown connected by lines with the respective spaces in the corresponding weave design given at P. In weaving the cloth the ground warp beam, carrying the threads G and G¹, is heavily tensioned, so that these threads are held tight all the time. The picks 1 and 2 are first woven into the proper sheds, but are not beaten fully up to the fell of the cloth by the slay at the time of insertion in their sheds; but when the pick No. 3 is inserted the parts are so operated that the three picks are driven together into the cloth

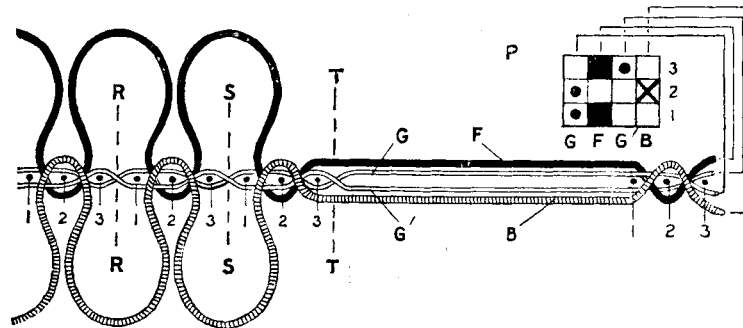


Fig. 396.

at the fell T T. During the beating up of the third pick the pile warp threads F and B are either given in slack, or are placed under very slight tension.

The picks 1 and 2 are in the same shed made by the tight ground threads G and G¹, which, therefore, offer no obstruction to the two picks being driven forward at the same time with the third pick. The pile threads F and B, on the other hand, change from one side of the cloth to the other between the picks 1 and 2, and they are, therefore, gripped at the point of contact with the two picks. As the three picks are beaten up this point of contact is moved forward to the fell of the cloth, with the result that the slack pile warp threads are drawn forward, thus forming two horizontal rows of loops, one projecting from the upper and the other from the lower surface of the cloth in the manner represented in Fig. 396.

In order to produce the loops on the three picks during the insertion of which the terry motion is in operation, the pile and ground threads must be interwoven with the weft in the exact order represented in Fig. 396. The three-pick terry structure is employed most extensively, but sometimes four, five, and even six picks are inserted in making each horizontal row of loops. The interweaving of the threads, on the subsequent picks, is, however, of little consequence so long as the cloth has the necessary firmness, and a natural connection is made with the weave of the three picks particularly referred to.

Turkish Towelling Weaves.—A number of standard designs for producing the fabrics are given in Fig. 397. These designs have been grouped so that comparisons can be readily made. The dots in the designs represent the interlacings of the ground warp threads; the full squares show the interweaving of the face pile threads, and the crosses of the back pile threads. Designs A, B, C, D, and E form the loops uniformly on the face side of the cloth only, whereas the remaining designs are for producing a pile surface on both sides of the cloth. In the designs A, B, C, D, and E, the warp threads are arranged 1 ground, 1 face pile, and in F, G, H, I, J, and K, 1 ground, 1 face pile, 1 ground, 1 back pile. The designs L, M, N, O, P, and Q produce corresponding effects to the designs F to K respectively, but they are arranged 1 ground, 1 face pile, 1 back pile, 1 ground.

In each design A to E in Fig. 397, there is a pile thread on the surface to each ground thread, but in the remaining designs F to Q, the proportion is one pile thread on each side of the cloth to two ground threads. The single-face pile cloths can, however, be made with one pile to two ground by leaving out the last thread in each of the designs A to E. The plans A, F, and L are for producing the pile effect on three picks; B, G, and M on four picks; C, H, N, D, I, O, J, and P on five picks; and E, K, and Q on six picks.

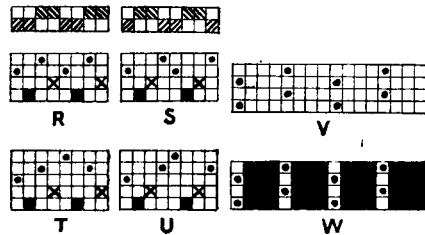


Fig. 397.

The five-pick effects, C, H, and N, are respectively similar to D, I, and O, except that the pile threads interweave more frequently in the latter three, while J and P show a further modification in which the face pile threads interweave more frequently than those which form the back pile. Less weft yarn can be introduced into the cloth with the more firmly interwoven designs, and at the

same time the resulting structure is stronger and more durable.

In the six-pick effects E, K, and Q, the ends interlace with the picks in exactly the same manner as in A, F, and L respectively, but in producing the loops at every six picks, the weft is beaten up to the fell of the cloth on four picks in succession. This structure, which is known as the "Osman," is much firmer than the three-pick terry, on account of the greater number of intersections that are made for each horizontal row of loops; and with finer yarns and more picks per inch, the cloth is made very strong and durable.

Every plan in Fig. 397 is constructed for the first and second picks to remain back from the edge of the cloth when they are first inserted, and for the reed to beat up firmly on the third and subsequent picks in the repeat. A comparison of the designs will show that in each case the interweaving of the respective threads is exactly the same on the picks 1, 2, and 3, and corresponds with the order of interlacing illustrated in Fig. 396. Thus, on the picks 1 and 2, the odd ground

threads are raised and the even ground threads depressed, while on the third pick they are in the reverse positions. The face pile threads are raised on the picks 1 and 3, and depressed on the second pick; the back pile threads being operated in the reverse order.

Methods of Drafting and Denting.—In drawing in the two warps for weaving, the pile threads are drawn on two healds at the front, and the ground threads (if the looped formation is to be continuous) on two healds at the back, as shown at R in Fig. 397 for the 1 ground, 1 pile order of arrangement, and as indicated at S for the 2-and-2 order. When, however, the cloths are made in short lengths with a cross-border at each end, the drafts given at T and U are frequently employed. This arrangement enables a weave with a weft float over seven warp threads to be obtained by the alternate lifting of the third and fifth heald, the remaining healds being left down in forming the float on the face, and lifted in forming the float on the reverse side, as shown respectively at V and W. In dobby shedding specially crammed and coloured cross-over effects (headings) can be readily formed in the borders in this manner.

Usually two threads are placed in each split of the reed, and in the 1 ground, 1 pile order, one of each series is placed in the same split, as shown above R in Fig. 397. In the 2 ground, 2 pile order, however, two ends of the same series are placed together, as shown above S. The two arrangements produce practically identical results, but the 2-and-2 structure has the advantage that by reeding as described, the threads in each split work opposite to each other, and at the same time the pile and ground threads, which on some picks work alike, are separated by the wires of the reed, so that a clear shed is more readily obtained.

The loom particulars of a good quality of cotton terry cloth are as follows:—

Pile warp, two ply 2/20's; ground warp, 2/18's; weft, 16's; ends per inch, 50; picks per inch, 58. 500 yards of pile warp and 102 yards of ground warp are required for producing 100 yards of terry. The shrinkage in width is about 12 per cent. In cheaper cloths the weft may be 20's, and the picks 36 per inch and upwards; the pile warp 16's and the ground warp 14's; 300 yards and upwards of pile warp for 100 yards of cloth. The ground ends are usually rather thicker than the pile ends. For a soft cloth the pile yarns should be soft spun, and for a crisp handle, moderately hard spun; but the feel of the texture varies according to the depth of the pile loops, a deep pile handling softer than a short pile. The depth of the pile is determined by the distance that the two picks are left away from the fell of the cloth, which is usually about $\frac{1}{2}$ inch.

Terry Motions.—Different systems have been devised to enable two successive picks of weft to be left back from the edge of the cloth at will. In one method, in which a fast reed is employed, the going part is moved forward for a shorter distance on the two "loose" picks; while in another fast reed type, movable front and back rails are provided, which enable the edge of the cloth to be traversed, when required, in advance of the stroke of the reed for the necessary distance. In the system which meets with the greatest favour, however, a loose reed is used which is caused to move backwardly at the bottom, the upper edge of the reed acting as the fulcrum.

An end view in partial cross-section of this type of terry motion (as made by Messrs. Butterworth & Dickinson, Ltd., Burnley) is given in Fig. 398, in which the mechanism is under the control of a dobby or jacquard. However, in weaving

cloths in which the looped formation is continuous, the principle may also be adapted to cam shedding. The parts of the reed motion are indicated in solid lines and the framework of the loom in dotted lines. A front view of the upper part of the mechanism is shown in Fig. 398, A.

The position of the reed S, during the beating up, is governed by the shedding mechanism through a cord A, which is attached to a lever B fulcrumed on a bracket

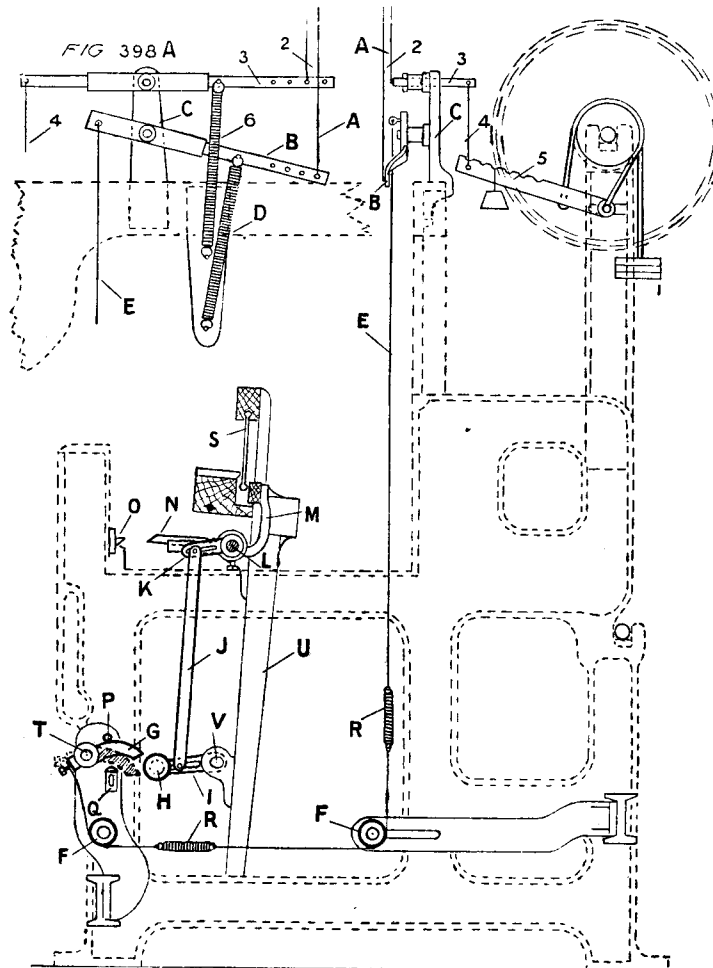


Fig. 398.

C. If the reed is required to be held firmly, the cord A is not lifted, and then the action of the spring D causes the rear end of the lever B to be raised. The cord E, which is connected to this end of the lever B and which passes around two guide pulleys F, draws upon the rear extremity of a cam G centred at T, and raises the curved portion of the cam to the position shown in solid lines. Then, as the going part moves forward, an anti-friction bowl H (carried at the end of a lever I which

is fulcrumed at V on a bracket attached to a sword U) passes below without touching the cam G, and the lever K, to which the link J is connected, occupies its normal position. The lever K is fixed to the stop-rod L, as are also the lever M (which presses against the lower edge of the reed) and the duck-bill N. In beating up the weft this duck-bill engages the underside of the heater O, and the reed is held firmly in the usual manner.

When the reed is required to fall back on the first two picks, the cord A is raised which lowers the rear end of the lever B. This action releases a sufficient length of the cord E to allow the curved portion of the cam G to fall by its own weight to the position indicated by the dotted and shaded lines. Then, as the sword U moves forward, the bowl H comes in contact with and rises on the face of the cam G. By means of the link J, this upward motion is transmitted to the lever K, which partially rotates the stop-rod L. The forward end of the duck-bill N, therefore, rises above the heater O, while the upper end of the lever M falls back, with the result that the lower edge of the reed moves backwardly, and the pick of weft is left a short distance from the fell of the cloth.

The extent of the backward movement of the reed may be regulated by moving the ends of the link J nearer to or further from the extremities of the levers I and K. Projections P and Q are used for the purpose of limiting the movement of the cam G. One or more springs R may be inserted in the length of the cord E in order to take up any excess movement of the shedding mechanism.

It is usually convenient to place a large quantity of yarn on the pile warp beam in order to compensate for its rapid delivery. This beam is supported by brackets at a considerable height above the line of the shed. During the production of the terry effect the pile warp is lightly tensioned, as shown in Fig. 398, by means of adjustable weight 1, but provision is made for increasing the tension whenever the looped formation is required to be discontinued. Thus, when the cord 2 is raised by the shedding mechanism the other extremity of the lever 3, to which the cord 4 is attached, is depressed; therefore, the beam-lever 5, to which the opposite end of the cord 4 is connected, is lowered, and additional weight is put on the pile warp beam. In the case of a towel with a border at each end, the cord 2 is left down while the terry centre is being woven, and the action of the spring 6 causes the beam-lever 5 to be raised, the additional weight thus being taken off. During the formation of the borders, however, in which the pile warp requires to be practically as heavily tensioned as the ground warp, the cord 2 is raised and the beam-lever 5 lowered all the time to produce the extra tension necessary.

TERRY ORNAMENTATION

When simple terry weaves are used, such as those given in Fig. 397, the only possible form of ornamentation consists of introducing coloured pile threads to form stripes, but if the loops are formed on both sides of the cloth one side may be coloured independently of the other. In producing more elaborate ornamentation the pile yarns are caused to form loops first on one side and then on the other side of the cloth in the manner represented in Fig. 399. This system may be employed either with one or two series of pile threads, and styles be produced ranging from simple checks to complex figures. The principle of ornamentation, in which certain pile threads form loops while others lie straight in the cloth, cannot

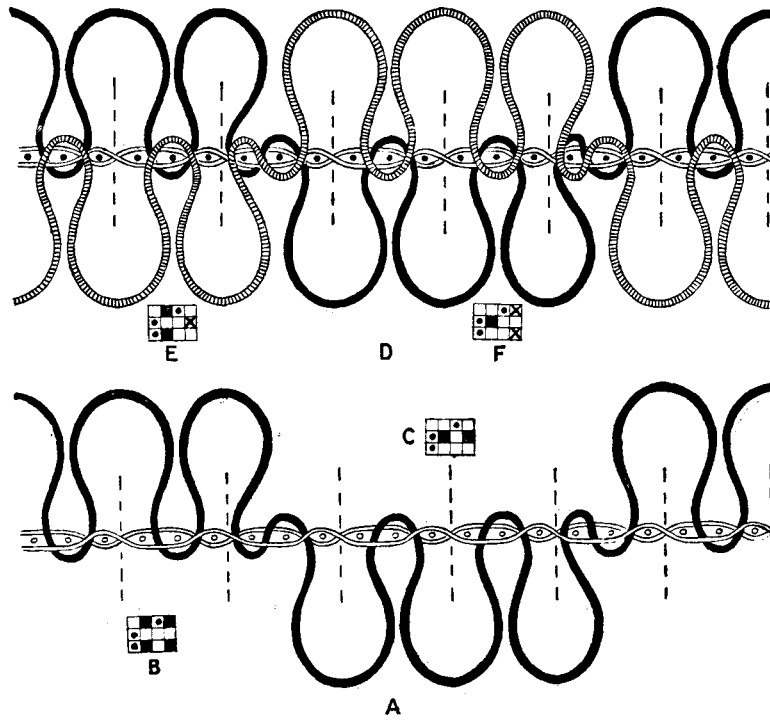


Fig. 399.

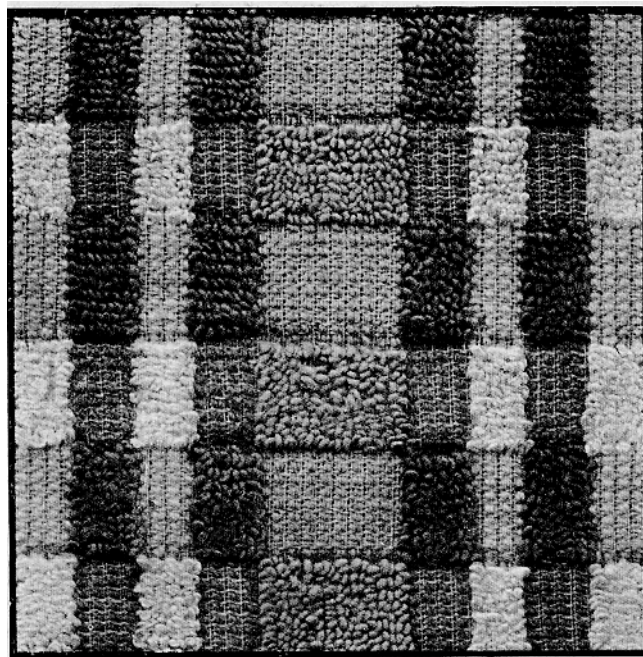


Fig. 400.

be employed, since all the pile yarn is brought from one warp beam, and it is, therefore, necessary for all the threads to form either pile or ground simultaneously.

When only one series of pile threads is used the pattern is due to the pile threads forming loops on the face and back in turn, so that alternate sections of pile and ground are produced on both sides of the cloth. In Fig. 399, diagram A illustrates this method of interlacing, while the weave design which forms the loops on the face is given at B, and on the back at C. In this system of ornamentation colours may be introduced either in the pile or in the foundation threads.

In Fig. 399 diagram D shows how the pile yarns interchange from face to back when two series are employed. In this case both sides of the cloth are covered by the loops, but one series of threads is differently coloured from the other series, so that alternate sections in different colours are formed. With the weave E, the loops are formed by the dark threads on the face and by the light threads on the back; and with the weave F they are formed by the light threads on the face, and the dark threads on the back.

Stripe and Check Dobby Patterns.—With dobby shedding simple reversible designs are obtained usually of a check character, and an example is given in Fig. 400, which shows an effect produced by a single series of pile threads, on the principle illustrated at A in Fig. 399. In this case, however, the threads are arranged in the order of 2 ground, 2 pile. The motive design of the cloth is shown divided into sections in Fig. 401. Sections G form pile on the face and ground on the back, and sections H form ground on the face and pile on the back. The drawing-in draft is shown at I and the lifting plan at J. In producing a given size of check, each section is repeated the required number of times.

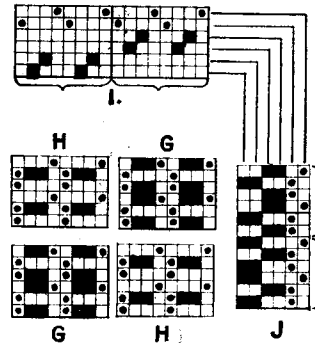


Fig. 401.

Fig. 402 shows a check pattern produced in two series of pile yarns, on the principle illustrated at D in Fig. 399. There is also a continuous stripe effect at each side of the check pattern. One series of pile threads is differently coloured from the other series, and in the corresponding design and draft given in Fig. 403, the black squares represent red pile while the crosses indicate white pile. Section K shows the weave used in producing the continuous stripe, while sections L and O form red loops on the face and white loops on the back, and sections M and N form white loops on the face and red loops on the back. The change of effect between sections L and M, and also between N and O, is due to a change in the weave. In the sections L and N, however, and also in sections M and O, the weave is exactly the same, the change of effect in this case being due to a change in the order of colouring. Thus, as indicated by the black squares and crosses respectively, the pile yarns in sections L and M are arranged 1 red, 1 white, and in N and O, 1 white, 1 red, two white pile threads coming together in the centre. The drawing-in draft is shown at P—three healds being used for the ground threads, and the lifting plan at Q.

The lower portion of Fig. 402 shows a cross-border, the bulk of which is formed

by continuing the centre weave with the terry motion out of action, but there

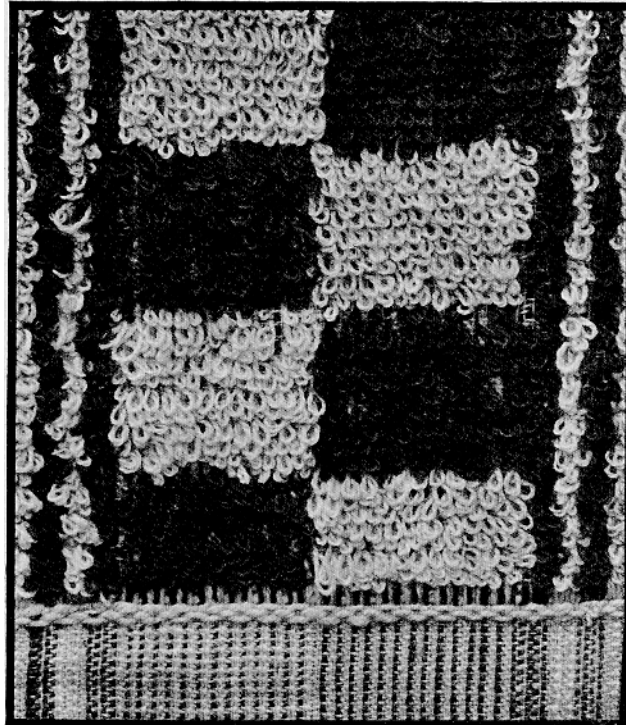


Fig. 402.

is also a heading produced by floating thick picks over seven threads. The weave design for the thick picks is shown at R in Fig. 403, the lifting plan being indicated at S. Three picks float on the face and then three on the back, in order that the border will be reversible similar to the centre.

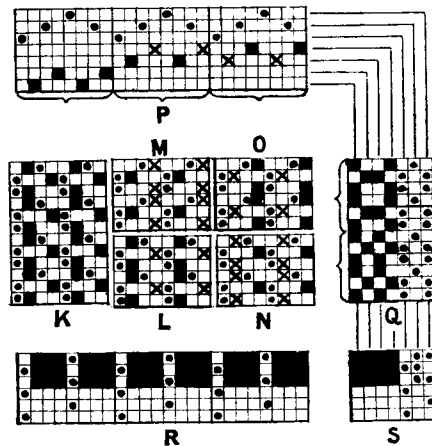


Fig. 403.

An interesting modification of the latter style of check pattern consists of separating the rectangular spaces from each other by narrow lines of ground, the longitudinal lines being formed by bringing about 6 or 8 threads consecutively from the ground warp beam, while the transverse lines are obtained by throwing the terry motion out of action for about 6 picks. This system of forming checks can also be employed

when the pile threads are all of one colour, and when no interchange is made from one side of the cloth to the other.

Figured Terry Pile Fabrics.—A representation of a figured terry pile texture, taken from the corner of a bath mat, is given in Fig. 404. The example is simply an extension of the principle (illustrated at D, E, and F in Fig. 399 and in Figs.



Fig. 404.

402 and 403), in which two series of differently coloured pile threads are interchanged. In the fabric represented a figure in white terry pile is formed on a blue terry ground on one side of the cloth, and a blue terry figure on a white terry ground on the other side. The warp threads are arranged in the cloth in the order of 1 ground, 1 white pile, 1 ground, 1 blue pile, and the structure is a three-pick terry.

From an examination of the plans E and F in Fig. 399, and L and M, or N

and O in Fig. 403, which represent opposite effects produced by two series of pile threads, it will be seen that one pile thread of each pair works exactly opposite to the other thread, while the ground threads are operated in the same regular order whichever thread is on the surface. A convenient system of shedding for figured fabrics, therefore, consists of an inverted hook jacquard and harness arrange-

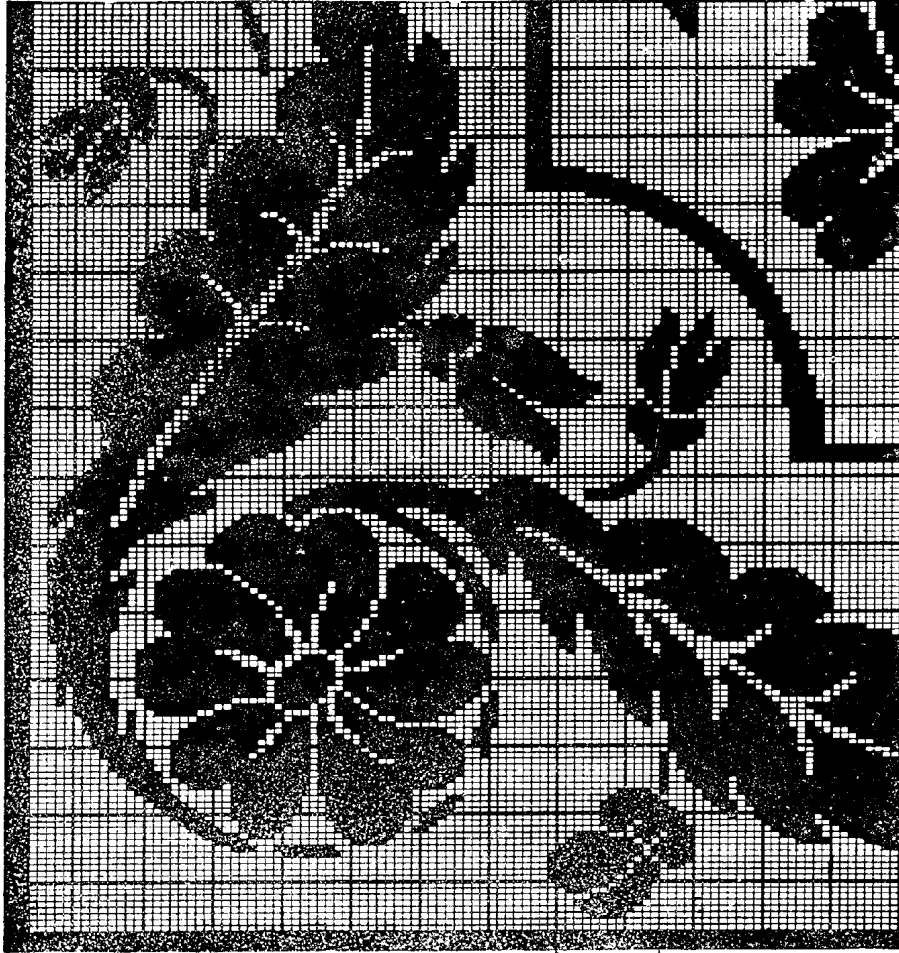


Fig. 405.

ment (as represented in Fig. 186, p. 161) combined with two or three healds placed behind the harness.

With the mount described a figure is simply painted solid, as represented in Fig. 405, which corresponds with a portion of the design shown in Fig. 404. Each vertical space of the plan represents a pile thread of each colour, and each horizontal space a transverse row of loops or three picks. The cloth contains 56 warp threads per inch including the ground threads, and 58 picks per inch. There are, therefore,

14 pile threads of each colour per inch, and $19\frac{1}{3}$ horizontal rows of loops per inch, so that for an 8-row jacquard the proper counts of design paper is 8×11 , as shown in Fig. 405.

If the colour of warp that is required to form the figure is controlled by the hooks that are normally over the lifting knives in an inverted hook jacquard, three cards are cut from each horizontal space of the design shown in Fig. 405, as follows:—First card, cut the marks; second card, cut the blanks; third card, cut the marks. The sectional plans given in Fig. 406 correspond with a portion on 12 vertical and 16 horizontal spaces indicated by the bracket below the design in Fig. 405. The plan A shows the weave of the pile threads produced by the jacquard, the solid marks representing the lifts that are cut on the cards, and the crosses the opposite lifts that are formed by the inverted hooks. The weave of the ground

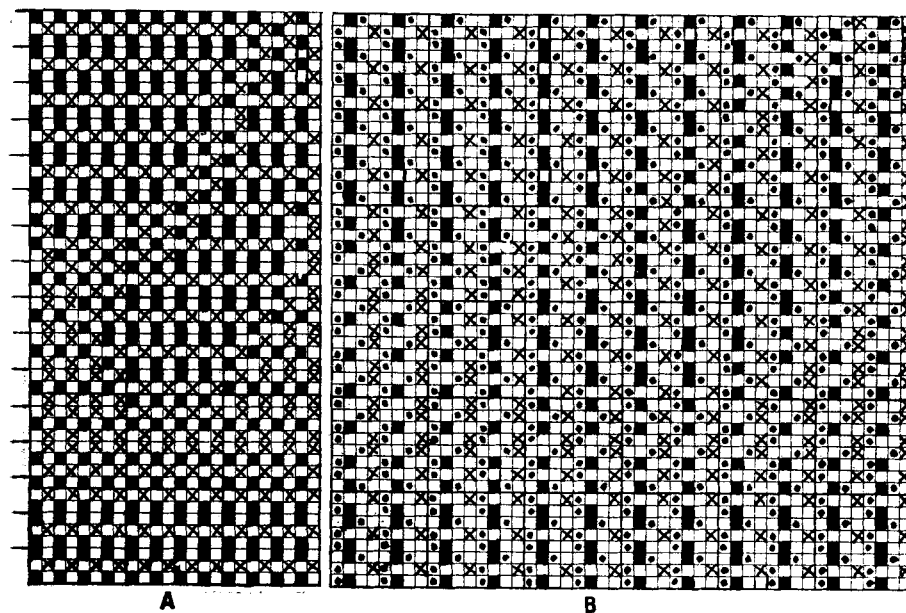


Fig. 406.

threads, represented by the dots, is also included in the plan B, which thus shows the complete structure of the cloth. The horizontal marks at the side of A divide the picks into groups of three, on the last of which the reed is held firm in beating up. The odd pile threads form loops on the surface where the solid marks predominate in the plans A and B, and the even pile threads where the crosses predominate.

The system of designing, illustrated in Fig. 405, is suitable to employ for the class of figured terry cloths in which there is only one series of pile threads. In this case on one side a figure is formed in pile upon a ground of the foundation cloth, while on the other side the foundation forms the figure and the pile the ground. The principle is illustrated by the examples shown at A, B, and C in Fig. 399, and in Figs. 400 and 401. An ordinary form of jacquard and harness combined with

healds may be employed, but the inverted hook arrangement, previously described, can be adapted to the purpose by casting out the harness cords that are controlled by the inverted hooks. The card-cutting particulars are as before.

Mixed Colour Effects.—In a further development of the Turkish towelling structure, which is applied to fancy household fabrics, such as antimacassars, mats, etc., white and two colours of pile warp are employed, and a design composed of four effects is produced. For instance, assuming that the pile threads are arranged 1 white, 1 pink, 1 white, and 1 green, the ground may be formed in white pile loops and the figure by mixtures of pink and green, white and pink, and white and green loops in the different sections of the design. There are really four series of pile threads in the cloth, two of which are on the surface and two on the back in every part.

A suitable shedding arrangement consists of a combination of healds with

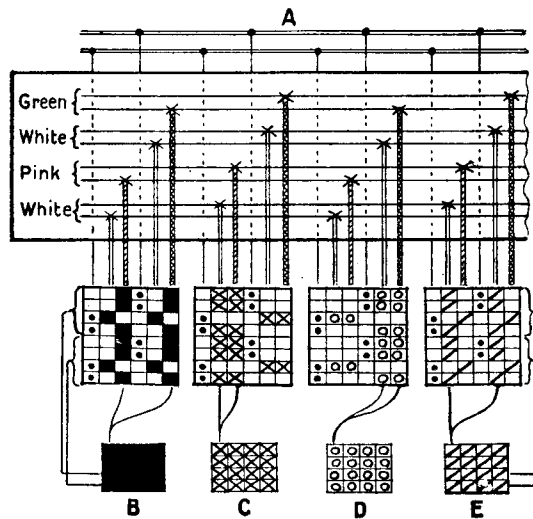


Fig. 407.

a jacquard and harness that is divided into four sections, as illustrated in the diagram given at A in Fig. 407. The first and third sections are allotted to the white pile threads of which there are two series, and the second and fourth sections to the pink and green threads respectively. The ground warp is drawn on two healds at the rear of the harness, and it will be seen that there are two pile threads, one of which is white and the other coloured, to each ground thread.

The system of mounting enables the four series of pile threads to be separately controlled by the cards, so that

the different effects formed in the cloth can be indicated solid on the design paper, as represented at B, C, D, and E in Fig. 407. Each vertical space in the plan corresponds to four pile ends, and each horizontal space to a group of picks, in this case four as the structure is a four-pick terry. The plans B, C, D, and E are shown connected by lines with the corresponding complete weaves, and the vertical spaces in the latter coincide with the ends in the draft A to which they are joined. The basis of the structure is similar to that illustrated by the plan G in Fig. 397, except that the ground ends interweave in 3-and-1 order in G, and in 2-and-2 order in the weaves given in Fig. 407.

The plan B in Fig. 407 represents the pink and green pile threads on the surface, and all the white pile threads on the back; C, white and pink on the surface and white and green on the back; D, white and green on the surface and white and pink on the back; and E, all the white on the surface and pink and green on the back. The card-cutting particulars are as follows:—First, third, and fourth cards of each group of four—cut C and E on the first white section,

B and C on the pink section, D and E on the second white section, and B and D on the green section. Second card—cut B and D on the first white section, D and E on the pink section, B and C on the second white section, and C and E on the green section.

CHAPTER XVIII

WARP PILE FABRICS

Formation of Warp Pile—Form of the Pile Wires—Structure of Warp Pile. *Plain Warp Pile Fabrics*—All the Pile over each Wire—Two Picks to each Wire—Three Picks to each Wire—Fast Warp Pile Designing—Method of Heald Drafting—Four Picks to each Wire—One-half the Pile over each Wire—Backed and Double Foundation Cloths—Warp Pile Astrakhan Textures—Reversible Warp Pile Structures—Double Plush Weaving—Ornamentation of Plain Warp Pile Fabrics. Stripe and Check Designs.

Formation of Warp Pile.—In the manufacture of true warp pile structures only one kind of weft is essential, but two series of warp threads, separately tensioned, are required—viz., ground threads and pile threads; the former produce with the weft a foundation texture from which the pile threads project. The cloths are of two kinds—viz., looped pile, to which the terms terry, boucle, or frisé are applied; and cut pile, which is termed velvet. The “Turkish towelling” structure represents a class of looped or terry pile which, as previously shown, is conveniently and economically produced by means of a special reed motion and warp-easing arrangement. In the better classes of warp pile textures, however, such as dress and mantle fabrics, hangings, chair coverings, Brussels and Wilton carpets, etc., the pile is formed with the aid of wires. In this system a wire is inserted, instead of a pick of weft, in a special shed on which only those warp threads are raised that have to form the pile, the threads thus being looped over the wires. Subsequently the wires are withdrawn from the cloth, and the pile threads then project from the foundation either in the form of loops (forming uncut or terry pile) or in the form of tufts of fibres (forming cut or velvet pile), according to the kind of wire that is used. Compared with the terry towelling structure, the pile formed on the wire principle is much superior as regards both firmness and regularity; also there is greater scope for producing diversity of design. A cloth may have a perfectly uniform surface composed of either terry or cut pile, or the two structures may be used in combination, while one or both classes of pile may be used in conjunction with other weaves to form stripes, checks, spots, and elaborately figured styles. The ornamentation may also include the use of extra warp and weft. The looped pile structure, however, is not employed alone to a great extent except in the case of Brussels and tapestry pile carpets, in which diversity of colour is the predominant feature; its chief use in other textures is to produce variety of pattern in conjunction with cut pile or other effects.

The materials used vary according to the class of texture and the purpose for which the cloth is intended; mohair, lustre, demi-lustre, and cross-bred worsted, woollen spun silk, tussah or wild silk, and artificial silk yarns, are largely used for the pile. Cotton, flax, and wool are used for the weft, and cotton, flax, and jute for the ground warp.

Form of the Pile Wires.—The pile wires vary in shape according to whether they are to be inserted and withdrawn by mechanical means or by hand, and also according to whether the pile is to be looped or cut. A and B in Fig. 408 represent in front elevation and plan respectively the form of a cutting wire which is used in power weaving. The body of the wire is nearly rectangular, as shown (on an enlarged scale) in the cross-section given at C. One end of the wire is provided with a handle which is shaped for the reception of a hook, by means of which it is drawn longitudinally out of the cloth. The other end is in the form of a flat blade with a very sharp upper edge which cuts the pile threads as the wire is withdrawn; the twist then runs out of the free portions of the threads, so that tufts of fibres are formed. Shapes of looping wires are shown at D and G in Fig. 408, that are manipulated by power and hand respectively, a handle being provided in each case for the same purpose as in the power-cutting wire. If only a short looped pile is required the wires may be circular in cross-section as shown at E,

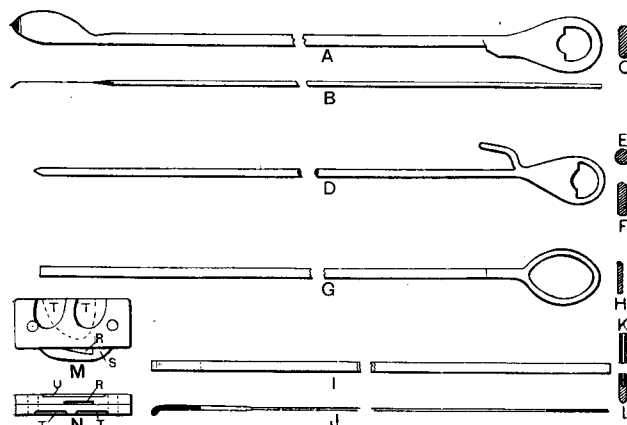


Fig. 408.

and in order to prevent damage to the reed the extremity opposite to the handle is tapered towards the cloth. In producing a rather long pile the circular form is not suitable, because the number that can be inserted per inch is limited; hence flat wires are employed, as represented by the cross-sections F and H, which vary in thickness according to the number required per inch. A hand-cutting wire in front elevation, plan, and cross-section respectively is shown at I, J, and K; this wire is a split or double wire except at the ends, where the two portions are soldered together. Another form of hand-cutting wire is represented in cross-section at L, the wire in this case being solid except that a groove is formed in the upper edge. In cutting the pile a sharp blade, projecting from the underside of a small instrument termed a trevete, is inserted at one end between the wires or in the groove. The form of a trevete, as viewed from the side that during cutting is near the reed, is represented at M, and in plan at N. The cutting blade is shown at R, and S is a flange which serves to keep the instrument in position. Shallow recesses T and U are provided on opposite sides of the trevete, where it is gripped by two fingers and the thumb; it is slid along the upper edge of the wire, and cuts the pile threads in its passage by means of the blade, after which the wire may be lifted from the surface of the cloth.

The length of the pile depends on the depth of the wire; common sizes are from $\frac{1}{16}$ to $\frac{1}{8}$ inch deep, but they vary in sizes of about $\frac{1}{32}$ inch difference to 1 inch deep and upwards. The very deep wires are employed for special fabrics, such as that represented in Fig. 409, which are made in imitation of long-haired skins.

The pile warp during weaving takes up much more rapidly than the ground warp, the difference in length varying according to the depth of the wires and the frequency in which the pile threads are raised over the wires. In an ordinary plain pile structure the pile warp may require to be from five to twelve times the length of the ground warp. During weaving, in order that the pile face will not be injured, the temples act only on the selvages, and in winding the cloth on to the cloth beam the underside is brought in contact with the friction beam. When the pile is long, however, the cloth is not wound on to a beam, but is passed directly into a box or other receptacle.

Structure of Warp Pile.—

The diagrams F and G in Fig 410, which show sections through the weft, represent the formation of looped and cut pile respectively; in each case the position of the threads previous to and after the withdrawal of the wires is shown. Both examples might have been shown as looped, or both as cut pile, as the only essential difference in the manufacture of the two structures is in the form of the wire. (For this reason the two kinds of pile are considered together in the following.) At intervals of two, three, or more ground picks, a shed is formed in which only the threads that have to form pile are raised, and a wire is inserted which is beaten up to the fell of the cloth in the same manner as a pick of weft. Several wires are woven into the cloth before one is withdrawn in order that the tension on the pile warp will not cause the threads to slip out; then, as the foremost wire is withdrawn it is placed in the following pile shed. The operation is repeated throughout the length of the piece, a number of wires—usually not less than four—being constantly retained in the cloth.

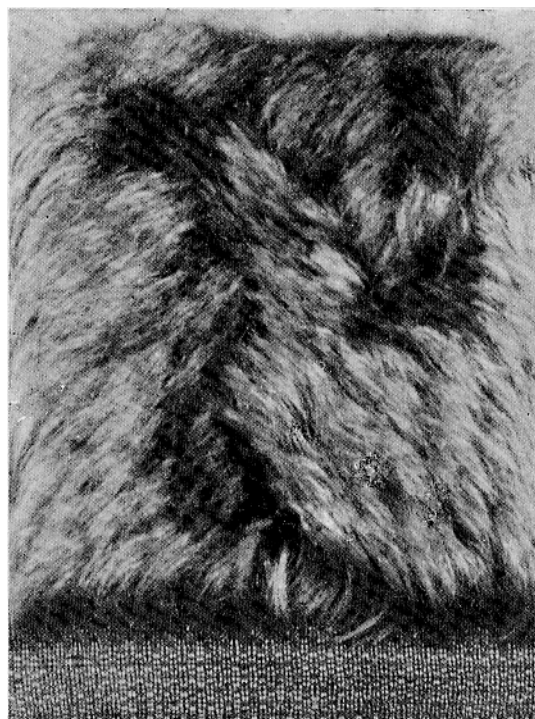


Fig. 409.

The ratio of ground threads to pile threads, and picks to wires, may be varied to a considerable extent. In the plain pile structure the foundation weave is usually very simple, as it is completely concealed on the face side by the pile; plain, rib, and hopsack ground weaves are largely employed. In figured styles a ground weave may be arranged to suit a given ratio of the threads, or a ratio to suit a given ground weave.

PLAIN WARP PILE FABRICS

In addition to the divisions of looped and cut, or terry and velvet, the plain pile structures are technically classified in several ways, although they are all woven on the same general principle. One system of classification is according to the relative proportion of picks to wires, as two-pick, three-pick, four-pick, etc. In a second system they are divided into velvets for clothing and velvets for upholstery. In a third system the structures in which all the pile threads are over each wire are distinguished from those in which only half the pile is over each wire, the term velvet being applied to the former, and plush to the latter. Fourthly, the cloths are classified according to whether the pile threads are left down on the picks which precede and succeed a wire over which they are raised, or are passed

over one or more picks next to the wire.

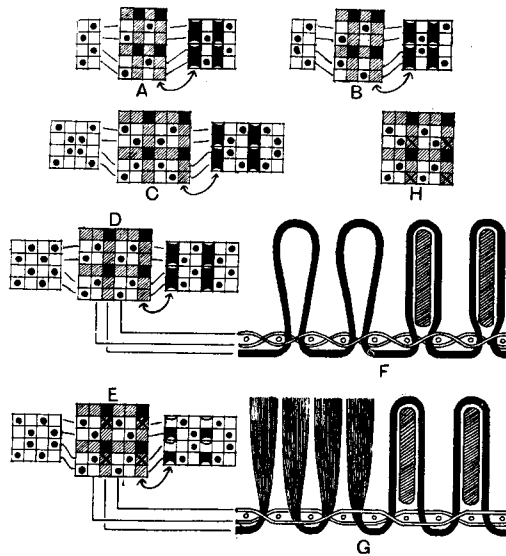


Fig. 410.

and the full squares where the pile ends float on the back; but oval spaces are indicated between the squares to indicate the positions where the pile threads are passed over the wires on the right side of the cloth. It is necessary to keep in mind that the wires simply form the pile, and though separate warp sheds are made for them, they do not enter into the composition of the cloth.

All the Pile over each Wire—Two Picks to each Wire.—The designs A to E in Fig. 410 are arranged two picks to one wire, and all the pile threads are over each wire. In A and B there is one pile thread to each ground thread; in the former the ground threads form plain weave, and in the latter 2-and-2 warp rib. These examples are used only to a limited extent. The designs C, D, and E are arranged two ground threads to one pile thread, and the respective ground weaves are 2-and-2 hopsack, plain, and 2-and-2 warp rib. In each design A to D the pile threads pass under all the picks, but in E they are raised over the pick that precedes a wire. The drawings F and G, which respectively correspond with

In the accompanying examples of plain pile designs the shaded squares indicate the positions of the pile threads and wire sheds; the full squares show where the pile threads are raised over the wires, and the crosses where they are raised over the picks, while the dots indicate the weave of the ground threads. In order that the examples may be readily analysed, the weave of the ground threads is shown separately on the left of each design, while on the right the complete weave, as viewed from the underside of the cloth, is given. In the latter it is assumed that the cloth is turned over horizontally; the dots show where the ground ends,

the designs D and E, will enable the two systems of construction to be compared. It will be seen that in F the centre of a wire rests over the space between two picks, and the pile threads pass under all the picks without interweaving with them. In G the wire rests above the pick that precedes the wire shed, and the pile threads interweave in plain order with the picks, so that there is less pile warp float on the underside of the cloth. This makes the pile less liable to be displaced by friction, hence the latter arrangement is more commonly used than the former; but in either system, if the pile is cut, the tufts are very liable to be disturbed or pulled out if friction is applied to the underside of the cloth. The plan H, which is a modification of E, shows the pile ends raised on the pick that succeeds a wire. This method is seldom employed; it is defective because the wires tend to lie at an angle, whereas with the interlacing shown at E they are held firmly in a vertical position.

Three Picks to Each Wire.—The examples I to M in Fig. 411 are arranged three picks to one wire, and two ground threads to one pile thread; all the pile threads are raised over each wire. The introduction of three picks between the wires enables the pile ends to be firmly bound into the foundation, so that a much faster and a more solid pile can be obtained than when there are only two picks to each wire (in cases where all the pile is brought over each wire). This will be seen by comparing N in Fig. 411 to F and G in Fig. 410. The plans I and J are similar, and both correspond with the drawing N; the latter represents the formation of looped pile, but it will be understood that the pile may be either looped or cut. The term "panne" velvet is applied to this structure. The difference between I and J is in the position of the 2-and-1 warp rib ground weave in relation to the pile interlacing. In I a pile end and the ground end on the right interlace with the weft in opposite order, whereas in J they work alike. In power weaving the wires are almost invariably withdrawn from left to right, which has a tendency to draw and lay the pile in that direction. This tendency is counteracted by making each pile thread cut with the ground thread on the right, hence the system of interlacing shown at I is more suitable for power wiring, while in forming cut pile that indicated at B is appropriate for hand wiring. Suitable weaving particulars are:—Pile warp, two-ply 60/2 spun silk; ground warp, 2/60's cotton; 72 ends per inch. Weft, 2/40's to 2/60's cotton, with from 48 picks and 16 wires per inch, to 90 picks and 30 wires per inch.

The plan K in Fig. 411 is a Lyons velvet in which the pile threads interlace

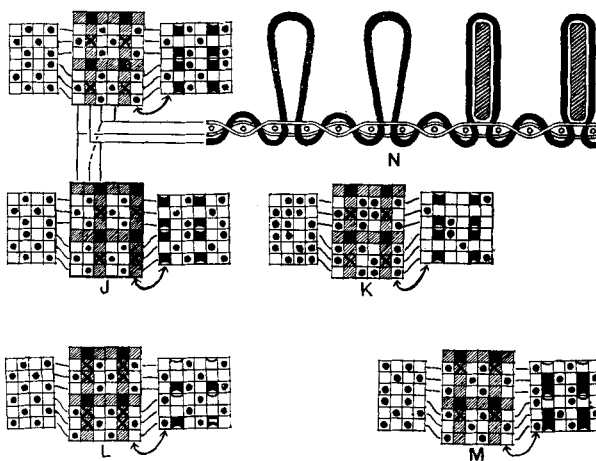


Fig. 411.

in the same order as in I and J, but in this case the ground weave is based on the 3-and-1 warp twill, which, however, is modified to repeat on six picks by making the picks between which a wire is inserted in the same shed.

In the design L in Fig. 411 the pile threads are not firmly bound in as they are raised on the two picks which precede each wire; the foundation weave is plain. The design M is similar, the pile threads being raised on one pick preceding each wire, but the ground weave is 2-and-1 warp rib. This system of interlacing gives a fuller and loftier pile, and a softer and more pliable handle to the cloth, than when the pile is firmly bound in; and the designs L and M, although lacking in firmness, are largely used in the manufacture of very fine and rich silk velvets for clothing purposes.

Fast Warp Pile Designing.—The conditions that have to be observed in producing a good foundation and a fast pile are illustrated by the examples given in Fig. 412, which show the construction of a plain pile weave in stages. The threads are arranged three pile to one ground, and there are three picks to each wire; all the pile is brought over each wire. The system of interlacing is similar to that shown at N in Fig. 411. At A the positions of the pile threads and wires are indicated lightly,

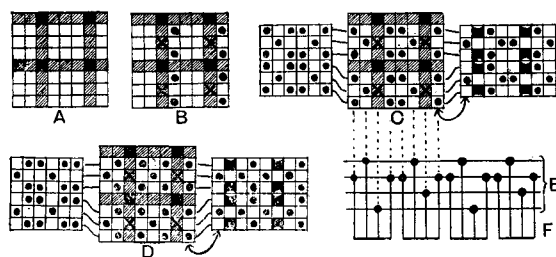


Fig. 412.

as shown by the shaded squares, and the lifts of the pile threads on the wire sheds are marked in, as shown by the full squares. At B the interlacing of the pile threads with the picks is illustrated; they are left down on the picks which precede and succeed a wire, and are raised on the centre pick, as shown by the crosses. For power weaving, the weave of the ground thread on the right of each pile thread is then inserted to cut with the marks of the pile thread. At C a weave is indicated on the remaining ground threads, which will form a natural connection with the marks already inserted; in order to ensure that an even foundation texture will result, the picks between which a wire is inserted should be in the same shed so that they will be readily beaten up close together. (It is for this reason that the 3-and-1 warp twill ground in the design K, Fig. 411, is made to repeat on six picks.) On the underside of the cloth, as shown in the plan on the right of C, the pile and ground threads form a foundation that is between hopsack and rib. The firmness of the foundation should always be considered, and the design D shows an alternative scheme of interlacing the ground threads which produces a firmer texture than C, as the pile and ground threads together form a 2-and-1 warp rib. By following the foregoing rules in constructing a pile weave a reliable structure will be formed so far as regards the interlacing of the threads, but many weaves are employed in which all the conditions are not present; and for some velvets, particularly those used for clothing purposes, they are not essential. In the two-pick cloths, when all the pile threads are over each wire, it is impossible to make the pile fast.

Method of Heald Drafting.—In drawing in the warp it is customary to draw the pile threads on the front healds, as represented at E in Fig. 412, which shows

the draft of the plan C. The arrangement of the pile and ground threads largely determines the order of denting, as in each split of the reed it is necessary for the pile and ground threads to occupy the same relative position. This is ensured by placing each group of pile and ground threads in one split, as indicated at F.

Four Picks to Each Wire.—The examples G to K in Fig. 413 are arranged four picks to one wire, and two ground threads to one pile thread, with all the pile over each wire. The four-pick arrangement is not so commonly used as the styles with two and three picks to each wire. The construction of the designs G and H will be understood by comparing them with C and D in Fig. 412. In G the ground weave is 2-and-2 warp rib, and in H 3-and-1 warp rib; in both styles the ground and pile threads together form a foundation which is between hopsack and rib. The design I is a modification of H, in which the pile threads are firmly bound

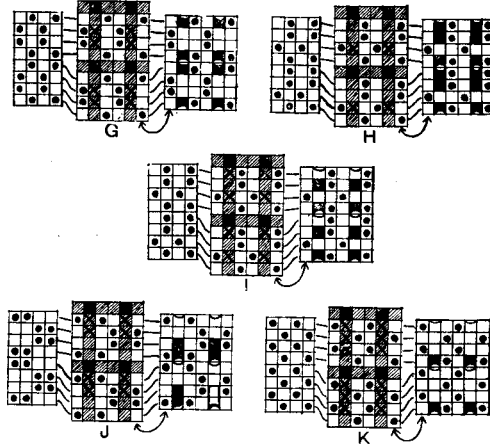


Fig. 413.

in, and are also raised on the pick which precedes each wire. In J the ground threads form 2-and-2 hopsack, and in K plain weave; the pile threads in the former are raised over two picks, and in the latter over three picks preceding each wire, this making it impossible to stitch the pile firmly into the foundation.

The designs L, M, and N in Fig. 414 are also arranged four picks to one wire with all the pile over each wire, but in L and M there are three ground threads to one pile thread, and in N four ground to one pile. In L the pile and ground threads together form a 2-and-2 hopsack foundation, and in M 2-and-2 twill; the weave of the ground and pile threads could also be arranged to form a 2-and-2 warp rib, or a 1-and-3 twill foundation. Such an arrangement, in which the pile interlacing forms a continuous weave in conjunction with the interlacing of the ground threads, is useful for styles in which a pile figure is formed on a simple weave ground, or *vice versa*, as the interweaving of the warp threads with the picks is the same throughout the cloth. The design N is also 2-and-2 twill ground, but in this case the pile threads are treated as extras, the stitching places occurring between ground warp floats. With this arrangement a pile figure might be formed

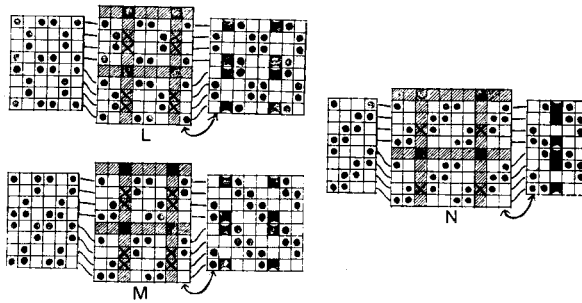


Fig. 414.

on 2-and-2 twill ground with the pile threads firmly bound into the latter, but quite invisible from the face side of the cloth.

One-half the Pile over each Wire.—In the preceding examples all the pile threads are over each wire, so that distinct rows of loops or tufts are formed running in line with the weft. This can be readily seen when a piece of cloth is folded horizontally. In the examples given in Fig. 415 only half the pile threads are over each wire, so that the loops or tufts are arranged alternately, and the foundation cloth is more uniformly covered. This type of structure is largely used for upholstery fabrics, and also for silk plushes in which a cut pile is formed of greater length than is usual. All the pile warp may be brought from the same beam, but the weaving is facilitated by using separate slackening bars for the odd and even pile threads.

The designs A and B in Fig. 415 are alike, except that the former is arranged for hand-wiring, and the latter (in which it will be noted that the interweaving

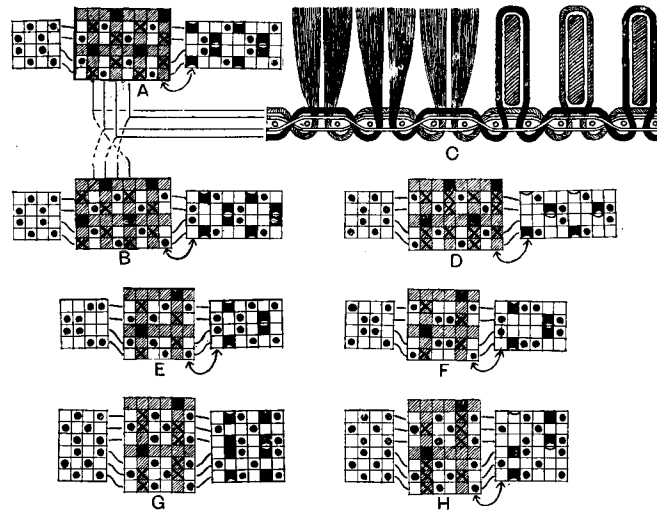


Fig. 415.

of each pile end cuts with the weave of the ground end on the right) for power-wiring. In both cases the threads interweave in the manner represented at C, the pile threads passing over the wires in alternate order. The threads in A and B are arranged in the proportion of one ground to one pile, and there are two picks to each wire—that is, there are four picks between the wires over which each pile thread is raised. The pile threads are firmly stitched into the foundation, and each is down on the picks that precede and succeed the wires over which it is raised, while the picks between which a wire is inserted are in the same shed. The term “Utrecht velvet” is applied to the structure. The weave of the ground threads is 2-and-2 warp rib, but the ground and pile weaves together form a 2-and-2 hopsack foundation. Suitable weaving particulars are:—Pile warp, 2/32's mohair; ground warp, 2/20's cotton; 64 threads per inch. Weft, 2/20's cotton; 64 picks and 32 wires per inch.

The design D in Fig. 415 is also arranged one ground to one pile, and two picks to one wire, and the ground weave is 2-and-2 warp rib. In this case, however,

the pile threads are not firmly stitched into the foundation, as each is raised over three picks preceding the wire over which it is passed. A very full, soft, and lofty pile results, which, however, readily frays out if friction is applied to the underside of the cloth.

In the designs E and F in Fig. 415 there are two ground threads to each pile thread, and two picks to each wire; the threads interlace in a similar manner to the example shown at C. In both E and F the weave of the ground threads is 2-and-2 hopsack, which, however, is arranged in different positions in relation to the pile interlacing, with the result that the complete foundation weave of E is 2-and-2 warp rib, and of F 3-and-2 hopsack; the former foundation being much firmer than the latter.

The designs G and H in Fig. 415 are arranged three picks to one wire, and in each case the pile threads are firmly bound in with as little float on the back as possible. In G each pile thread is down on the picks that precede and succeed the wire over which it is raised, but in H each is raised on the three picks preceding the wire.

Backed and Double Foundation Cloths.—In fabrics in which the pile threads are not firmly stitched in, the liability of the pile being disturbed by friction may be almost entirely eliminated by making the cloths backed or double. Also, in cases where the cloth is raised on the under side in order to increase its softness and warmth, such an arrangement is useful, as the

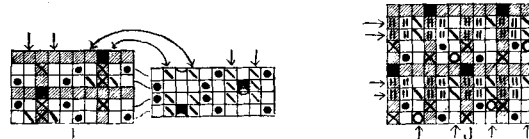


Fig. 416.

pile floats on the back are concealed by the additional threads, and are, therefore, not acted upon in the raising process. The design I in Fig. 416 shows a modification of E in Fig. 415 in which the pile threads are not firmly bound in; and an additional (backing) warp thread is introduced on each side of each pile thread where indicated by the arrows. The additional threads are interwoven as shown by the diagonal marks; on the underside (as shown on the right of I) they have a float of three between which the pile threads are woven into the foundation and concealed.

The design J in Fig. 416 shows a double cloth style which is suitable for a raised finish on the underside. The face texture exactly corresponds to the design B in Fig. 415, but additional warp and weft threads are introduced (where indicated by the arrows) which form a cloth with a four-thread weft sateen surface on the underside. In the design the full squares represent the pile threads raised over the wires, and the crosses the same threads raised over the picks; the dots show where the face ends pass over the face ground picks, the diagonal marks where the backing ends pass over the backing picks, the circles where the backing ends pass over the face picks in order to stitch the back cloth to the face, and the double vertical marks where the ends of the face texture are raised on the backing picks.

Warp Pile Astrakhan Textures.—The designs given in Fig. 417 are used for warp pile Astrakhan structures, the typical curly appearance of which is enhanced by using for the pile warp thick worsted yarn which has been subjected to a boiling process while wound round spindles or twitched tightly in the hank. The pile threads are usually raised alternately on the wire sheds, and in most cases are

lifted on several picks preceding, as shown at A and B ; but they are always firmly bound into the foundation. The design C shows a modification in which the pile threads are raised over the wires in 4-sateen order. In the design D the odd pile threads are raised over all the wires, while the even threads are raised alternately ; by having the former in finer yarn than the latter, and bringing the two series from separate beams, different heights of pile are obtained. Generally, the Astrakhan structure is made in looped pile ; the design E shows how both cut and looped may be combined in the same cloth, by using one kind of wire on the sheds in which the circles are indicated, and the other kind where the full squares are inserted.

Reversible Warp Pile Structures.—Warp pile cloths that are to be used as hangings are sometimes made with a cut pile on both sides. A method of accomplishing this is illustrated at A in Fig. 418, and the corresponding section given at B, which shows how the warp threads interlace. Half the pile is over each wire, and in this case, after the insertion of a wire, an extra pick is intro-

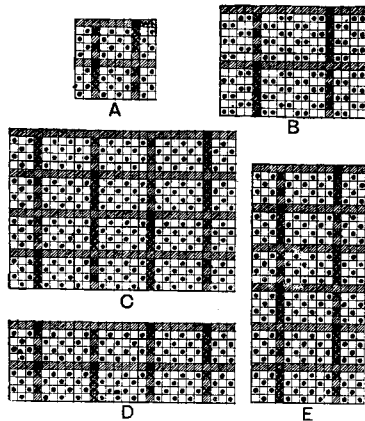


Fig. 417.

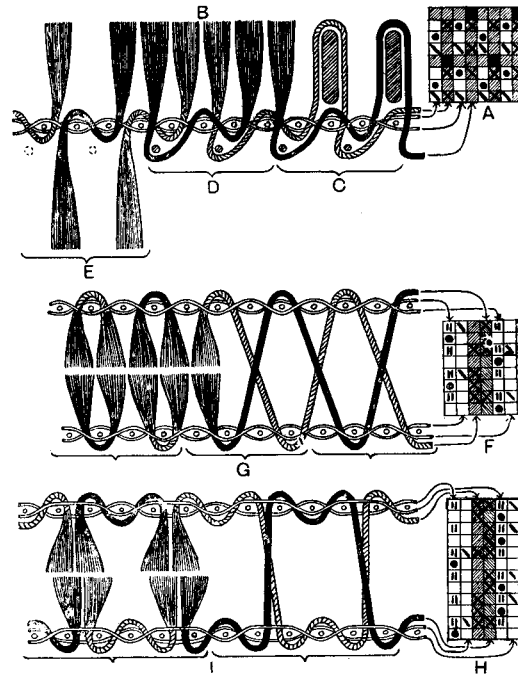


Fig. 418.

duced on which all the ground ends are raised (as shown by the diagonal marks in A), and alternate pile ends. In the section B the extra picks are indicated below the level of the plain ground threads, while one pile thread is shown shaded and the other solid in order that the system of interlacing may be readily seen. Exact repeats of the weave are indicated by the brackets, the portion lettered C representing the cloth previous to, and D following, the withdrawal of the wires. After the cloth is woven, the extra picks, which are usually thicker than the ground picks, are drawn away from the underside of the cloth ; this causes one-half of each double tuft to pass to the reverse side, as shown in the section E, where the dotted circles indicate the positions which the extra picks previously occupied.

Double Plush Weaving.—The plans F and H and the corresponding sections

G and I in Fig. 418 show two methods of interlacing the threads in "double plush" weaving, in which, without the use of wires, two separate cut warp pile fabrics are produced at the same time. This system is employed to a considerable extent, as the production of a loom is much greater than when wires are used; but the pile is less regular, and a long pile cannot be obtained. Each cloth has a distinct series of ground warp and weft threads; the pile threads are common to both cloths, and pass from one to the other, as shown on the right of G and I. As the weaving proceeds the pile threads are cut by means of a knife which is run horizontally between the cloths, the pile being formed on the lower side of the upper cloth, and on the upper side of the lower cloth, as shown on the left of the drawings. In each case the brackets indicate exact repeats of the weave; in F and G the ground weave is plain, and in H and I, 2-and-1 warp rib. In the latter each pile tuft is firmly bound into the foundation.

Ornamentation of Plain Warp Pile Fabrics.— After weaving, the plain pile structures are ornamented in various ways. An imitation of Astrakhan is obtained in the plain Utrecht structure by tying the cloth tightly with twine while it is in a crumpled condition, and boiling it in water. The pile surface may be figured by printing, or embossed effects be produced



Fig. 419.

by submitting the cloth to the pressure of engraved rollers. In the latter method the pile, where the figure is required, may be pressed down, while that in the ground sections, which stands vertically from the foundation, is partially cut away. The flattened pile is then raised, with the result that a distinct pile figure is formed. An illustration of this style is given in Fig. 419, in which the arrangement of the threads and the system of interlacing correspond with the example shown at I in Fig. 416.

A design may also be produced, as in tapestry pile carpets (see p. 437), by

printing—previous to the weaving operation—a figure on the pile yarn in an elongated form, the degree of elongation varying according to the amount of contraction of the pile threads.

During manufacture, the plain structures may be ornamented by introducing differently coloured pile threads so that stripes are formed ; while a check appearance may be given to the cloth, as shown in the fabric represented in Fig. 420, by afterwards pressing down the pile in transverse bars. This is an illustration of a silk plush fabric, the structure of which corresponds to the example given at D in Fig. 415.

A variation in the structure may be produced by employing both cutting and

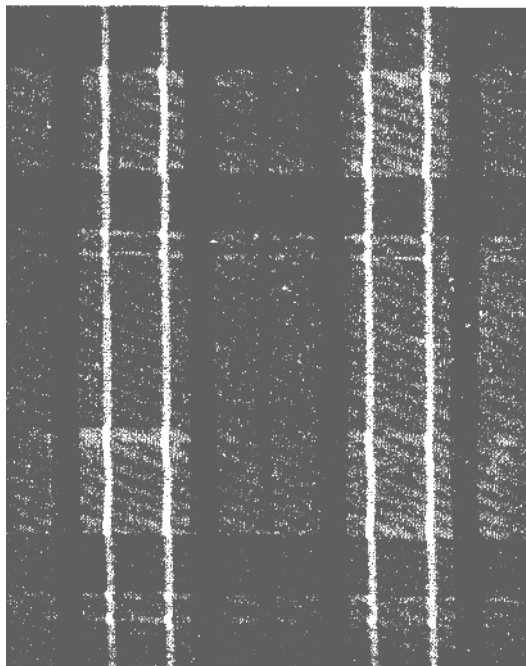


Fig. 420.

looping wires, or by using two different heights of wires ; whilst both systems may be employed in conjunction with differently coloured pile threads. Thus, in the examples A, B, and C in Fig. 421, the differently shaded spaces indicate—horizontally—different forms of wires and—vertically—different colours of pile warp. In A and B the full squares may represent cut pile in one colour, and the circles looped pile in another colour ; or one colour may be developed in a longer pile than the other. In C each colour of pile is developed in two ways, as, for instance, the full squares may indicate cut pile and the circles looped pile in one colour, and the horizontal and vertical strokes cut and looped pile respectively in the other colour. Stripes of cut and looped pile, in one or more colours, may be produced in the manner shown at D, in which the brackets denote the different

sections. The structure in each section corresponds to the example given at I and N in Fig. 411.

Stripe and Check Designs.—A form of ornamentation obtained without having recourse to a jacquard machine consists of combining the pile structure with other forms of interlacing in stripe and check form. The design E in Fig. 421 is an illustration of a stripe composed of pile and 2-and-2 warp rib. The pile interlacing corresponds with E and G in Fig. 410, while the rib stripe is simply a continuation of the weave of the ground threads, and can, therefore, be produced by the same healds. Different widths of stripes can be obtained by repeating the sections enclosed by brackets.

The design F illustrates the formation of alternate squares of pile on a warp rib ground, with longitudinal spaces of ground between, which may be coloured different from the pile sections. There are two picks to each wire, and the warp is arranged 1 worsted ground, 1 worsted pile, and 1 cotton; the worsted threads work in pairs except on the wire sheds, in order to develop the rib formation. The rib structure is made more pronounced by weaving the cotton ground threads at greater tension than the worsted ground threads, and by wefting one pick fine, one pick coarse. Four warp beams are necessary — viz., two for the pile threads and one each for the worsted and cotton ground threads, while six shafts are required, as shown in the draft indicated at G.

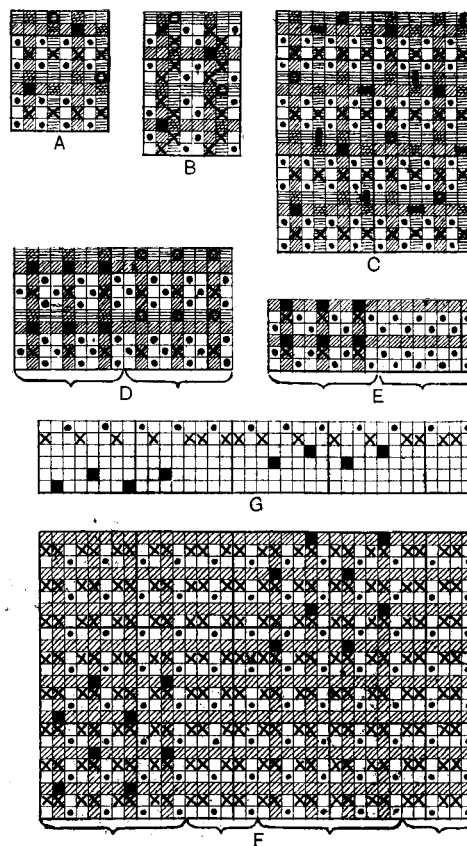


Fig. 421.

CHAPTER XIX

FIGURED WARP PILE FABRICS

Figuring with Cut and Looped Pile. Warp Pile Figuring on Ordinary Weave Grounds—Pile Figuring with Extra Threads—Figuring with Pile Threads which interweave in the Ground—Combinations of Pile and Figured Warp Rib. Combinations of Pile and Double Plain Cloth. Combination of Pile and Weft Figure. Looped Pile and Warp_Rib Figure on Cut Pile Ground.

FIGURING WITH CUT AND LOOPED PILE

THIS type of structure, an illustration of which is given in Fig. 422, is largely used for upholstery purposes, the ground warp being composed of cotton or linen, the



Fig. 422.

weft of cotton, and the pile warp of worsted. There is only one series of pile threads, but each thread forms either cut or looped pile continuously, so that the surface of the foundation is entirely covered by the pile—the cut and loop structures alternating according to the form of the design. In order to provide a suitable background to the pile the ground warp and weft are generally dyed before weaving, whereas the pile yarn is woven in the grey or natural state, and is dyed in the piece. Although subjected to the same dye, there is such a difference in the reflection of the light from the looped and cut pile surfaces that one appears quite distinct from the other. The looped pile, which generally forms the figure, reflects the light more directly to the eye of the observer, and appears lighter and brighter than the

cut pile; the rays of light penetrate more readily in the cut pile sections and become saturated with the colour, and when they are reflected they are dispersed in all directions by the innumerable points of the fibres, so that the colour appears deep and rich.

The structure of the cloth, shown in Fig. 422, corresponds to the example given at B and C in Fig. 415, except that both a cutting and a looping wire are introduced after the insertion of each pair of ground picks. The following are suitable weaving particulars :—Pile warp, 2/30's worsted; ground warp, 22's linen; 32 pile and 32 ground ends per inch; weft, 15's cotton; 64 picks, 32 cutting, and 32 looping wires per inch; depth of wires, $\frac{1}{8}$ inch. The pile warp requires to be from five to six times as long as the ground warp. As shown in the draft given at A in Fig. 423, the ground ends are operated by healds placed behind the harness; the latter, on which the pile ends are drawn, is placed as near the fell of the cloth as possible. A convenient method of indicating a design is illustrated at B in Fig. 423, which shows a portion of the effect given in Fig. 422. Each vertical space in B represents a pile thread, and each horizontal space, four sheds—viz., two sheds for the ground picks, one shed for a cutting wire, and one shed for a looping wire. The counts of the design paper is, therefore, based upon the proportion of pile threads per inch to wires of each kind per inch, or with the foregoing particulars as $32 : 32 = 8 \times 8$ design paper.

The figure is indicated lightly in colour on the design paper; then plain weave is inserted on both the figure and the ground, the marks representing the lifts of the pile threads. Different marks, however, are used for the respective sections; thus, in B the full squares represent lifts on the cutting wire sheds, and the dots lifts on the looping wire sheds. It is generally sufficient to insert the plain weave at the edges of the figure, as shown in the upper portion of B. It is an advantage to indicate lifts, as when a narrow line of an effect is required it can be seen that the proper marks are inserted to make the line continuous and of sufficient prominence. One-half the pile threads are raised on one pair of wires (those required up for a cutting wire being left down for a looping wire, and *vice versa*) and the other half on the following pair. Therefore, so long

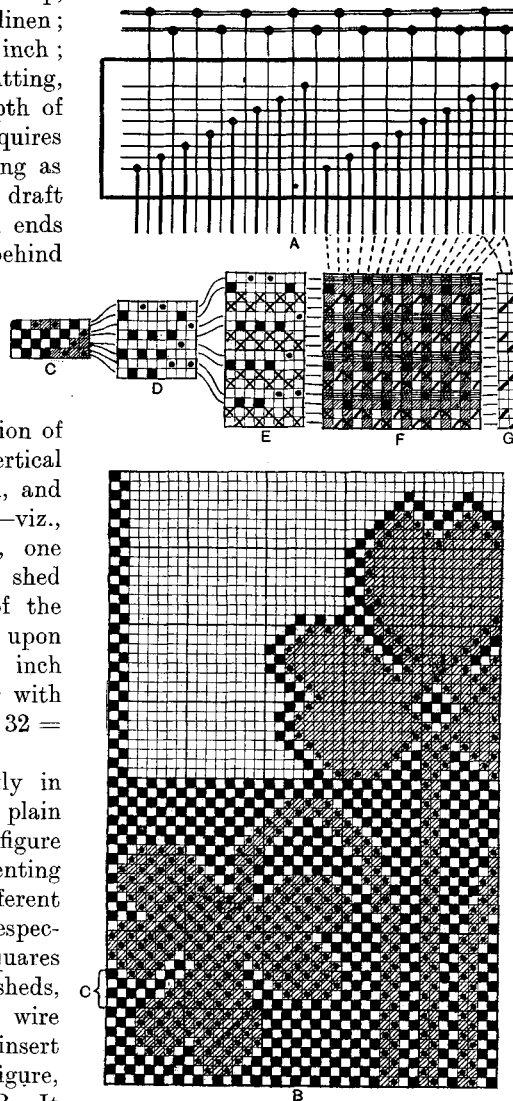


Fig. 423.

as both kinds of wires are of the same depth, the take-up of the pile warp is uniform, and all the pile threads may be brought from one beam.

The gradual development from the design to the complete structure is illustrated at C, D, E, and F in Fig. 423. C corresponds with the bracketed portion on the left of B; D shows how the figuring cards alternate, the full squares in each horizontal space of C being cut on the first card and the dots on the second; E shows the full effect produced by the jacquard, two plain cards for the ground picks being introduced between the pairs of figuring cards; and F shows the complete structure

produced by the combined action of the jacquard and healds, the latter being raised alternately on each pair of ground picks, as indicated at G.

A great saving in cards may be effected by mounting the harness on the knotted comber-board principle, with the tie arranged as shown in Fig. 424, as the plain cards, which in an ordinary mounting are used to raise the pile threads on the ground picks, may be dispensed with. The draft of the warp threads is represented in the lower portion of Fig. 424, and in the upper portion the hooks C are shown specially connected with the needles D; lines indicate how the knotted harness cords pass from the neck cords to the separate comber-boards A and B. The odd pile threads are drawn on the harness cords which pass through the comber-board A, and are controlled by the odd needles; while the even pile threads are drawn on the cords which pass through the comber-board B, and are controlled by the even needles. With this arrangement the designing is the same as for an ordinary machine, and the harness cords are perfectly straight when the card cylinder is at the front or back of the jacquard. On one ground pick of each pair the board A and the heald No. 1 are raised by means of tappets, and on the other ground pick the comber-board B and the heald No. 2, during which the jacquard is stationary.

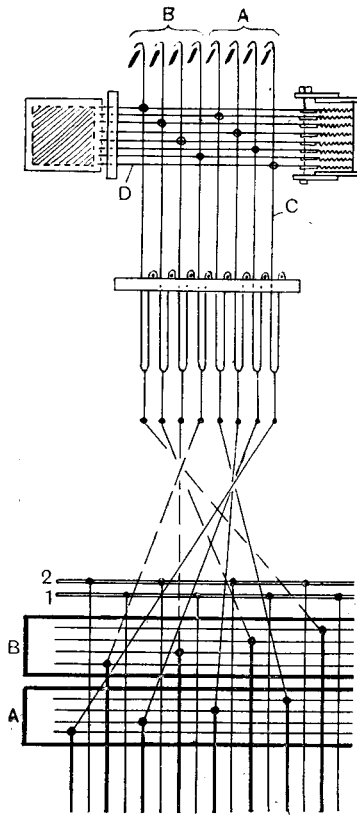


Fig. 424.

The comber-board and the healds are then stationary while the jacquard lifts the pile threads on the cutting and the looping wire sheds in succession.

WARP PILE FIGURING ON ORDINARY WEAVE GROUNDS

In these styles the pile threads are not forming pile all the time, and the amount of take-up of the threads varies. It is, therefore, necessary for each pile thread in the repeat of a design to be run off a separate bobbin; each bobbin may carry as many threads as there are repeats of the design in the width of the fabric.

In some cases the bobbins are supported in a vertical creel placed at the rear of the loom ; but in weaving fine silk plushes, for which small bobbins are employed, they may be placed in a horizontal frame, fixed underneath the ground warp. Each bobbin is so constructed that a cord and weight may be connected to it to give the required tension.

Pile Figuring with Extra Threads.—Fig. 425 illustrates a cloth in which a cut pile figure (similar in structure to the example given at E and G in Fig. 410, p. 398) is formed on a check foundation. The pile threads are extra, and, where not forming pile, float loosely on the back of the cloth, from which they are afterwards brushed away. At the upper and lower edges of a figure one-half of each double tuft is, therefore, removed from the surface of the cloth ; a feature which requires to be taken into account in drafting a design, although in the case of a

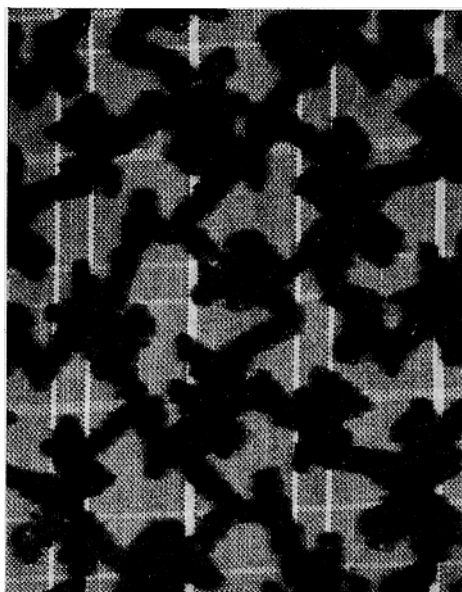


Fig. 425.

massive figure it is not of much importance. The ground ends work in 2-and-2 order with the picks throughout, hence a heald-and-harness draft, as indicated at A in Fig. 426, may be employed. All the pile threads are over each wire ; therefore, in indicating a figure on design paper it is marked solid, as shown at B in Fig. 426. The complete structure of the first 16 ends and 8 picks of B is given at C, in which it will be seen that there are two ground threads to each pile thread, and two picks to each wire ; while where the figure is formed the pile threads are raised on the pick which precedes a wire. If an ordinary jacquard is employed a separate card is required for each shed, so that each horizontal space of B represents three cards. On the first ground pick all the pile threads are left down, a blank card being used ; on the second ground pick and the wire shed following,

the pile threads are raised where the figure is formed, hence the marks of the design are cut the same on two successive cards. One figure card will serve for the three sheds, however, if the jacquard is driven by means of a tappet which makes one revolution for every three revolutions of the crank shaft, and if the tappet is so

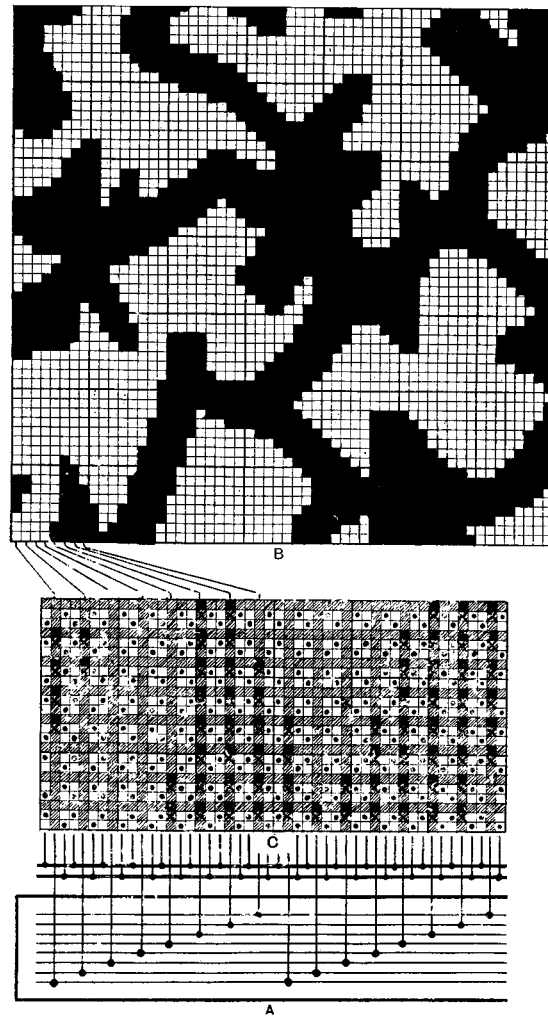


Fig. 426.

shaped that the griffe is lowered on the first ground pick and raised on the second ground pick and the wire shed following.

The foundation texture may be varied in the 2-and-2 warp rib ground weave by the way in which the warp and weft threads are balanced. In the example represented in Fig. 425 there are nearly twice as many picks as ground ends per inch, and the weft is finer than the warp, so that the texture appears like plain

cloth, and the ground warp and weft colours are about equally prominent. On the other hand, if more ends than picks per inch, and finer warp than weft, were employed, a pronounced warp rib ground texture would be formed which, while

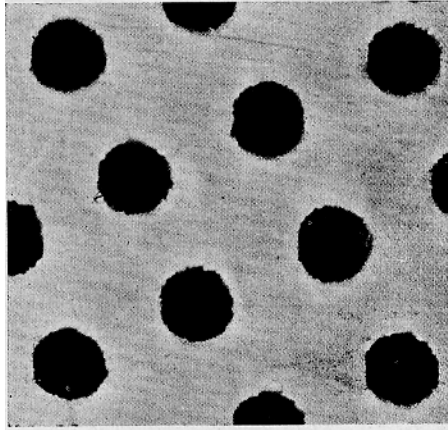


Fig. 427.

concealing the weft, would bring a lustrous ground warp prominently to the surface.

In the cloth represented in Fig. 427, extra warp spots in cut pile are formed

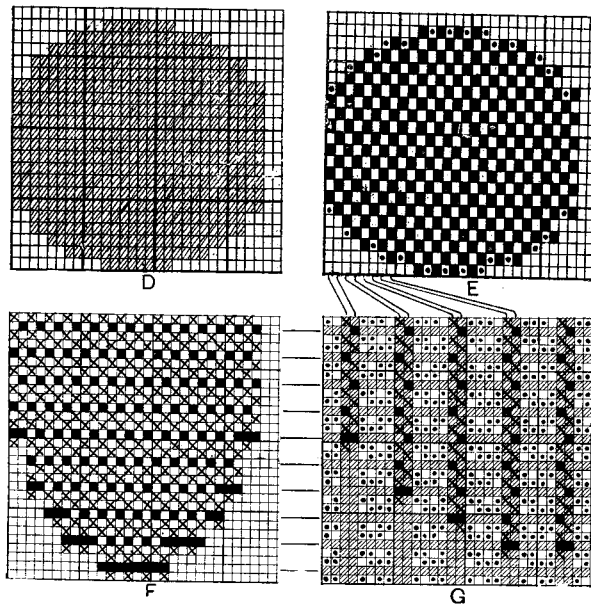


Fig. 428.

on a warp sateen ground texture, from the underside of which the surplus threads are removed where they are not required to form the figure. In the warp there

are four ground threads to two pile threads, and two picks are inserted to each wire. The ground ends, which interweave in 4-warp sateen order in both the ground and under the figure, may be operated by four healds placed behind the harness; therefore, in the designing it is only necessary to consider the figure. The form of a spot is indicated at D in Fig. 428, the pile threads being shown in



Fig. 429

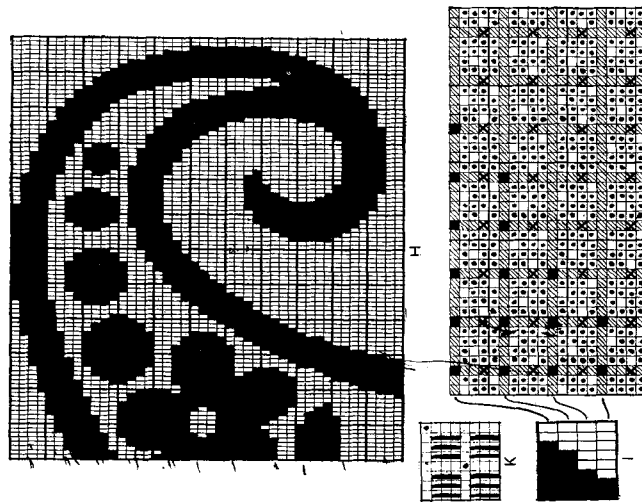


Fig. 430.

pairs; while E shows a corresponding form ready for the card-cutting, the marks representing the lifts of the pile threads. The alternate pile threads only are raised over each wire, hence plain weave is inserted over the figure, as shown by the full squares. At the upper and lower edges, however, additional marks are put in, as shown by the dots, in order that all the threads will be raised at these places

and thus compensate for the removal of the tufts, which, in this structure, would otherwise make the edges of the figure appear thin.

Each horizontal space of the plan E represents two picks and a wire, and three cards are cut from each as follows:—For the wire shed, cut the marks of the figure; for the weft sheds, cut the figure except where the full squares are inserted—two cards alike, one of which is placed before, and the other after the wire card. A portion of the pile effect, as cut on the cards, is shown at F, while G represents the complete structure of the first 10 threads of F, including the ground threads.

In the example represented in Fig. 429, the pile threads are extra, but in this case they are bound in on the back of the cloth. The ground weave is 8-thread warp sateen throughout, and the threads are arranged four ground to each pile, and four picks to each wire, to fit with the repeat of the sateen weave. Where the figure is formed, all the pile is brought over each wire, and as the pile threads may be operated by eight healds placed behind the harness the figure is designed solid,

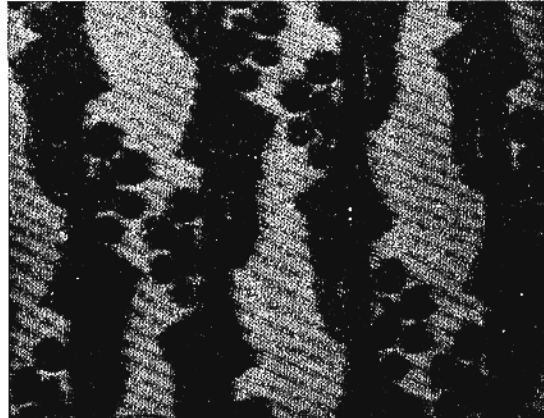


Fig. 431.

as shown at H in Fig. 430. Each horizontal space of H represents five cards—viz., three blank cards for the first, third, and fourth picks; one card all cut for the second pick, on which the pile threads are bound in; and one card for the wire on which the marks of the figure are cut. A sectional plan is given at I, and the corresponding effect at J, which illustrate the development from the solid design to the complete structure of the cloth, including the weave put in by the healds. The pile threads, each of which is composed of three threads, are stitched on the back of the cloth in 3-and-1 order. The warp is very finely set, and the pile threads spread out and cover the underside of the foundation texture, which, therefore, has the appearance of a warp rib, similar to the effect shown at K.

When the pile threads only are operated by the harness, the counts of the design paper is in the proportion of the pile threads per inch to the wires per inch. Thus, for the cloth illustrated in Fig. 429, which has 280 ground and 70 pile threads per inch, and 128 picks and 32 wires per inch, the counts of the design paper is in the proportion of 70 to 32, or 8×4 nearly.

Figuring with Pile Threads which Interweave in the Ground.—In the cloth

illustrated in Fig. 431 the pile threads are not extra ; they form figure, and then interweave in the foundation in the same manner as the ground threads. The latter are black cotton, and the pile threads black worsted, while the weft is coloured mercerised cotton. There are three ground threads to each pile thread, and three

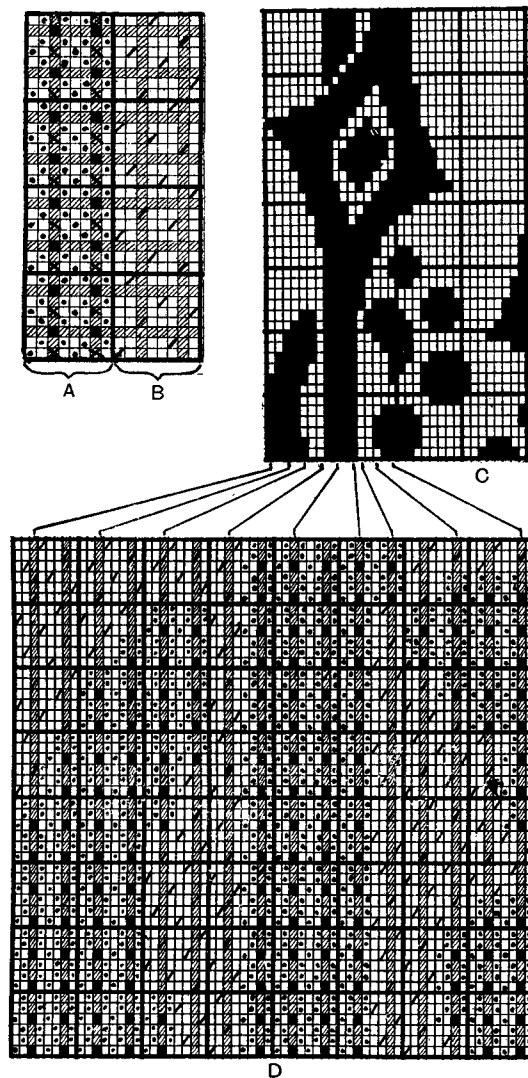


Fig. 432.

picks to each wire ; and the cloth contains 136 ends and 81 picks per inch. In the pile figure the weave is as shown at A in Fig. 432 (which corresponds with the example given at D in Fig. 412, p. 400), and in the ground as indicated at B. The weft sateen weave in the ground covers the warp, so that a black worsted

pile figure is formed on a coloured cotton foundation. As the weave of the ends is different in the pile and ground sections it is necessary for all the warp to be controlled by a jacquard. A figure may, however, be first designed solid, as shown at C in Fig. 432, which corresponds with a portion of the effect given in Fig. 431; the counts of the design paper is in the proportion of $136 \div 4$ to $81 \div 3$, or 8×6 paper. The full plan for the card-cutting may then be readily constructed, each vertical space of C representing four threads, and each horizontal space three picks and one wire. It is, however, unnecessary to include the wire sheds in the enlarged plan (which only makes the insertion of the sateen ground weave more difficult), as these lifts may be indicated by using a special kind of mark to represent where the pile threads are raised over the weft in the figure. Thus, in D, Fig. 432, which shows the card-cutting plan of the first 16 ends and picks of C, a wire shed occurs between the second and third of each group of three picks. A card is cut from

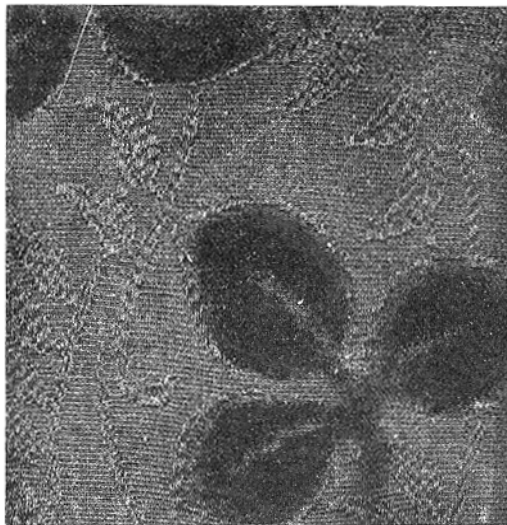


Fig. 433.

each horizontal space of D for the weft sheds, all the weave marks being cut, while the cards for the wire sheds are obtained by cutting the full squares only on the first pick of each group of three. Then the complete order of lacing is two ground cards, one wire card, and one ground card in each group.

Combinations of Pile and Figured Warp Rib.—In the fabric shown in Fig. 433 the pile threads are interwoven in the ground; but in this case they are brought prominently to the surface of the cloth in the form of a warp rib, and they are also used for figuring in the ordinary manner. This method is largely employed, as by it the more costly threads are made use of to the greatest advantage. Two systems of combining the pile with a figured warp rib are illustrated in Fig. 434. In the first system the threads are arranged two ground to each pile and two picks to each wire, and the pile threads are raised alternately over the wires. The ground threads interweave with the weft in plain order throughout; hence they may

be drawn on to two healds placed behind the harness in the manner illustrated

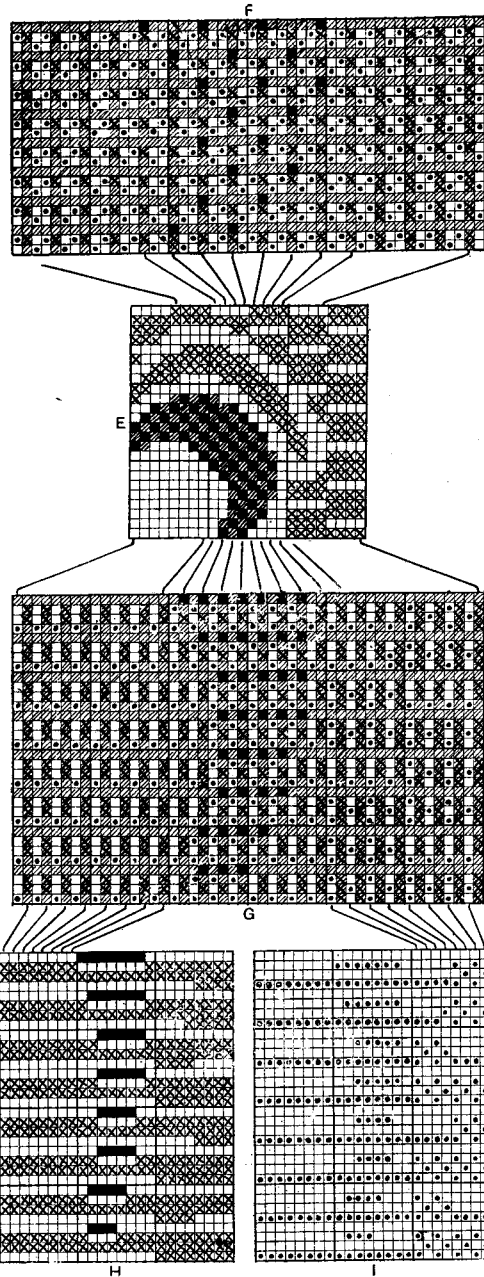


Fig. 434.

the centre pick of each group of three is much thicker than the first and third.

at A in Fig. 426. A design is then drafted as shown at E in Fig. 434, in which each vertical space represents a pile thread, and each horizontal space two picks and a wire. The pile figure is indicated by a wash of colour, and plain weave is inserted over it, as shown by the full squares on the shaded figure in E; the crosses represent the warp figure, and the blanks the rib ground. From each horizontal space three cards are cut as follows:—First card, cut the crosses; the second card is all cut; third card, cut the full squares. The complete structure of 16 ends and 8 picks of the plan E is shown at F, in which it will be seen that on the even picks the odd ground ends are always raised along with the pile ends. These ends are given in more rapidly than the even ground ends, which are held very tight, so that they help the pile ends in forming the rib, the prominence of which is further accentuated by employing thick weft for the even picks and fine weft for the odd picks.

The second system of combining pile with figured warp rib is illustrated at G in Fig. 434, which shows the complete structure of the first eight picks of the plan E. The ends are arranged one ground, one pile, and where the pile is formed all the pile threads are raised over the wires; hence the pile figure is cut solid and not plain as indicated in E. There are three picks to each wire, and in the rib ground the ground threads are raised on the first pick and the pile threads on the second and third picks. In

In this arrangement the ground threads work differently in different sections of the cloth; therefore they cannot be operated by healds, but must be drawn on the harness. If an ordinary harness draft is used the design will require to be indicated in full for the card-cutting, as shown at G. By employing a sectional harness tie and draft, however, such as is illustrated in Fig. 183 (p. 157), the cards may be cut from the solid plan. In the example the ground and pile threads are in equal proportions, therefore the hooks are divided into two equal parts A and B, and the harness cords are passed through separate longitudinal divisions A and B of the comber-board to correspond. The pile threads are drawn through the harness mails of the comber-board at the front, and the ground threads through those of the comber-board at the back, as represented in the lower portion of Fig. 183. The lifts of the pile threads are cut on the first half of each card, and of the ground threads on the second half, four cards being cut from each horizontal space of the plan E in Fig. 434, as follows:—

	Pile Section A.	Ground Section B.
First card, .	Cut the crosses.	Cut the pile figure, the blanks, and the crosses plain.
Second card,	All cut.	Cut the crosses reversed plain.
Third card,	Cut the crosses and the blanks.	Cut the pile figure and the crosses plain.
Fourth card,	Cut the pile figure.	All blank.

In order that a comparison may be made, the lifts that are cut on the pile and ground sections of the cards, from the first eight picks of E, are shown separately at H and I in Fig. 434; the combination of the harness tie and the draft produces an alternate arrangement of the threads, with the result that in the cloth the structure is as shown at G.

COMBINATIONS OF PILE AND DOUBLE-PLAIN CLOTH

The example illustrated in Fig. 435 shows a further development in which the pile is combined with warp rib, warp figure, and double-plain cloth, the respective sections being represented at J in Fig. 436 by the full squares, blanks, crosses, and shaded squares. The complete weaves of the several structures are shown at K; the arrangement in the warp is 2 silk, 1 cotton; and in the weft, 1 fine silk,



Fig. 435.

1 thick worsted, 1 fine silk, 1 wire. The silk ends work in pairs in the rib ground and warp figure; but in the pile section only one of each pair is raised over the

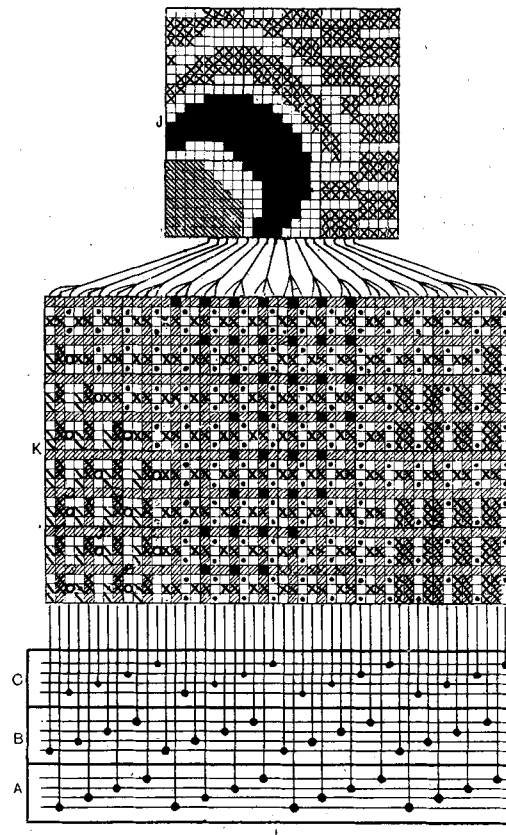


Fig. 436.

wires, the other, along with the cotton end, forming the ground under the pile. In the double-plain section (in which the circles and diagonal strokes are shown in K) the silk ends form plain cloth on the surface with the silk picks, while the cotton ends similarly form plain cloth with the thick worsted picks on the back. In the rib ground the surface is spotted by the silk picks, which float over the silk ends and under the cotton ends. In an ordinary harness tie and draft this style requires to be designed in full, as shown at K, whereas with a sectional harness tie and draft the cards may be cut from a design marked solid, such as is indicated at J. In this case, as there are three series of ends, the hooks are divided into three sections, from each of which the harness cords are passed through a corresponding longitudinal section of the comber-board. The draft is then as shown at L in Fig. 436, in which A represents the pile warp section, B the silk warp section, and C the ground warp section. In cutting the cards

from the solid plan J, four cards are cut from each horizontal space, as follows:—

	Pile Section A.	Silk Section B.	Ground Section C.
First card, .	Cut the crosses.	Cut the crosses and the shaded squares.	Cut the blanks, the full squares, and the crosses plain.
Second card,	All cut.	All cut.	Cut the shaded squares plain
Third card,	Cut the crosses and the shaded squares.	Cut the crosses.	Cut the blanks, the full squares, and the crosses reversed plain.
Fourth card,	Cut the full squares.	All blank.	All blank.

The cloth illustrated in Fig. 437 consists of a worsted pile figure on a double-plain silk crepon ground, but in this case the pile threads are only brought to the surface where the pile figure is formed. The structure is indicated in Fig. 438, where M shows a small plan in which the marks represent the pile figure and the

blanks the double-plain ground ; while the complete design to correspond is given at N. The warp is arranged 1 cotton, 1 worsted pile, 2 silk, and the weft, 2 silk, 1 wire, 1 worsted ; in the worsted pile section the threads form a single cloth, while in the double-plain ground the silk ends and silk picks form the face, and the cotton and worsted ends and the worsted picks the back. The crepon effect

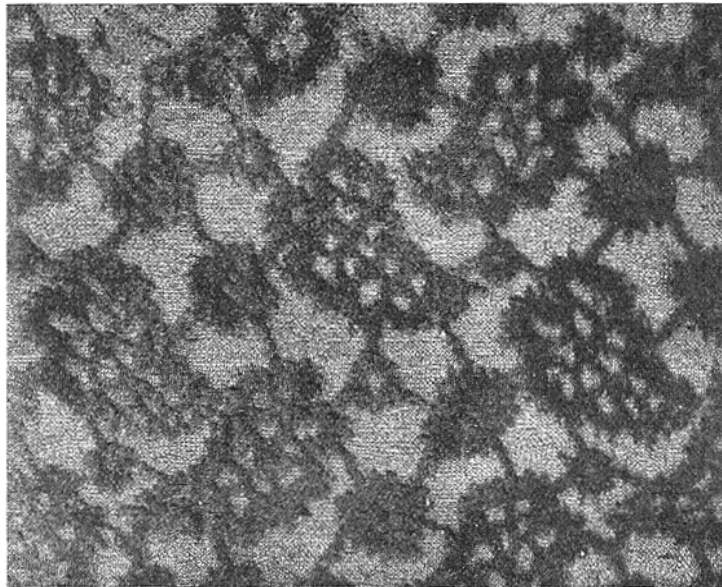


Fig. 437.

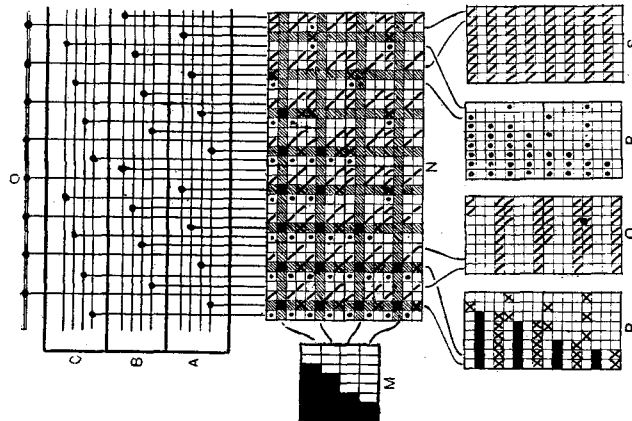


Fig. 438.

is developed in the double plain by having the worsted weft hard twisted, which causes it to shrink when the cloth is submitted to moisture in the finishing operation. The first of each pair of silk ends works exactly the same in both the pile and the double plain, therefore these ends may be operated by a heald. By combining the heald draft with a sectional harness tie and draft, as represented at O, the

cards may be cut directly from a condensed plan such as is shown at M. The pile threads are drawn on Section A, the silk threads on the heald and section B, and the cotton threads on section C. Four cards are cut from each horizontal space of the solid plan, as follows :—

	File Section A.	Silk Section B.	Cotton Section C.	Heald.
First card, .	Cut the marks.	All cut.	All blank.	Depressed.
Second card,	All blank.	All blank.	Cut the marks.	Raised.
Third card, .	Cut the marks.	All blank.	All blank.	Depressed.
Fourth card,	Cut the blanks plain.	Cut the blanks.	Cut the marks, and the blanks plain.	Raised.

The lifts that are cut from the plan M on the different sections of the cards are indicated separately at P, Q, and R, while S shows how the threads are raised by the heald ; the threads are combined in the cloth in the order shown in the draft O, and the structure given at N results.

COMBINATION OF PILE AND WEFT FIGURE

The weft may be employed for figuring in conjunction with the pile, and in Fig. 439 a cloth is represented in which, between the pile sections, a figure is formed in two colours of weft. The pile threads are extra, and where not forming pile are floated on the back and are afterwards removed. The method of designing

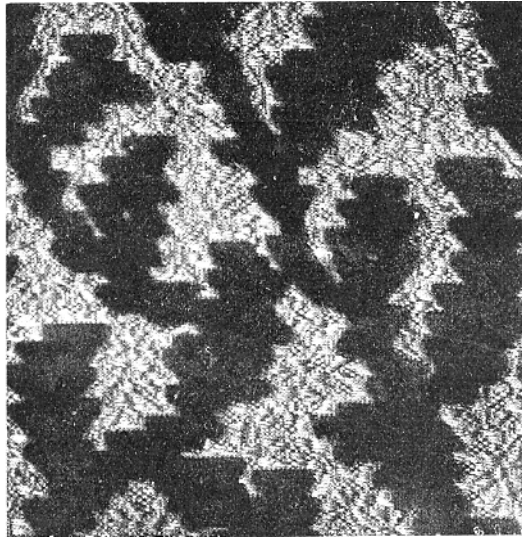


Fig. 439.

is illustrated at T in Fig. 440, the full squares indicating black pile figure, the circles gold weft figure, the diagonal strokes purple weft figure, and the blanks 2-and-2 warp rib ground. The complete structure of the centre 32 threads of the last eight picks of T is indicated at U ; the arrangement in the warp is 1 cotton, 1 silk pile, 1 cotton, and in the weft, 1 gold silk, 1 wire, 1 purple silk. All the marks in U represent lifts except where the faint circles are inserted to show the figuring

weft floats. All the warp threads require to be operated by the jacquard, and the most convenient arrangement, as regards the designing and card cutting, is a

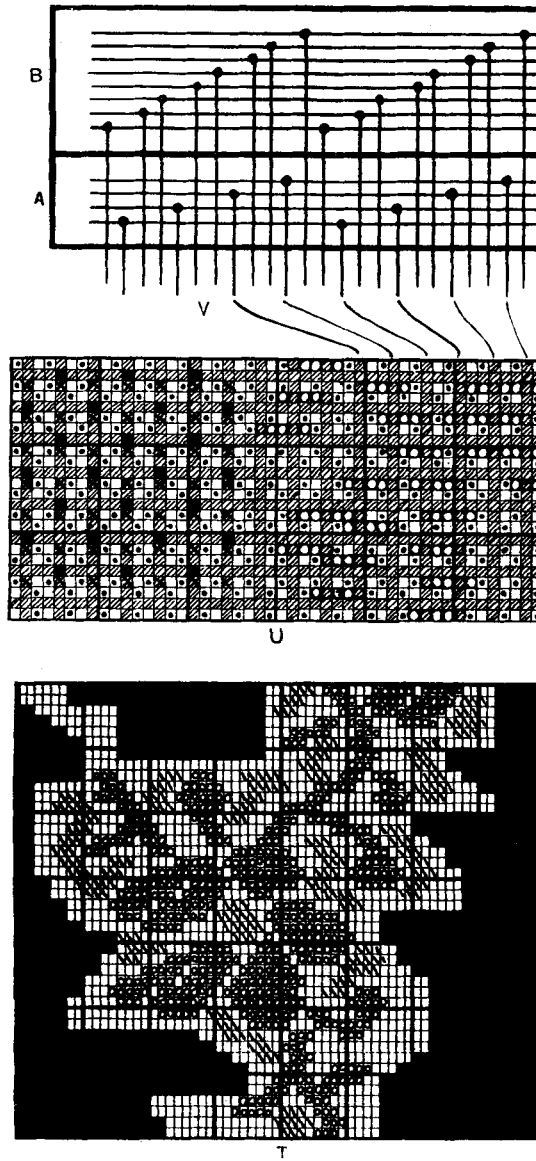


Fig. 440.

sectional harness tie and draft. In this case there is one pile thread to two ground threads, so that the former will occupy one-third of the hooks, and the latter two-thirds; while the corresponding longitudinal sections of the comber-board

will be in similar proportions, as shown at A and B in the draft indicated at V. In the plan T each vertical space on the design paper represents a ground thread, whereas two spaces represent a pile thread, and for this reason at the edges of the pile figure the moves are marked in pairs of ends. In the cloth there are 64 ground and 32 pile threads per inch, and 90 picks and 45 wires per inch; the counts of the design paper is in the proportion of 64 ends to 45 picks of each colour per inch—viz., 8×6 . Three cards are cut from each horizontal space of T, as follows:—

	Pile Section A.	Ground Section B.
First card (gold weft) . . .	Cut the full squares.	Cut plain except the circles.
Second card (wire), . . .	Cut the full squares plain.	All blank.
Third card (purple weft), . .	All blank.	Cut plain except the diagonal strokes.

LOOPED PILE AND WARP-RIB FIGURE ON CUT PILE GROUND

Fig. 441 illustrates an upholstery cloth which consists of looped pile and warp figure on cut pile ground. In the pile structure (both cut and looped) the pile threads are not firmly bound in, but additional backing ends are interwoven on

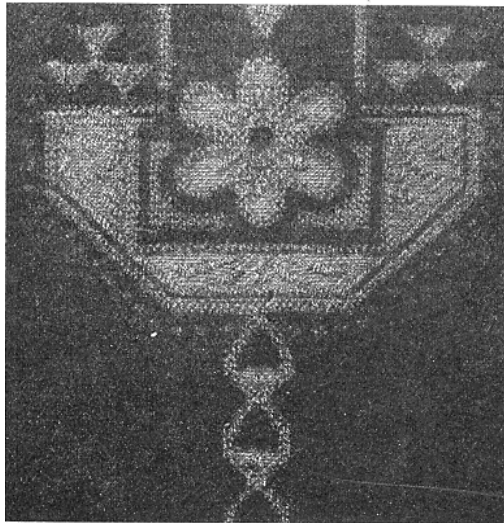


Fig. 441.

the underside to prevent the pile from being displaced. A in Fig. 442 shows a portion of the figure given in Fig. 441, and B the complete structure of a portion of the last eight picks of A, while C represents the heald-and-harness draft. In addition to a separate bobbin for each pile thread in a repeat of the design, one beam is required for the ground warp and another for the backing warp, the former contracting about 4 per cent. and the latter 42 per cent.; where the pile is

formed the ratio of pile warp to cloth is about 5 to 1. The pile warp is 2/36's worsted; the ground warp, two-ply 2/48's cotton; the backing warp, 2/30's cotton; and the weft, 2/36's cotton. The warp threads are arranged 1 ground, 1 backing,

1 pile, 1 backing, with 152 threads per inch; and the weft, 2 picks, 1 cutting wire, 1 looping wire, with 76 picks and 38 wires of each kind per inch. The counts of the design paper is in the proportion of the pile threads per inch (38) and the wires of each kind per inch—viz., 8 × 8. Where the pile is formed the threads are raised alternately over the wires, hence plain weave is inserted in both the cut and the looped pile sections of the design. In A, Fig. 442, the full squares indicate the lifts on the cutting wire sheds, and the dots on the looping wire sheds, while the crosses show where the pile threads form warp figure. Four cards are cut from each horizontal space of A as follows:—First card (ground pick), cut all the marks; the second card (ground pick) is all cut; third card (cutting wire), cut the full squares; fourth card (looping wire), cut the dots. The healds lift in the order indicated at D. In the complete structure of the cloth represented at B the full squares and the dots respectively show where

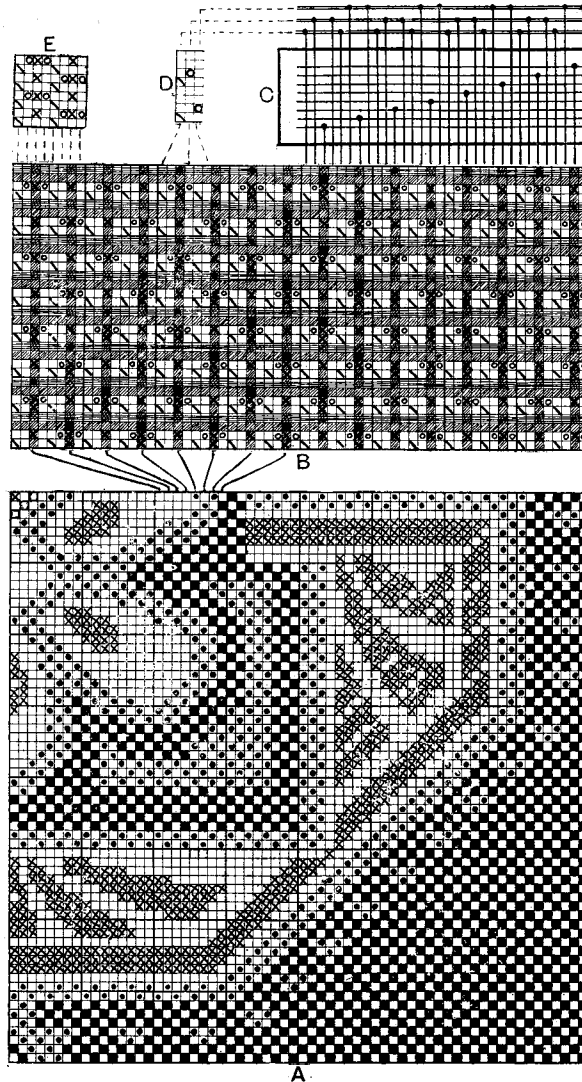


Fig. 442.

the pile threads are raised over the cutting and looping wires, while the crosses indicate where the same threads are raised over the weft; the diagonal strokes show the lifts of the ground ends, and the circles of the backing ends. The warp figure is separated from the pile by a rib ground, the weave of which is shown at E; the lifts of the backing threads assist the pile threads in forming the rib.

CHAPTER XX

FIGURED PILE FABRICS IN WHICH THE DESIGN
IS DUE TO COLOUR

Wilton and Brussels Structures—Comparison of the Cloths—Distinguishing Feature of the Cloths—Planting—Method of Designing—System of Loom Mounting—Card-cutting—Six-frame Mounting—Structure of Wilton Pile—Structure of Brussels Pile—Two-pick Wilton Pile Structure—Moresque Effects—Development of the Colours in both Cut and Looped Pile. *Tapestry Pile Carpets*—Comparison with Brussels and Wilton Structures—Tapestry Pile Designing—Preparation of the Pile Yarn for Printing—The Printing Drum—The Printing Pulley—The Scale Board—Operation of Printing—Beaming the Pile Warp—Structure of Tapestry Pile—Tapestry Pile Weaving. *Chenille or Patent Axminster Pile*—Comparison with Tapestry Pile—Chenille Pile Designing—Formation of the Chenille—Setting—Structure of the Fabric. *Moquette or Royal Axminster Pile*.

SEVERAL important classes of pile textures, which include Wilton, Brussels, Tapestry, and Axminster carpets, and similar but lighter fabrics that are used for hanging and upholstery purposes, are woven with a uniform surface of either cut or looped pile. The chief purpose of the form or figure in these cloths is to serve as a medium for the display of colour. Special machines and processes are employed in their production, which enable the designs to be composed without regard to the method in which the threads interlace. It is only in the Wilton and Brussels structures that the use of a jacquard machine is required in forming the figure.

WILTON AND BRUSSELS PILE STRUCTURES

Comparison of the Cloths.—The principles of designing for Wilton and Brussels carpets, and corresponding hanging and upholstery cloths, are practically the same, while the cloths are very similar in structure. The chief differences between them are that in a typical Wilton carpet the pile is cut and there are three picks to each wire, whereas in a Brussels carpet the pile is looped and there are two picks to each wire. Wilton pile carpets require the insertion of three picks to each wire in order to ensure that the tufts will be held firm enough to resist the friction that is applied to the cloth, but cut pile hangings, in which the tufts are not so liable to be disturbed, are very largely made with two picks to each wire. A Wilton pile is generally composed of finer material, and is deeper than a Brussels pile; and both structures, when used for hanging and upholstery purposes, are made lighter, finer, softer, and more flexible than when they are employed as carpets. Flax and jute yarns, made very stiff by sizing, are used for the foundation of carpets in order that the back will be firm and unyielding, whereas cotton yarns of a pliable nature enter into the foundation of hanging and upholstery cloths.

Distinguishing Feature of the Cloths.—In each longitudinal line of the Brussels and Wilton structures as many differently coloured pile threads are employed as there are different colours brought to the surface in the line. The pile threads are thus in sets or groups in which, so far as regards the pile structure, each thread is a duplicate of the others; one thread in each group, of the proper colour according

to the design, is raised over each wire. The cloths are classified according to the number of pile threads in each group, and technically the term "frame" is applied; thus, three-frame, four-frame, and five-frame are respectively applied to cloths in which there are three, four, and five duplicate, but differently coloured pile threads in each longitudinal line. The textures mostly range from two to five frames, but six frames are employed to some extent. In a five-frame cloth there are always four pile threads lying in the foundation to one thread on the surface, while in a four-frame three pile threads are in the foundation for each thread on the surface, and so on. Therefore the higher the number of the frame the greater is the consumption of the pile yarns, but (if other things are equal) this is accompanied by no improvement in the texture, except that the greater number of colours gives more scope to the designer, and the foundation is better as regards bulkiness and elasticity. The quantity of pile yarn used is not in direct proportion to the number of the frames, because, however many frames are employed, there is always one, but never more than one, thread of each group taken up rapidly by being raised over the wires. For example, assuming that the contraction of the pile threads in forming the pile is from 300 to 100, and in the foundation from 104 to 100: for 100 yards of cloth each group of threads in a six-frame effect will require $(1 \times 300) + (5 \times 104) = 820$ yards of pile yarn, whereas a three-frame pattern will require $(1 \times 300) + (2 \times 104) = 508$ yards of yarn, or about five-eighths the length that the pattern with twice as many colours requires.

Each pile thread is on a separate bobbin, and the bobbins are arranged in a creel behind the loom in layers to correspond with the frames. As many groups of threads are required in the width of a cloth as there are loops or tufts formed in each transverse line. In Brussels and Wilton carpets the number of groups in the standard width of 27 inches ranges from 260, or about 10 per inch, to as few as 130, or about 5 per inch, very thick pile yarns being employed for the latter; while the number of wires per inch ranges from 13 in the finest Wilton structures to about 7 in the cheapest qualities of Brussels. On the other hand, hanging and upholstery cloths are made finer, and from 18 to 14 groups of pile threads per inch, and from 18 to 14 wires per inch are employed.

Planting.—The number of colours in the width of a fabric is not limited to the number of frames employed; the threads in different groups may be differently coloured, in which case one, two, or more of the frames each contains more than one colour of pile. Thus, in a five-frame structure one portion of a design may require the colours 1, 2, 3, 4, and 5, and another portion the colours 1, 2, 3, 6, and 7, and yet another portion the colours 1, 2, 3, 8, and 7; the colours 1, 2, and 3 being constant, while the colours 4 and 5 are replaced by the colours 6 and 7, and then the colour 6 by the colour 8. The substitution of one colour for another is termed "planting," and if this is judiciously performed a design may be produced in a four or five-frame cloth which contains as many as—say—twenty colours. In the same quality the higher the number of the frame is the more costly is the cloth, on account of the greater quantity of pile yarn required, and frequently a cloth, by successful planting, is given the appearance of being produced in a higher frame, and, therefore, more costly than is actually the case. The chief point to note in planting is to avoid the formation of stripes in the woven design, and for this reason a planted colour is sometimes graduated at both sides towards the adjacent colours in the frame.

Method of Designing.—In originating a large design a neat sketch of the figure is usually first made in pencil to a reduced scale on plain paper, and the proper colours are then indicated more or less roughly on the several sections. In transferring the design to point-paper it is customary to use paper that is ruled according to the pitch of the cloth, so that in drawing and painting the figure it is shown exactly the size it will appear when woven. Also, it is usual to paint in the several parts of the ornament in the exact colours that it is intended to employ in the cloth, although subsequently the colours of the woven design may be changed by substituting other threads in the loom. Each vertical space of the design paper represents a group of pile threads, and each horizontal space a wire, hence each



Fig. 443.

small square of the paper represents a loop or tuft. An illustration of a five-frame Wilton or cut-pile structure is given in Fig. 443, in which the same five colours are employed throughout. In Fig. 444, which corresponds with a portion of the design given in Fig. 443, the five colours are represented by different kinds of marks, as shown in the "gamut" below the plan; each mark in the plan indicates a pile tuft formed in the corresponding colour.

System of Loom Mounting.—A form of jacquard-harness and heald mounting is shown at A in Fig. 445, that is used in weaving the textures. The card cylinder is over the weaver's head, and in each short row there are 10 hooks and needles which are connected in the same manner as in an ordinary single-lift machine. The arrangement of ten per short row is convenient for five-frame designs, and any smaller frame can be woven by casting out in long rows. The harness is on

the knotted comber-board principle, and the comber-board M is supported at each side by a strong flat bar N to which a vertical movement is given by means of a cam, all the harness being thus capable of being raised by the comber-board M at regular intervals. Behind the harness there are two ground (or fine chain) healds P and R, and a stuffer heald S, the latter being connected at each side to a bar N by means of a rod T, so that the stuffer ends are lifted at the same time as the harness ends are raised by the comber-board. The ground healds P and R are operated in reverse order by means of positive tappets.

In the diagram A in Fig. 445 the hooks, needles, and harness cords are shown

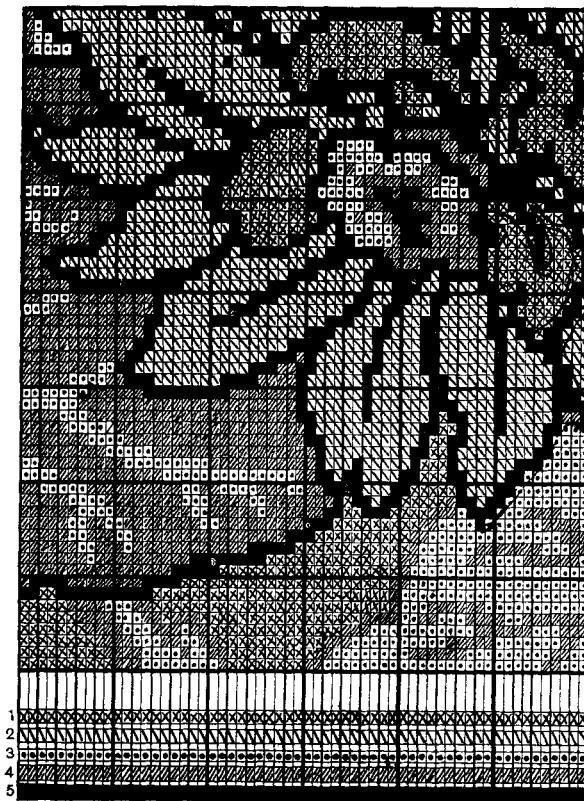


Fig. 444.

bracketed together in pairs, and numbered to indicate the numbers of the frames—that is, the several colours of the pile warp that the respective parts control. At B in Fig. 445, which represents how the warp threads are drawn on the healds and harness, the pile threads are correspondingly numbered; and the order of denting is indicated by the horizontal lines which connect the lower ends of the threads—two ground (or fine chain) threads, five pile threads, and one stuffer thread being passed through each split of the reed. In one split the five-pile threads are drawn on the odd rows of the harness, and in the next split on the even rows,

each colour being thus allocated to two consecutive rows of the harness, as shown by the numbers at the side of the harness draft. A comparison of the harness draft with the arrangement of the hooks and needles will show that the numbers coincide, and that each short row of the jacquard controls two pile threads of each colour.

Each vertical space of the design given in Fig. 444 represents one pile thread of each colour, so that two vertical spaces are equivalent to one row of needles and hooks, and one row of a card which is 10 holes deep. In carpets the design most frequently extends the full width of the texture, and if there are 260 groups

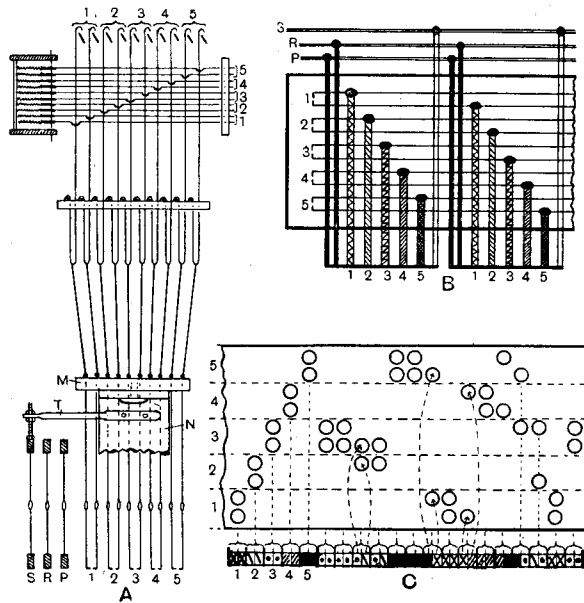


Fig. 445.

of threads in the width a jacquard with a capacity of 1,300 needles is required. The machines are usually made with 1,320 needles divided into three sections of 440 needles each, while the card cylinder is similarly divided into three sections, and three separate sets of cards to correspond are employed. For upholstery cloths different sizes of machines are used according to the class of design required.

Card-cutting.—The system of card-cutting which corresponds with the draft B is illustrated at C in Fig. 445, where a portion of a card is represented as having been cut to coincide with one horizontal space of a five-frame design in which the same marks are used as in Fig. 444. A card may be considered to be in five longitudinal sections of two rows each, each section corresponding with a distinct colour of pile warp (a frame), as indicated by the numbers at the side of the example shown. The spaces in the card-cutting plan are bracketed together in pairs to coincide with the rows of the card, and two holes are cut in each row, the several colours or marks of the design being cut on the corresponding sections of the card. On the left of C the marks of the plan are arranged in the order of the frames, and numbered from one to five in order that they may be readily compared with the

position of the corresponding holes in the card. Dotted lines also connect certain marks with the corresponding holes, and it will be seen that the first mark of a pair is cut on an odd row of the card, and the second mark on an even row. One card acts for as many picks as there are picks to a wire, and a wire is inserted at the same time as one of the picks.

Six-frame Mounting.—A six-frame design can be woven by employing 12 hooks and needles in each short row, and using a 12-rowed card, and this method is sometimes adopted. However, a mounting is illustrated in Fig. 446 by means of which a 10-rowed card can be used to produce a six-frame design. In this case there are 10 needles and 12 hooks in each row, of which 10 hooks, lettered A, are inverted, and when in the ordinary position are away from the path of the lifting knives, while the rear two hooks B face the cylinder, and are arranged over the lifting knives in the usual manner. Each needle is connected with both an inverted hook and a hook B, the five odd needles that govern one group of pile threads being connected to one hook B, and the five even needles that govern the next group to the other hook B. In order that an inverted hook A will be raised it is necessary for the corresponding needle to be pressed back by a blank in the card. If any one of either the odd or of the even needles is pressed back, the corresponding hook B is pushed off the lifting knife and is left down, the needles being provided with long eyes where they are connected with a hook B, in order that the latter may be acted upon without obstruction by any one of the five needles. If none of the odd, or of the even needles, is pressed back, the corresponding hook B remains vertical, and is raised by the griffe. In this system, therefore, in order that a pile thread governed by a hook A will be raised, four holes are cut in the card and one left blank. In order that a hook B will be raised, all the holes (five) are cut opposite the corresponding needles, a thread of the sixth frame being thus automatically lifted whenever none of the frames 1 to 5 is required up. In the card-cutting, therefore, all the card is cut except where the colours of the frames 1 to 5 are indicated. A five-frame design can be woven simply by casting out the rear two rows of the harness. Compared with the system illustrated at A in Fig. 445 the method has the disadvantage that as at least four-fifths of the holes are cut, the cards are weaker, are more readily damaged, and do not last so long.

A modified form of the mounting, shown in Fig. 446, which, however, is the same in principle, is employed in which vertical cords (suspended from a stationary board at the top) are used instead of wire upright hooks, and a slotted lifting board instead of lifting knives, while a levelling board acts against the rear ends of the needles instead of springs.

Structure of Wilton Pile.—In Fig. 447 D shows a small plan in five colours,

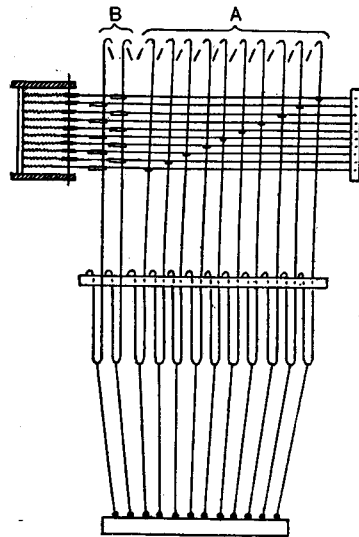


Fig. 446.

and E the complete structure of a Wilton pile to correspond ; while F represents how the threads interlace in forming the pattern indicated in the first vertical space of D. The marks which represent the colours in the plan D are similar to those indicated in Fig. 444. A line is shown connecting each vertical space of D in Fig. 447 with five vertical spaces of E, at the top of which the colours are represented in the same order as in the gamut below the design in Fig. 444. To correspond with the three-pick Wilton structure each card acts while three picks and a wire are inserted.

The comber-board, and the stuffer heald along with it, are raised on the second of each group of three picks, and all the pile threads and the stuffer threads are lifted high enough to form a shed for the shuttle carrying the ground weft to pass through. On the same pick the jacquard griffe is raised a greater distance than the comber-board, and lifts up one pile thread in each group so that a second shed opening is made in which a wire is inserted below the threads which have to form pile. The full squares in E indicate the threads which are raised by the jacquard to form the upper wire shed ; while the horizontal marks represent the pile threads, and the vertical strokes the stuffer threads which are raised by the comber-board and suffer heald respectively to form the lower weft shed. In conjunction with this order of lifting, the ground healds are operated alternately, and lift the ground threads in 3-and-3 order, as shown by the circles.

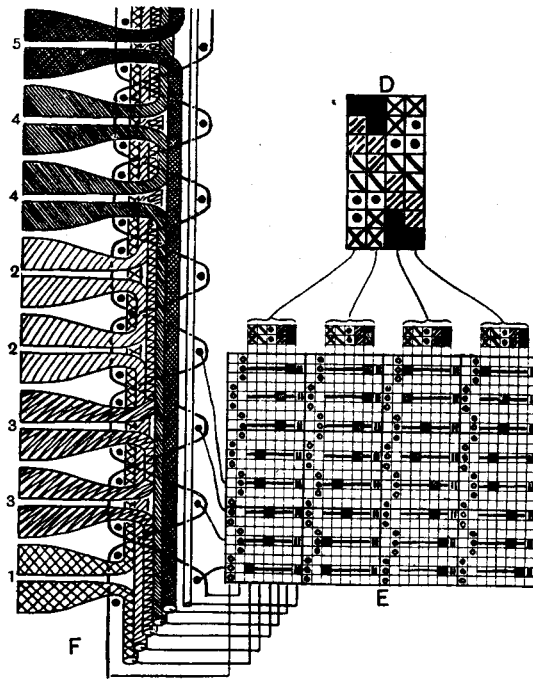


Fig. 447.

The fabric represented in Fig. 443 is an upholstery texture which is composed of two-ply 2/30's worsted warp, 2/12's cotton ground (or fine chain) warp, two-ply 2/16's cotton stuffer warp, and 2/14's cotton weft. The stuffer threads lie straight in the cloth, while the ground threads contract about 16 per cent. ; the shrinkage in width is about 6 per cent. In the cloth there are $87\frac{1}{2}$ pile threads, 35 ground threads, and $17\frac{1}{2}$ stuffer threads per inch, and it is woven with 42 picks and 14 wires per inch, so that in the width there are $17\frac{1}{2}$ and in the length 14 tufts per inch, giving a total of 245 tufts or points to the square inch. The counts of the design paper is in the ratio of $17\frac{1}{2}$ tufts to 14 wires per inch, or 10×8 ; but the number of vertical and horizontal spaces in each large square is immaterial so long as they are in the right proportion for the design to be drawn to the proper scale. Since, however, two vertical spaces are equivalent to one row of the card,

it is convenient, as regards the card-cutting, to have an even number of vertical spaces between the thick lines of the design paper.

For a Wilton pile carpet suitable particulars are:—Three-ply 2/18's worsted pile warp, 3/8's cotton warp, 16 lbs. per spyndle jute stuffer warp, and 8 lbs. per spyndle flax weft, with 10 pile threads of each colour per inch, and 10 wires per inch. In making the design exactly the size that it will appear in the cloth to the foregoing particulars, each square inch of the design paper would be divided vertically and horizontally into ten spaces. In Fig. 444, however, the paper is 10 × 8, and the example would, therefore, be suitable for producing in a cloth with 10 pile threads of each colour and eight wires per inch.



Fig. 448.

Structure of Brussels Pile.—

An illustration is given in Fig. 448 of a four-frame Brussels, or looped-pile structure, the design for a portion

of which is shown in Fig. 449. The second, third, and fourth frames are each in the same colour throughout, but the first frame is planted in several colours, as shown in the gamut below the design. The system of designing is the same as in the previous example, each section of the design being painted out in the proper colour; and either of the foregoing systems of jacquard mounting may be employed with the harness cast out. The system of card-cutting is also the same, but all the colours of the planted frame are cut on the

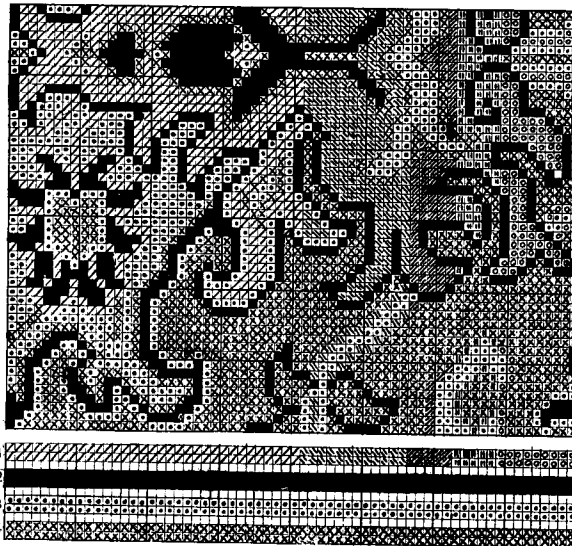


Fig 449.

same longitudinal section of the cards. A small plan in four colours is given at A in Fig. 450, while B shows the corresponding complete structure, and C the interlacing of the threads in forming the pattern in the first vertical space of A. The plan B is arranged similar to the plan E in Fig. 447, but in this case there are two picks to each wire, the comber-board, stuffer heald, and jacquard thus lifting on alternate picks (the even picks), while the ground healds work in 2-and-2 order. The particulars of the cloth shown in Fig. 448, which is an upholstery, are as follows:—Pile warp, two-ply 2/36's worsted; ground warp 2/16's cotton; stuffer warp, 2/12's cotton; weft, 2/12's cotton; 16 pile threads of each colour, and 16 wires per inch, giving 256 loops to the square inch. Cloths of this character are frequently made without stuffer warp.

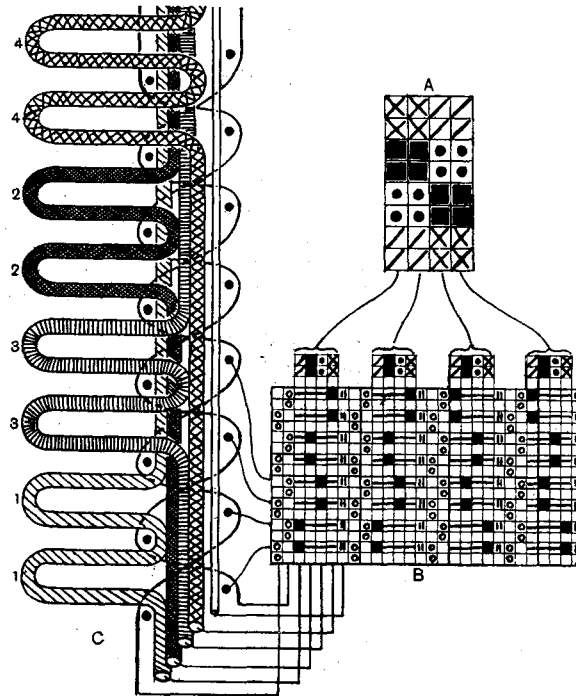


Fig. 450.

The following are suitable particulars for a Brussels carpet structure:—Pile warp, three-ply 2/16's worsted; ground or fine chain warp, 3/8's cotton; stuffer warp, 12 lbs. per spynkle jute; weft, 8 lbs. per spynkle flax; 9 threads of each colour of pile, and 9 wires per inch, giving 81 loops to the square inch. In this quality there are generally 234 groups of pile threads in the standard width of 27 inches.

Two-pick Wilton Pile Structure.—Fig. 451 illustrates a three-frame cut-pile upholstery cloth, the point-paper design for which is given in Fig. 452. The first frame is planted in two colours, while in the portions of the design indicated by brackets below the gamut, only the colours of the first and second frames are brought to the surface. As far as regards the design, the threads of the third frame can

be omitted at these places, because if they are present they simply lie "dead" in the cloth. In order, however, that the foundation will be uniform in density, it is customary to introduce an equal number in each group, and sometimes old stock is used up as "dead" threads, while in other cases the pile threads are replaced by stuffer threads.

A small plan in three colours, similar to the design given in Fig. 452, is represented at D in Fig. 453, while E shows the corresponding complete structure of the cloth. Two picks are inserted to each wire, but there are no stuffer threads, while the ground threads work in plain order. The same mounting as before may

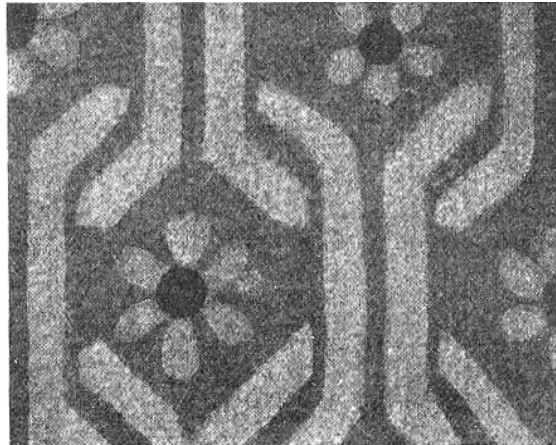


Fig. 451.

be employed by casting out the harness, but the stuffer heald will be dispensed with, and the ground healds will be operated in plain order. In the illustration F shows the interlacing of the first pick of the plan E, and G of the second pick and the wire, which are inserted together. It will be found useful to compare the warp sections shown at F and G, with the weft sections given in Figs. 447 and 450, as the principle of construction is the same in each case. The cloth represented in Fig. 451 is composed of 3/22's worsted pile warp, 2/10's cotton ground warp, and 2/12's cotton weft, and there are 17 groups of threads and 16 wires per inch, giving 272 points to the square inch.

Moresque Effects.—Usually in the Wilton and Brussels structures each part of a design is developed in a solid colour, and it is to this that the characteristic clearness of design is chiefly due. In some cases, however, one or more sections of a design are developed in a mixture of two colours, to which the term "moresque" is

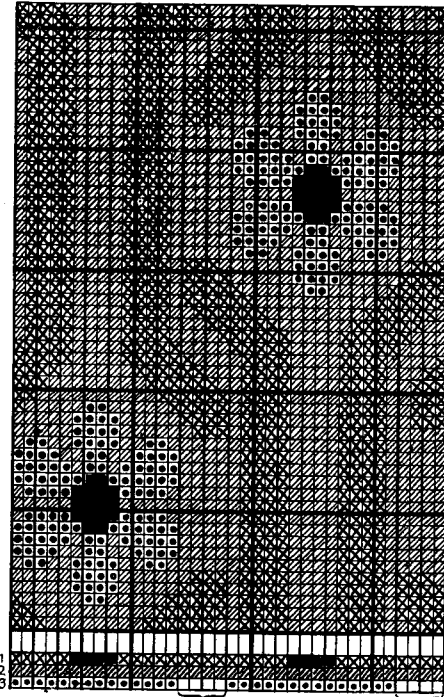


Fig. 452.

applied. One method of producing a moresque effect is to use a pile thread which is composed of two or more separate but differently coloured threads that are twisted together. In another method each frame is in a distinct solid colour,

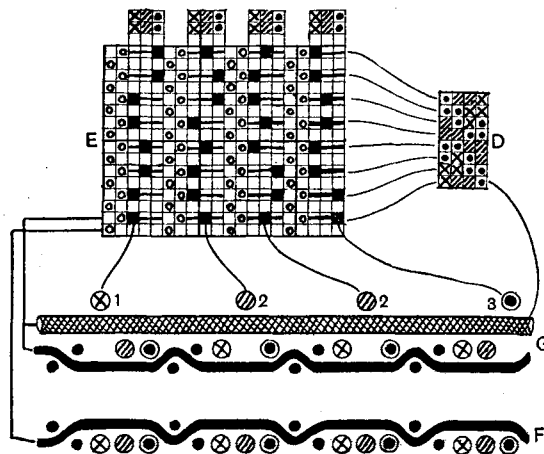


Fig. 453.

but the threads of two frames are combined by lifting them together, such threads being half as thick as those that are used to form solid-coloured effects. For example, if five frames are used, and frames 1 and 2 are in 3-ply 2/18's yarn, and frames 3, 4, and 5 in 3/18's yarn—the solid colours of the frames 1 and 2 may be used in conjunction with mixed effects produced by combining the frames 3 and 4 together, 3 and 5 together, and 4 and 5 together. Five effects may thus be produced, and still further variety by planting,

although, as regards the actual quantity of pile yarn used, the number of the frame is only $3\frac{1}{2}$. A mixed effect produced in separate threads may be designed by indicating each colour on one-half of each small space of the paper; then in the card-cutting each space thus indicated represents two holes.

Development of the Colours in both Cut and Looped Pile.—

Fig. 454 illustrates a three-frame upholstery cloth in which each colour is developed in both cut and looped pile, a design in six shades being thus produced from three colours of pile warp. A portion of the design is given at A in Fig. 455, in which the crosses, dots, and solid marks represent cut pile in the three colours, while the diagonal strokes, circles, and shaded squares indicate looped pile to correspond, as shown in the gamut below the design. The foundation of the cloth is the

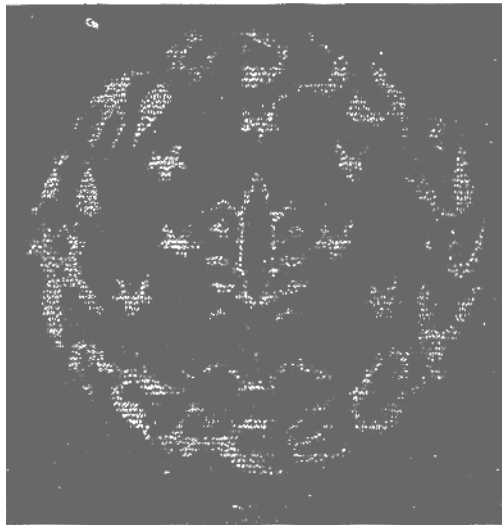


Fig. 454.

same as that of the cut-pile structure illustrated in Fig. 447, but for every three ground picks both a cutting and a looping wire shed are made, on one of which all the threads are left down except those that have to form the pile. Two

cards are cut from each horizontal space of the design A, the crosses, dots, and full squares being cut on the first, and the diagonal strokes, circles, and shaded squares on the second. In order to illustrate the system of cutting more fully, a small plan is given at B in Fig. 455, with the corresponding complete order of cutting indicated at C. The cloth is constructed as follows:—Two-ply 2/36's worsted pile warp, 3/28's cotton ground warp, two-ply 2/20's cotton stuffer warp, 1/12's cotton weft; 18 pile threads of each colour per inch; 17 cutting wires and 17 looping wires per inch.

TAPESTRY PILE CARPETS

Comparison with Brussels and Wilton Structures.—The tapestry pile texture is made to resemble both the Brussels and Wilton structures. Compared with the latter structures, instead of from two to six duplicate solid-coloured pile threads (according to the number of frames) in each longitudinal line of the cloth, there is only one pile thread, which, however, is printed in different colours throughout its whole length in accordance with the colours that are required to show on the surface

in the line. All the pile threads that are different from each other in a design are separately printed, and any number of colours may be applied to each thread. There is, therefore, no limitation to the number of colours that can be used (although for practical reasons it is not convenient to apply more than about forty in a design), whereas in the Brussels and Wilton structures there cannot be more than a certain number of colours woven in each longitudinal line. Further, in the tapestry pile structure the pile threads are all raised over the wires at the same time, and are, therefore, brought from one beam instead of each thread from a separate bobbin, while a tappet shedding motion is employed instead of a jacquard. The texture is, therefore, more economical to weave, and requires a smaller quantity of pile yarn than a Brussels or Wilton structure, but, on the other hand, the printing of the pile yarn is a more expensive process than solid-colour dyeing, while the cloth is inferior as regards bulkiness and springiness, and the design is not so definite and smart.

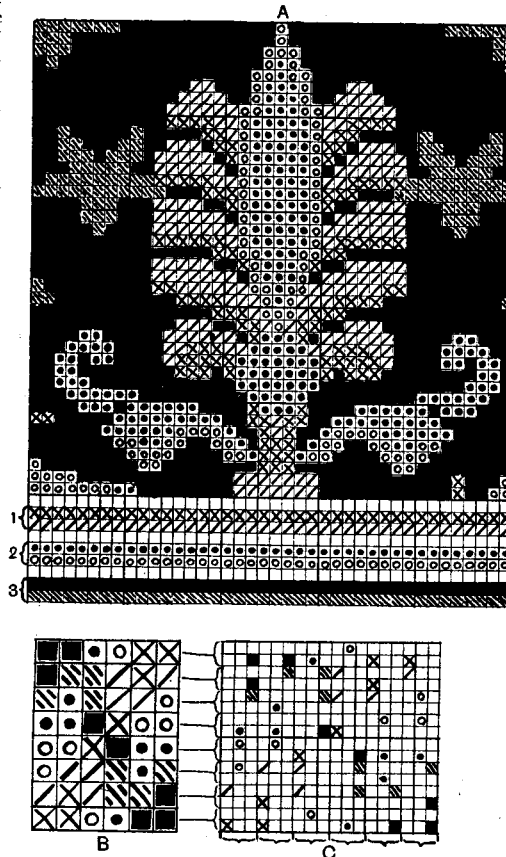


Fig. 455.

Tapestry Pile Designing.—The method which is chiefly employed in producing the tapestry pile texture is illustrated in Fig. 456. The principle of designing is the same as for the Brussels and Wilton structures; the design being painted out in the colours required in the cloth, on design paper of the proper pitch according to the number of pile threads and wires per inch. A in Fig. 456 represents a portion of a design in which the different marks indicate different colours. Each large square of the design paper corresponds to one square inch, and in the example is ruled to coincide with a cloth that is woven with eight pile threads and nine wires per inch. Each vertical space of the design represents a pile thread, and is termed a cord, while each horizontal space represents a wire, and is termed a type. Theoretically, each small space of the design represents a pile loop or tuft in the colour indicated, but this does not work out exactly in practice, partly because the colours “bleed,” or run into each other, and because it is impossible to regulate the take-up of the pile threads to the wires with absolute accuracy, so that in the cloth the colour of a thread may change in any part of a loop or tuft.

Preparation of the Pile Yarn for Printing.—Previous to the printing operation the pile yarn is scoured and stoved in the hank form, then the threads are wound on to bobbins, from which they are wound side by side, as represented at C in Fig. 456, round the periphery of a large revolving drum with a wood surface which is covered with a sheet of oilcloth. The drums vary in circumference from about $6\frac{1}{2}$ feet to $31\frac{1}{2}$ feet and upwards, while the face is from 33 to 39 inches wide, and will accommodate about 960 threads wound alongside each other. The threads from several bobbins are passed through guide eyes spaced at suitable distances apart, and are wound on the drum at the same time. As the winding proceeds the guide eyes are moved slowly in a horizontal direction, and as many circuits of the thread from each bobbin are made as will uniformly fill the space between the separate threads. The face of the drum may be completely or partly filled by the threads; in the latter case fewer bobbins than the full capacity of the drum are wound from so that the surface is left uncovered at one side. In completely filling a drum, six bobbins, for example, may be used with the threads spaced 6 inches apart, and 160 circuits of the thread from each bobbin be made in filling the spaces between the separate threads. If the drum is $18\frac{3}{4}$ feet in circumference— $(160 \text{ circuits} \times 18\frac{3}{4}) \div 3 = 1,000$ yards of yarn are drawn from each bobbin, or a total of 6,000 yards from the six bobbins. If only four bobbins are wound from, two-thirds of the surface of the drum will be filled, and with the same length of yarn drawn from each bobbin, a total length of 4,000 yards of yarn will be obtained. The length of yarn drawn from each bobbin is treated separately after the printing operation, and is called a hank, and each hank supplies one thread of the pile warp that is subsequently placed on the weaver's beam. The length of thread that can be used to form a hank is limited for various practical reasons, one of which is that it should not exceed what can be placed upon a “setter's” bobbin.

The Printing Drum.—A printing drum is provided at one side near the rim with a series of ratchet teeth, represented at R in Fig. 456, which are engaged by a pawl or catch P. The pitch of the teeth is arranged to coincide with the length of yarn that it is estimated will form one loop. Thus, assuming that .3 inches of pile yarn are required to form 1 inch of cloth with 9 wires per inch, in changing the catch P from one tooth to the next, the yarn on the surface of the drum will be moved $3 \text{ inches} \div 9 \text{ wires per inch} = \frac{1}{3} \text{ inch}$. The circumference of a drum

is divided into a definite number of teeth, usually a number which is a multiple of several smaller numbers, and the teeth are numbered on an index alongside from 1 upward. A drum with 648 teeth will permit the printing of a design repeating in length on 648 loops, or wires, or horizontal spaces of the design paper, or on any number which is a division of 648. Each tooth represents a traverse of the printing pulley, or a type, or a horizontal space of the design.

A drum generally has two indices each provided with ratchet teeth, one index being coarser than the other in order that the drum may be used for textures which are different in pitch and in length of pile. Thus, one index of a drum may have 648 teeth to the circumference, and the other 432; then if the former gives $\frac{1}{3}$ inch

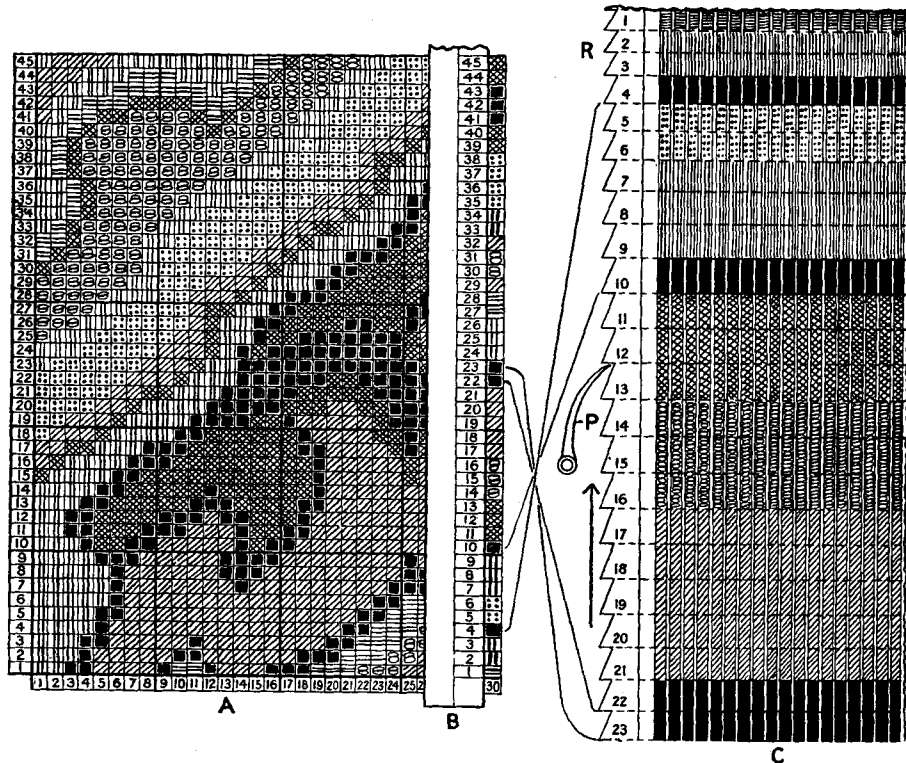


Fig. 456.

of pile yarn to each loop or type, the latter will give $\frac{1}{3}$ inch. Suitable sizes of drums, with the number of teeth to the circumference, are as follows:—18 feet 9 inches circumference with 648 teeth in the fine pitch and 432 teeth in the coarse pitch; 25 feet 6 inches with 864 and 576 teeth; 28 feet 10 inches with 972 and 648 teeth; and 31 feet 6 inches with 1,062 and 708 teeth. The largest sizes are used more especially in the manufacture of carpet squares. In every case the fine pitch gives 0.35 inch to each type, and the coarse pitch, 0.534 inch, or rather more than $\frac{1}{3}$ inch and $\frac{1}{2}$ inch respectively. A small drum is also used which is 6 feet 5 inches in circumference, with 216 teeth, the pitch being the same as the fine pitch of the large drums.

The Printing Pulley.—Situating immediately underneath the drum is a metal carriage which is provided with four grooved wheels that rest on a pair of rails running the width of the drum. The carriage is so constructed that a colour box can be readily put in or taken out; and as many colour boxes are employed as there are different colours in the design to be printed. Each colour box contains a supply of the proper dye solution, and the colour is applied to the pile yarn, while it is wound round the drum, by means of a printing pulley which is partly immersed in the liquid. The width of the face of the printing pulley is approximately equal to the distance that the yarn is moved by the drum when the latter is turned one tooth. The carriage is made to traverse the breadth of the drum, and the printing pulley revolves in the dye solution and runs with its upper surface in contact with the yarn, thus printing on the threads the colour which is contained in the colour box. The width of colour printed at each traverse is equal, theoretically, to the length of yarn required to form one loop or tuft, and corresponds to one wire or one horizontal space of the design paper. If only part of the width of the drum is covered with yarn the printing pulley is automatically “dipped” or lowered out of contact with the surface which is uncovered.

The Scale Board.—A large design is divided longitudinally into sections each of such a width that it can be conveniently handled during printing, and each portion is pasted to a separate board and then varnished. If the time available for printing a design is limited two or more of the separate sections may be printed simultaneously at different drums. As shown in A Fig. 456, the spaces of the design are numbered along the bottom to indicate the number of each pile thread in the design, and at the side, to correspond with the numbering of the teeth of the drum. The printer uses as a guide a narrow piece of wood with a bevelled edge, termed a scale board, which is divided by horizontal lines to suit the pitch of the design paper, as shown at B in Fig. 456; and the horizontal spaces of the scale board are also numbered to correspond with the numbering of the teeth of the drum. The scale board is placed on the design with the bevelled edge alongside the vertical cord (or thread) to be printed—No. 30 in Fig. 456—with the numbers on the board and at the side of the design coinciding.

Operation of Printing.—Each colour of the design is indicated by a letter or number, and the colour box which contains the corresponding colour is similarly indicated in order to avoid trouble in selecting the colours. The colour, which is judged to be the most suitable to print first, is selected, and assuming that this is represented by the solid marks, which, in the cord numbered 30 in Fig. 456, are indicated on the spaces numbered 4, 10, 22, 23, etc., the drum is turned by means of a hand wheel so that the pawl P engages in succession the teeth that are correspondingly numbered. At each engagement the printing carriage, containing the proper colour box, is traversed with the scroll pulley in contact with the threads. When all the types of the cord 30, which correspond with the spaces on which the first colour is indicated, have been printed round the entire circuit of the drum, the colour box is changed for one containing another colour. Assuming that this is represented by the vertical marks in the cord No. 30 in Fig. 456, the drum is then turned so that the pawl P engages the teeth numbered 2, 3, 7, 8, 9, etc., in succession. The printing of each colour is completed round the circumference of the drum before another colour is commenced, and the process is continued until the last colour has been applied and every portion of the threads has been

printed the proper hue. C in Fig. 456 represents a portion of a drum covered with threads which are printed to coincide with the types 1 to 23 of the vertical cord numbered 30; and a few connecting lines are shown between the horizontal spaces of the cord and the teeth that are correspondingly numbered. The drum is rotated in the direction shown by the arrow.

If a design repeats in length on $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$, of the number of teeth of the drum, each colour is carried forward round the drum for a corresponding number of repeats before the colour box is changed. Thus, assuming that the design shown at A in Fig. 456 repeats on 216 horizontal spaces or types, and that the drum has 648 teeth, the design will be repeated three times in the circumference, and the first colour (indicated by the solid marks) will be printed with the pawl engaging the teeth 4, 10, 22, 23, etc., then the teeth 220, 226, 238, 239, etc., and then the teeth 436, 442, 454, 455, etc., and so on. In such a case a scale board would be used which is divided vertically into three portions, the first numbered from 1 to 216, the second from 217 to 432, and the third from 433 to 648.

If all the threads in a design are different from each other each vertical cord represents one filling of the drum and one operation of printing; thus, if there are 216 different threads in the repeat the printing process is repeated 216 times. The printer works at two drums alternately—printing at one while the yarn is prepared at the other. In the case of “centred,” or “wheel,” designs, in which one-half of the design is like the other half, but turned over or round, each filling of the drum and process of printing enables two threads to be obtained, so that 216 threads of such a design can be produced by repeating the process 108 times. In small repeating designs the number of printing processes may be reduced to one-third, one-fourth, etc., the number of pile threads in the width of the cloth. Carpet “squares” are made up to 144 inches wide, but they are generally designed on the centred or wheel principle; and from 288 to 576 separate processes of printing are necessary (according to the pitch of the cloth and the form of the design) in producing a “square” 72 inches to the half width.

The operation of printing a design is, therefore, a long and tedious process (occupying from two or three weeks for an ordinary design to eight or ten weeks for a large square if only one printer is employed), but a very large number of repeats of the design can be produced at one printing operation. For instance, if a drum has 648 teeth, and there are 648 wires in the repeat of the design, as many repeats are printed at the same time as there are threads alongside each other on the drum; while three times as many repeats as threads are printed, if the design occupies one-third of the number of teeth, or 216 wires. Thus, if 160 circuits are made from each of six bobbins, 960 repeats are obtained if there is only one repeat to the complete circle of the drum, and 2,880 repeats if there are three repeats to the circumference. With nine wires per inch the approximate length of carpet produced by one complete operation of printing will be:—(648 types \times 960 threads) \div 9 wires = 69,120 inches or 1,920 yards.

Processes that Follow Printing.—Following the complete printing of each drumful, the next process is “rubbing,” in which a piece of wood with a flat end is rubbed over the surface of the yarn on the drum, each colour being treated in succession. This process causes the colouring matter to more completely penetrate the threads, and at the same time superfluous colour is removed. The drum is then stripped by lifting the sheet of oilcloth clear away along with the threads,

and to the latter a ticket is attached that is numbered to coincide with the number of the vertical cord in the design, and each hank (or thread from a separate bobbin) is tied separately.

The processes of steaming (to fix the colours), washing, and drying follow, then the thread from each hank is wound on to a setter's bobbin, which is numbered to correspond with the number of the thread. After all the threads of a design have been wound, the bobbins, by means of the numbers upon them, are placed in proper order in a bank or creel in readiness for the beaming. Assuming that six hanks (previously wound from six bobbins) have been printed at each filling of the drum, the creel will be filled six times if all the threads in the design are different from each other, and three times if the design is centred or on the wheel principle. Each filling of the creel with setter's bobbins usually supplies the yarn for one pile warp.

Beaming the Pile Warp.—The winding of the pile threads on to the weaver's beam requires to be very carefully performed, and is done in a special manner as in this process the printed threads have to be so placed alongside each other that the colours are brought in correct relative position *horizontally* according to the design. In front of the bobbin creel there is a carriage with two rack wheels at each side, the teeth of which fit into the teeth of two rack rails fixed to the floor. The pile threads are passed from the bobbins through a reed at the rear of the carriage, then between a pair of flat bars which can be clasped together, and over a setting board (at the front of the carriage) that has grooved horizontal lines on its surface. There is also a pair of clasp bars in front of the warp beam stand at the other end of the rack rails. The warp is run on to the beam in short lengths at a time, the threads being first compared with and set to the design with the aid of the grooved lines on the setting board, then held firmly by the clamps connected to the carriage while the threads are wound on to the beam, during which the carriage is moved forward on the rack rails. The clamps in front of the warp beam stand are then closed and those in front of the carriage opened while the latter is run back on the rails, when the pile threads are again adjusted to the design on the setting board. The process is repeated, the carriage being run to and fro between the creel and the warp beam, throughout the length of the warp. The design shows in an elongated form on the threads as they are wound on to the beam.

Structure of Tapestry Pile.—The structure of a looped pile tapestry carpet is illustrated in Fig. 457, in which E shows a small design, and F the corresponding complete plan of the cloth. Each group of threads consists of two ground or fine chain threads, one pile thread, and three stuffer threads, which are passed through one split of the reed. G shows how the threads in the first group interlace with the picks, the pile thread changing colour, as represented by the different markings, to correspond with the different marks shown in the first vertical space of E. The similarity of the structure to that of the Brussels pile will be seen by comparing G with C in Fig. 450. A large quantity of stuffer yarn is introduced in the tapestry cloths in place of the pile threads, which, in the Brussels structure, lie in the foundation.

Tapestry Pile Weaving.—There are two picks to each wire, and the same as in Brussels pile weaving, a double shed is formed and a wire is inserted at the same time as each alternate pick of weft. The pile and the stuffer threads, which are lifted on the even picks in the plan F, Fig. 457, are drawn on the same heald. This

heald, however, is provided with a special form of mail, as shown at H in Fig. 457, and the pile threads are passed through small eyes K, and the stuffer threads through long eyes L. The heald is placed at the front, and is given a greater movement than the two healds which carry the fine chain threads, with the result that an upper line of pile threads is formed below which a wire is inserted. At the same time the lower portion of the long eyes of the mails raises the stuffer threads level with the fine chain threads that are lifted by one of the fine chain healds to form the top line of the weft shed.

Cut-pile tapestry cloths are largely made with two picks to each wire, a cutting wire being used in place of a looping wire, but in some cases, in order to render the cut pile firmer, three picks are inserted to each wire. The structure is then the same as the Wilton pile structure illustrated at F in Fig. 447, except that there is only one pile thread in each group, and a greater number of stuffer threads are introduced.

The particulars of a good quality of a worsted tapestry pile carpet are as follows:— Three-ply 2/15's worsted pile, 3/8's cotton fine chain, 14 lbs. per spyndle jute stuffer, 8 lbs. per spyndle hemp weft; 8 pile threads and 9 wires per inch; 88 inches of carpet from 225 inches of pile yarn. In lower qualities the number of pile threads and wires is reduced to about $6\frac{1}{2}$ per inch, jute is used instead of cotton for the fine chain warp, and from 112 to 125 inches of carpet are produced from 252 inches of pile yarn.

A heavy woollen rug may be made with 160 pile threads, on 30 inches, of 4/125 yards per ounce woollen; $18\frac{1}{2}$ wires on 3 inches, 2-ply 14 lb. jute stuffer, 3-ply 7 lb. jute fine chain, and 2-ply 8 lb. jute weft.

The bleeding or running of the colours into each other is one of the chief sources of irregularity in designs for these textures, light colours suffering most. The difficulty is got over to some extent by allowing a relatively larger number of cords in the design for the lighter colours; while, again, a narrower printing pulley may be employed for the dark than for the light colours.

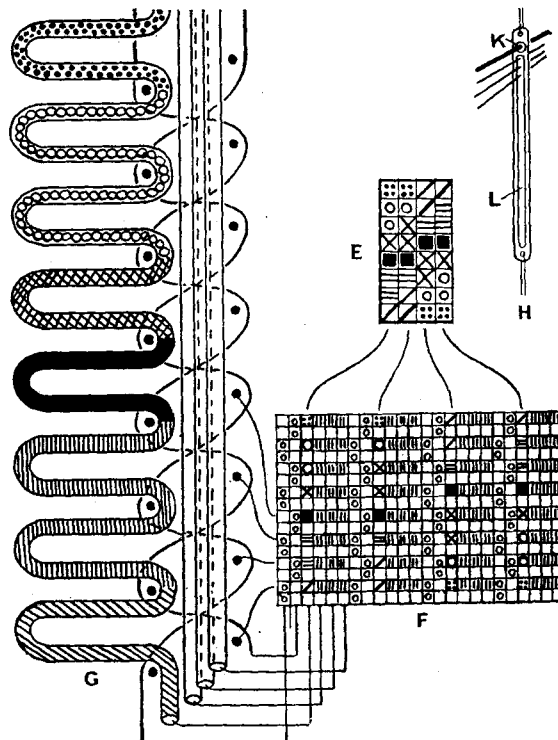


Fig. 457.

CHENILLE, OR PATENT AXMINSTER PILE

The distinctive features of chenille Axminster pile fabrics are:—(1) A cut pile is produced without the aid of wires, (2) all the pile material is on the surface of a foundation cloth, (3) any number of colours can be employed, each of which appears definite and smart. Two separate operations of weaving are required in producing the texture. In the first operation, which is termed "weft weaving," the pile yarn, in the form of weft, is interwoven with groups of warp threads that are placed some distance apart. This is followed by a process in which the fabric is converted into a number of long threads that form the chenille pile, which

in the second operation of weaving (termed setting) is inserted as weft in such a manner as to form the pile surface of a foundation texture.

Comparison with Tapestry Pile.—The mode of preparing the chenille produces a certain degree of similarity in the pile to the printed tapestry pile, as in both cases any number of colours can be introduced, the colours are arranged in the pile threads in the exact order in which they are required to show in the cloth, while a large number of repeats of the design are obtained at one operation. In a chenille thread, however, the colours are developed in the form of tufts of

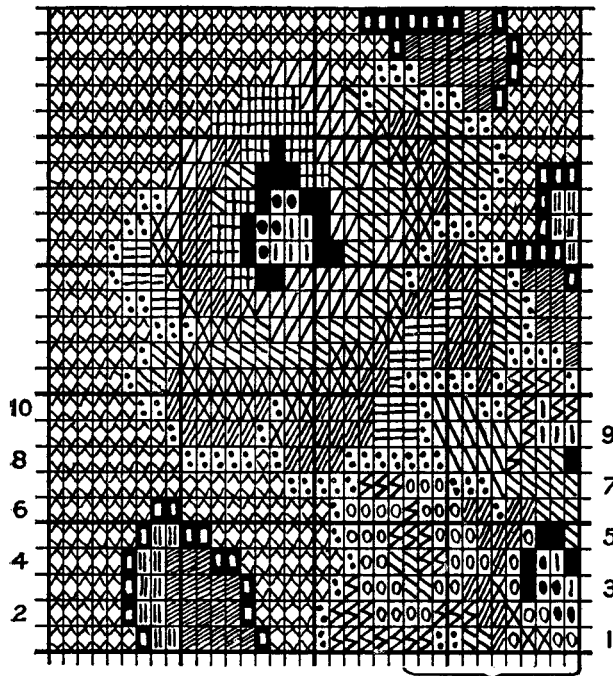


Fig. 458.

fibres (a looped pile cannot be woven on the chenille principle), and each colour is quite distinct from the neighbouring colours. In a tapestry pile thread, on the other hand, the colours run into each other, and are not clearly defined at their joinings, while the pile (which may be either looped or cut) is produced during the subsequent weaving of the texture. Further, the chenille thread is traversed from side to side of the cloth, whereas the tapestry pile thread is introduced longitudinally.

Chenille Pile Designing.—The principle of designing is the same as in other pile textures in which the pattern is due to diversity of colour, the design being painted out exactly as it is required to appear when woven. On account of the means employed in producing the cloth it is of greater importance in this than

in any other class of pile that the design be drafted on paper to the proper size, and for this reason a special quality of design paper is generally used.

A portion of a chenille Axminster design is illustrated in Fig. 458, in which 16 different colours are represented by as many different marks. Each large square of the design paper, which represents 1 square inch, is divided into 9 spaces vertically and 5 spaces horizontally, each vertical space corresponding to two picks of the weft which forms the chenille, and each horizontal space to one chenille thread. The design paper is thus ruled in the proportion of one-half the number of picks put in during the first weaving operation to the number of chenille threads inserted in the second weaving operation. Each small space of the design paper represents two pile tufts formed in the colour that the mark indicates.

The pitch of design paper shown in Fig. 458 is suitable for a texture in which the chenille threads are woven with 18 picks per inch, and which contains 5 chenille threads per inch, giving 90 tufts to the square inch. The pitch varies greatly in different cloths, ranging from 26 picks per inch in the chenille and 12 chenille threads per inch (giving 312 tufts to the square inch) to 8 picks per inch in the chenille and 3 chenille threads per inch (giving 24 tufts to the square inch). For

the former each square inch of the design paper is divided into 13×12 spaces, and for the latter into 4×3 spaces.

Although a design may repeat two or more times across the width, it must be extended to the full width of the texture to be woven. The horizontal spaces are numbered in consecutive order, the odd numbers on the right and the even numbers on the left, as shown in Fig. 458.

Formation of the Chenille.—In weaving the chenille the design is turned so that the horizontal spaces are in line with the warp threads, and the cords or spaces are gone through in succession, beginning at the bottom and then at the top of succeeding cords, where the number is indicated. The weaver uses as many shuttles (which are changed by hand) as there are colours in the design, and two picks of the proper colour of weft are inserted to each horizontal space in a cord. This is illustrated in Fig. 459, which shows the order of wefting to correspond with the

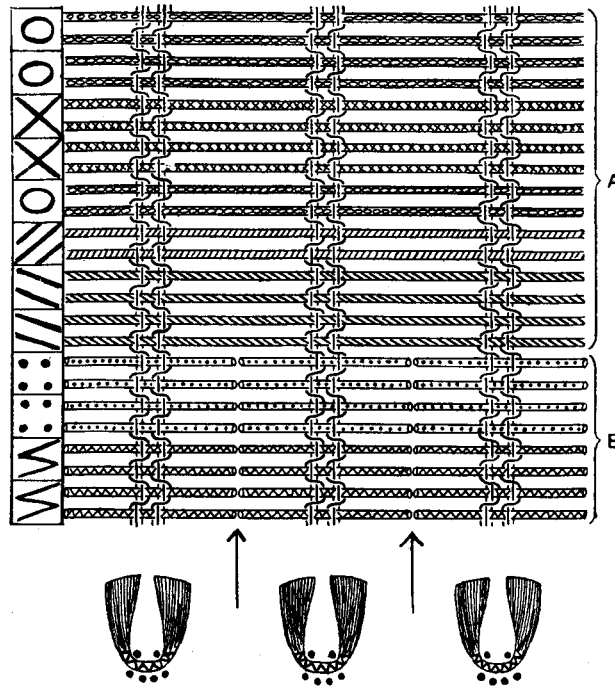


Fig. 459.

bracketed portion of the first horizontal space of Fig. 458, an enlarged plan of which is given on the left of Fig. 459. The different colours are inserted in the order indicated in the design until the given longitudinal cord is completed, then a small space may be left without weft in order that in the setting the chenille thread will more readily turn at the sides of the cloth. Afterwards, the next longitudinal cord is gone through in the same manner, but in the opposite direction, and the process is continued until every cord in the repeat has been gone over.

The total length of chenille thread required to produce a design is equal to the length of a cord (originally a horizontal space) multiplied by the number of cords. Assuming that in the repeat of a design there are 120 chenille threads which are different from each other, and that 216 double weft picks are inserted in weaving each chenille thread the width of the cloth, there will be $120 \times 216 \times 2 = 51,840$ picks inserted in producing the chenille for the full design. However, a large number of chenille threads may be woven alongside each other at the same time, so that one operation of chenille weaving enables very many repeats of the design to be obtained. Moreover, in the case of wheel designs and designs which are centred horizontally, it is only necessary to weave one-half of the chenille threads in the repeat in order to produce the full pattern.

For convenience in selecting the shuttles in the weft weaving each colour in the design may be indicated by a number, and the shuttles containing the corresponding colours be numbered to coincide. Two methods are employed by which the weaver is enabled to compare the distances woven in the different colours with the spaces occupied by the respective colours in the design. In a recent system the design is suspended vertically, and is made to travel up and down at the rate that the fabric is drawn forward in the loom, while from the position of a pointer, which can be slid laterally from one vertical space to the next as each is completed, it can be seen when the proper number of picks of each colour have been inserted. In an older system, which is still largely used, the design is cut into strips, each two cords wide, and each strip is in turn attached to the cloth, passed through a wide space in the reed, and lightly weighted at the other end. The strip is drawn forward with the fabric, and as each colour in a cord reaches the edge the shuttle, with the corresponding colour, is inserted. After the first cord is completed the strip is turned round and the second space is similarly gone through.

The chenille is woven in a plain loom which is fitted with a gauze mounting. The warp threads are arranged one end crossing two standard ends, and two groups of threads are reeded into consecutive splits of the reed with a space between them and the next two groups. Frequently, an ordinary form of reed is used, a number of splits being left empty between the groups of warp threads, but in some cases the reed contains splits only where the groups of threads are required to pass through. The space between the groups is varied according to the length of pile required, the pitch ranging from about $\frac{2}{3}$ inch for a short pile to 1 inch and over for a very deep pile.

Fig. 459 shows how the threads interlace, as viewed from the side that is underneath during the weaving of the chenille. A texture is produced across which the variously coloured picks of weft extend, being firmly bound in at intervals by the gauze interlacing, as shown in the portion lettered A in Fig. 459. The next process consists of cutting the picks in the centre of the space between the groups of gauze threads, as represented at B. This is followed by a process in which the

strips are subjected to heat, moisture, and pressure, which causes each to assume the form of a thread in which the severed weft picks are shaped as illustrated below B. The threads are then indicated by a letter or number, and each is wound separately in a convenient form for subsequent use.

All the chenille threads that are woven alongside each other (with the exception of the selvage threads which are wasted) are, of course, exactly alike, and as many threads—within the capacity of the loom—are woven at the same time as will give the required number of repeats of the design. The counts of the pile weft is usually

equal to 2's or 3's worsted, and may be $2/4$'s, three-ply $2/12$'s, or two-ply $2/12$'s worsted, but for a very deep coarse pile a yarn ranging from 30 to 40 yards per ounce may be used. The gauze threads are generally equal to about 10's or 12's cotton, and $3/30$'s or $4/50$'s may be used for the crossing threads, and $2/24$'s or $3/36$'s for the standard threads. For 100 yards of chenille thread about 115 yards of the standard threads, and from 170 to 220 yards of the crossing threads are required, the lengths varying according to the thickness of the weft and the number of picks per inch.

Setting.—In this—the second weaving operation—the chenille pile thread, in which the differently coloured tufts are arranged in precise order according to the design, is traversed from side to side, and is bound in by means of a fine linen or cotton warp to

the surface of a foundation texture. The length of each pile thread that is taken up at each horizontal traverse is equal to the width of a horizontal space of the design. In a recent method of “setting,” a length of the chenille thread is placed within an oblong metal case in such a manner that when it is withdrawn it is free from twists. The case is placed in a specially shaped shuttle, and the chenille is woven into the cloth in the same way as weft, except that the loom stops after the insertion of each pick of chenille while the weaver combs the thread forward and “sets” it in the proper relative position to the preceding pick of chenille.

Structure of the Fabric.—The structure of the foundation varies according to the purpose of the fabric—table covers, hangings, etc., being made lighter and

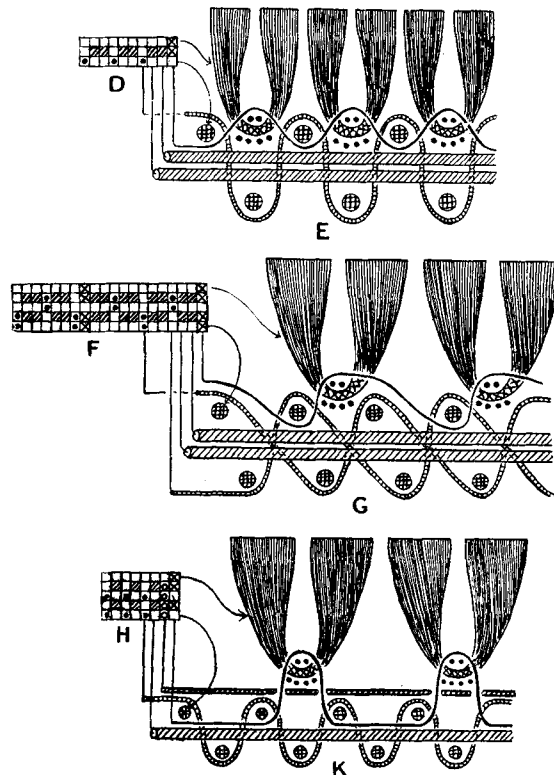


Fig. 460.

more flexible in the foundation than carpets and rugs which require to be very stiff. D in Fig. 460 shows the weave plan, and E a cross-section through the weft of a structure in which there are two picks to each chenille thread, one ground end to two stuffer ends, and one fine binder end or catcher to every nine ends of the foundation. F and G similarly show a weave plan and a cross-section of a structure in which there are four picks to each chenille thread, one ground end to two stuffer ends, and two fine catcher ends to eighteen ends of the foundation. Both structures may be woven with nine ground ends, eighteen stuffer ends, and three catcher ends per inch, while for the first example, 12 picks and 6 chenille threads per inch are suitable, and for the second, 16 picks and 4 chenille threads per inch. The catcher ends unite the chenille pile threads to the foundation, as shown in the diagrams E and G.

H and K in Fig. 460 illustrate another structure which is woven with 4 picks to each chenille thread. In this case the warp is arranged 1 ground end, 1 stuffer end for three times, 1 float end, and 1 fine catcher end. The float end is raised over all the picks of the foundation, but passes under the chenille thread, and the object of its insertion is to raise the chenille above the foundation and bring it more prominently to the face. In each example given in Fig. 460 only the fine catcher ends pass over the chenille pile threads.

MOQUETTE, OR ROYAL AXMINSTER PILE

Royal Axminster pile belongs to the tufted class, the designs for which are painted out in exactly the same manner as for chenille Axminsters, and like the latter they possess practically no restrictions as to the number of colours that can be introduced. The sectional plan given in Fig. 458 will, therefore, serve to illustrate the method of designing for the cloths. The tufted pile may be formed by hand, as in certain classes of Eastern carpets and rugs, or by machinery, the latter method being now much more commonly employed because of its greater productiveness and cheapness.

In machine tufting the differently dyed pile yarns are first wound side by side on bobbins which are as long as the width of the texture to be woven, and a separate bobbin is employed for each horizontal space in the design—that is, each horizontal row of tufts. As many tufting bobbins are, therefore, employed as there are horizontal spaces in the repeat of the design, and the bobbins, which are numbered from one upwards to coincide with the horizontal spaces, are arranged in consecutive order in two endless chains by which they are carried. As many pile threads are wound on to each bobbin as there are tufts of pile to be formed in the width of the cloth, and these threads are arranged as to colour in the order in which the colours are indicated in the corresponding horizontal space of the design. Assuming that a design repeats upon 144 vertical spaces, and 216 horizontal spaces, 144 tufts will be formed in each horizontal line of pile, and 216 bobbins will be used, each containing 144 threads. A separate thread is provided for every small space in the design, and each thread is dyed the colour that is indicated upon the corresponding space.

The chains carrying the bobbins are slowly rotated, and a fresh bobbin is presented every 4 or 6, etc., picks. The pile threads from each bobbin are passed separately through tubes, and each time a row of tufts is formed a length sufficient

to form a tuft is cut off each thread. This is inserted in the shed, and passed below a double weft pick with the free ends pointing upward. (The method of inserting the weft causes the picks to run in pairs.) One type of this class of structure is illustrated in Fig. 461. In the

weave given at A, the picks, which are double in the cloth, are shown separately, the dots indicating the lifts of the ground or fine chain threads, the shaded squares the lifts of the stuffer threads, while the oval marks indicate the picks under which the pile tufts are inserted. The diagram B represents how the threads interlace with the picks;

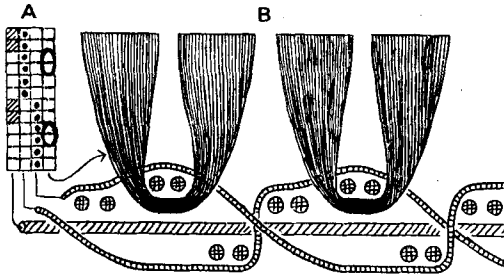


Fig. 461.

the latter are shown arranged to correspond with the order in which they are inserted, whereas in the cloth the two picks in the lower line are directly below those in the upper line, and thus form a back to the pile tufts. In the example three double picks are inserted to each row of tufts.

INDEX

A

- Advantages and disadvantages of warp backing, 13
- " and disadvantages of extra warp figuring, 131
- " of backed, double, and treble systems, 1
- Alhambra quilts, 135, 219
 - Heald and harness mounting for, 135
 - Interweaving of extra ends in ground, 137
 - Method of designing for, 137
 - Particulars of, 136
 - Structure of, 135
- Astrakhan, Imitation, 405
 - Warp-pile, 403
 - Weft-pile, 377
- Axminster pile, Chenille or patent (*see* chenille)
- Axminster pile, Royal or Moquette, 448
 - Colouring of, 448
 - Method of designing for, 448
 - Preparation of pile yarn for, 448
 - Structures of, 449

B

- Backed cloths, 1
 - Comparative setting of, 18
 - Figured reversible (*see* reversible)
 - Imitation or pseudo (*see* imitation)
 - Number of threads in repeat of, 4, 10, 16
 - Stitching or tying in (*see* stitching)
 - Warp- (*see* warp-backed)
 - Weft- (*see* weft-backed)
 - with firm and loose back, 7
 - with warp-pile face, 403
- Backed cloths with wadding threads, 21
 - Drafting in healds for, 22, 23
 - Interweaving of wadding with backing threads, 23
 - Method of warp stitching, 21
 - weft " " 23
 - Object of, 21
 - Warp-backed and weft-wadded, 22
 - Weft-backed and warp-wadded, 21
- Backed, double, and treble systems, Advantages of, 1
- Backing weave, Position of, in double cloths, 52, 55
 - Relative position of ties to, 52
- Beaming for double cloths, 41
 - warp-backed cloths, 15
- Bed mats, 220
- Book-muslin fabrics, Figured, 169
 - Card-cutting for, 171, 173, 174
 - Card-saving mechanism for, 175
 - Counts of design paper for, 175
 - Features in painting out designs for, 172
 - Ground weave variation in, 173

- Book-muslin fabrics, Ground weft cords in, 174
 - Limitations in, 171
 - Production of variety in, 171
 - Proportion of cover in, 175
 - Structure of, 170
 - System of loom mounting for, 170, 175
 - Weaving particulars of, 174
- Bottom and top douping, 221, 235, 278
- Broad double plain stripes, 75
- Brussels pile structures (*see* Wilton)

C

- Card-cutting for book-muslin fabrics, 171, 173, 174
 - for double-plain jacquard, 202
 - for extra warp figures, 142, 145
 - for extra weft figures, 108, 110, 116, 118
 - for extra weft and extra warp figures, 150
 - for gauze fabrics, 260, 261, 263, 276, 280
 - for heald and harness mounts, 118, 142, 145, 193
 - for ingrain carpets, 202, 203, 205, 207, 208
 - for inverted hook jacquards, 163
 - for Madras gauze fabrics, 291, 293
 - for Marseilles quilts and fast-back toilets, 211
 - for Mitcheline or patent satin quilts, 218
 - for pick-and-pick figuring, 120, 121, 123, 124
 - for reversible weft-face cloths, 129, 131
 - for sectional jacquard arrangements, 160
 - for split harness mountings, 165, 167, 197
 - for swivel figures, 337, 342, 343, 346
 - for tapestry and upholstery cloths, 124, 189, 191, 193, 194, 197, 199
 - for Turkish towelling fabrics, 393, 394
 - for warp pile fabrics, 410, 412, 415, 417, 419, 420, 422, 424, 425
 - for weft pile fabrics, 380
 - for Wilton and Brussels structures, 430
- Card-saving, Methods of, 161
 - in book-muslin fabrics, 175
 - in damask fabrics, 177, 180, 184
 - in double-plain jacquard, 202, 204
 - in fancy toilet cloths, 210
 - in inverted hook jacquards, 162
 - in Marseilles quilts, 212, 216
 - in Mitcheline or patent satin quilts, 218
 - in pressure harness, 180
 - in self-twill jacquard, 184
 - in split harnesses, 164
 - in warp pile fabrics, 410, 412
 - in Wilton and Brussels carpets, 431
- Cellular tennis shirting, 230
- Centre-stitched double cloths, 92
 - Check-lined, 92, 95
 - Method of heald drafting, 94
 - Reversible, 94

- Centre-stitched double cloths, Warp-method of stitching, 93
 Weft-method of stitching, 95
- Check designs, Double-plain, 81
- Check-lined double cloths, 92, 95
- Chenille or patent Axminster pile, 444
 Colouring of, 444
 Comparison with tapestry pile, 444
 Counts of design paper for, 445
 Distinctive features of, 444
 Formation of chenille, 445
 Method of designing for, 444
 Particulars of, 447
 Setting, 447
 Structure of, 447
 Use of float ends in, 448
- Chintzing, 126, 175, 291
- Circular-swivel mechanism (*see* swivel mechanisms)
- Colouring of backing ends in double plain stripes, 79, 86
 „ of book-muslin fabrics, 175
 „ of chenille Axminster pile fabrics, 444
 „ of double plain stripe cloths, 70, 75, 76, 79, 81, 82
 „ of double twill and sateen stripe cloths, 87
 „ of double weave figured combinations, 151
 „ of extra weft and extra warp figures, 107
 „ of gauze fabrics, 221, 229, 231, 275
 „ of ingrain carpets, 200, 203, 205, 207
 „ of interchanging double weaves, 67, 70
 „ of lappet fabrics, 312, 319
 „ of Madras gauze fabrics, 288, 292, 295
 „ of Mitcheline or patent satin quilts, 217
 „ of moquette or royal Axminster pile, 448
 „ of net or spider lenos, 234
 „ of plain warp pile fabrics, 406
 „ of swivel fabrics, 335, 339, 341, 343
 „ of tapestry and upholstery cloths, 186, 187, 190, 194, 195, 199
 „ of tapestry pile fabrics, 437
 „ of Turkish towelling fabrics, 387, 394
 „ of weft pile fabrics, 371
 „ of Wilton and Brussels pile structures, 426, 427, 433, 435
- Comber-boards, Working (*see* working comberboards)
- Combination of backed and single weaves, 18
- Combinations of lifting rods or bars with jacquard machines, 164, 197
- Common wheel lappet system (*see* lappet)
- Comparative setting of backed cloths, 18
- Comparison of ordinary and special jacquards, 156
 „ top and bottom doup pegging plans, 235
- Corded velveteen (*see* weft pile)
- Crepon ground with warp pile figure, 421
- Crepon structures, 155
- Cut double cloths, 65
 Beaming and drafting, 68
 Method of designing, 69
 produced by interchanging the threads, 66
 „ interweaving in 3-and-3 order, 67
 Stitching or tying in, 65, 68
- Cut pile, 395, 397
- D
- Damask fabrics, 177
 Card saving in, 175, 177, 180, 184
 Counts of design paper for, 186
 Method of designing, 177, 179, 184
 Non-reversible, 164, 177
 Pressure harness (*see* pressure harness)
 Production of diversity of effect in, 185
 Reversible, 177
 Self-twilling jacquard (*see* jacquard, self-twilling)
- Decked mails, 177
- Defective conditions in double cloths, 51, 53, 58, 60
 „ „ weft backing, 6, 9, 11
- Denting extra warp patterns, 138, 140, 150
 „ gauze fabrics, 220, 230, 232, 235, 249
 „ Madras muslins, 283
 „ Wilton and Brussels structures, 429
- Distorted weft effects, 244, 246, 252
- Dogskin weft pile, 378
- Double cloths, 2, 24
 Arrangements of threads in, 25
 Beaming, 41
 Centre-stitched (*see* centre-stitched)
 Construction of designs for, 28, 55
 „ drafts for, 42, 59, 61
 „ pegging plans for, 44, 59, 61
 Cut (*see* cut double cloths)
 Defective conditions in, 51, 53, 58, 60
 Double-stitched, 4, 41, 46, 47
 Effect of stitching on number of healds, 45
 in which the threads interchange (*see* interchanging)
 Marking for warp in, 31
 „ weft in, 28
 Origination or selection of weaves for, 26
 Position of backing weave in, 52, 55
 Relation of ties to weaves in, 52
 Relative position of healds in drafting, 42
 „ thickness of threads in, 26, 30
 Reversible, 61
 Reversing the healds in weaving, 44
 Special classes of, 63
 „ features in, 47
 Stitching or tying (*see* stitching double cloths)
 Structure of, 24
 Systematic construction of designs for, 55, 57, 59
 Wadded (*see* wadded double cloths)
 warped and wefted 1-and-1, 28, 42, 44, 45, 46, 48, 51, 56, 57, 62

- Double cloths—
 warped and wefted 2-and-1, 31, 47, 49, 59, 62
 „ „ 3-and-1, 34
 „ „ 2-and-2, 40
 „ „ in mixed order, 35
 „ „ irregularly, 36
 wefted in even picks, 36
 with centre wadding cloth, 106
 „ compound face weaves, 61
 „ warp pile face, 403
- Double cloths, Figured, 151, 187
 Fine and coarse fabrics combined, 153
 in combination with warp pile, 419, 420
 in double plain weaves, 75, 151, 160, 187, 200, 216
 „ twill weaves, 153
 „ weaves and warp and weft float, 154, 190
 „ „ weft figure on warp rib ground, 155
 in ingrain carpets, 200
 in tapestry and upholstery cloths, 187
 Methods of arranging the colours in, 151
 producing crepon effects, 155, 420
- Double-face Turkish towelling fabrics, 383, 384
 „ warp pile fabrics, 404
- Double plain check designs, 81
- Double plain figured cloths, 75, 151, 160
 in fine and coarse fabrics, 153
 in ingrain carpets, 200
 in Marseilles quilts, 211, 215
 in Mitcheline quilts, 216
 in tapestry and upholstery cloths, 187
 Sectional jacquard and harness arrangements for, 156
 Special jacquard and harness arrangement for, 200
 with pile figure, 419, 420
 with weft or warp figure, 154, 190
- Double plain jacquard (*see* jacquard, double plain)
- Double plain stripe cloths, 69
 arranged 1-and-1 as to colour, 70
 „ 1 face, 1 back in the warp, 76
 Broad stripes in, 75
 Correct joining of weaves in, 72
 Cutting and joining the weaves in, 78
 Drafting in healds, 81
 Horizontal hairline in, 73
 Intermingled colour effect in, 73
 in three and four colours, 82
 Methods of arranging threads in, 70
 „ colouring the backing ends in, 79, 86
 „ construction compared, 76
 „ designing, 72, 79
 Specially arranged, 74
 „ coloured in the warp, 76
 3-shade patterns warped 1 face, 1 back, 84
 4-shade patterns warped 1 face, 1 back, 85
 4-shade patterns coloured 1-and-1 in the warp, 82
 Union of fabrics in, 69, 76, 81
 Vertical hairline in, 70, 78
- Double-plush weaving, 404
- Double-scale harnesses (*see* split harness)
- Double stitching, 4, 41, 46, 47
- Double-twill and sateen stripe cloths, 86
 arranged 1 face, 1 back in the warp, 87
 coloured 1-and-1 in the warp, 87
- Double twill figured cloths, 153
- Double-wefted reversible figured cloths, 126
- Doup healds, 221
 Setting of, 224
- Drafting in healds for backed cloths with wadding threads, 22, 23
 for centre stitched double cloths, 94
 for cut double cloths, 68
 for double cloths, 42, 59, 61
 for double-plain stripes, 81
 for extra warp stripes, 138, 141
 for gauze fabrics, 222, 233, 237, 257
 for tapestry pile carpets, 442
 for treble cloths, 101
 for Turkish towelling fabrics, 385
 for warp-backed cloths, 15
 for warp pile fabrics, 400, 407
 for warp-wadded double cloths, 92
 for weft-backed cloths, 9, 12
- E
- Easer or slackener, 223
- Embroidery and swivel ornamentation compared, 335
- End-and-end figuring, 145
- Extra threads, Introduction of, 1.
 Disposal of surplus, 107
 Economical use of, 148
 in both warp and weft, 148.
 Methods of introducing, 107
 Objects of introducing, 1
 Principles of figuring with, 106
- Extra warp figuring, 131
 Card-cutting for, 142, 145
 Combination of continuous and intermittent, 141
 combined with gauze, 240, 249
 Comparison with extra weft figuring, 131
 Continuous in one extra, 132
 Counts of design paper, 135
 Denting stripe patterns, 138, 140
 Drafting stripe patterns, 138, 141
 End-and-end, 145
 Extra warp cut away, 133
 „ stitched between face floats, 137
 „ „ by special picks, 140
- Heald and harness mounting for, 135
 „ knitting plans for, 138
 in Alhambra quilts (*see* Alhambra)
 in four colours, 146
 in two extras, 140
 intermittent in one extra, 137
 Method of designing, 133, 137, 138, 143
 Ornamentation of ground by stitching, 137
 Planting in, 145
 Reversible warp-face, 147

- Extra weft and extra warp figuring, 148
 Double weave combinations (*see* double cloths, figured)
 Economical use of extra threads, 148
- Extra weft figuring, 106
 Arrangement of loom motions in, 116
 Card-cutting for, 108, 110, 116, 118, 120
 Chintzing in, 126, 175, 291
 Combined with gauze, 242
 " " ground weft figure, 116
 Continuous in one extra, 108
 " " two extras, 119
 Counts of design paper, 111, 119
 Extra weft cut away, 112, 169, 281
 " stitched between face floats, 113, 116
 " " by special ends, 117
 Intermittent, 115
 in two or more colours, 118
 Method of designing, 108, 111, 113, 115, 118
 Modification of ground weave, 114
 Persian style of, 125
 Pick-and-pick (*see* pick-and-pick)
 Reversible tapestry style, 124
 " weft-face (*see* reversible weft-face)
 Selection of positions for figuring floats, 112
 Solidity of figure in, 110, 111, 119
 Wefted 1-and-1, 108
 " 1-and-2, 111
 " 2-and-2, 110
 " 2-and-4, 111
- F
- Fancy toilet cloths (*see* toilet cloths)
 Fast-back toilet cloths (*see* Marseilles quilts)
 Figuring capacity of jacquards (*see* jacquards, increasing the)
 Frisé, boucle, or terry pile, 395
- G
- Gauze and leno fabrics, 220
 Application of colour to, 221, 229, 231, 275
 Arrangements of threads in, 220
 Beaming the warp for, 228
 Bottom and top douping, 221
 Cellular tennis shirting, 230
 Combinations of gauze and other weaves, 229, 240, 253
 Combined with plain and warp or weft figure, 255
 Comparison of, 227
 Construction of pegging plans for, 224, 235
 Denting of, 220, 230, 232, 235, 249
 Distorted weft effects, 244, 246, 252
 Easer or slackener, 223
 Forms of doups, 221
 Heald drafting for, 222, 233, 237, 257
 Heald-knitting plans for, 250
 Healds used in weaving, 221
 Loom mounting for, 221
- Gauze and leno fabrics—
 Modifications of pure gauze and leno, 229
 Net or spider lenos (*see* net or spider)
 Pointed drafting in, 229, 234, 237
 Relative position of healds, 222, 243
 Russian cords, 230
 Setting of doups, 224
 Shaker motions, 225, 227
 Sheds formed in weaving, 223
 Simple cross-over and check patterns, 231
 Structure of, 220, 228
 2-doup patterns, 243
 3-doup patterns, 244
 Use of several back crossing healds and one doup, 248
 with extra warp effects, 240, 249
 " weft effects, 242
- Gauze and leno fabrics, Figured, 258
 Beaming the warp for, 263, 267
 Card-cutting for, 260, 261, 263, 265, 276, 280
 Combinations of gauze, plain, and warp or weft figure, 260
 Combinations of twill and gauze, 267
 Construction of ground weaves for, 262, 266, 272
 Counts of design paper for, 260, 265, 266
 Harness drafting for, 260, 261, 265, 266, 269
 Madras (*see* Madras)
 Method of designing, 260, 261, 263, 265, 275, 280
 Net-lino styles, 267
 1-crossing-1 styles, 260
 1-crossing-2 styles, 263
 1-crossing-3 styles, 267
 2-crossing-2 styles, 269
 Ordinary jacquard and doup-heald mountings, 258
 Simplification of designing for, 265
 Special gauze jacquard for (*see* gauze jacquard)
 Styles of, 259
 Styles which require no shaker motion, 259
 Systems of mounting for, 258
 Use of two doup healds in, 263
- Gauze imitation in lappet weaving, 324-328
 Gauze jacquard and harness, Special, 269
 Arrangement of harness, hooks, and needles, 269
 Construction of ground weaves for, 272
 Inverted hooks in, 280
 Method of designing figures for, 275, 280
 " douping and easing, 269
 Sheds formed in top douping, 279
 System of card-cutting, 276, 280
 " drafting, 269, 279
 Top douping in, 278
- H
- Hairline effects in double-plain stripes, 70, 73, 78
 Harness and jacquard mountings, Special (*see* jacquard and harness)

- Heald drafting (*see* drafting in healds)
 ,, and harness mountings (*see* jacquard harness and heald)
 ,, knitting plans, Construction of, 138, 250
- I
- Imitation gauze in lappet weaving, 324-328
 ,, ,, stripes, 143, 144
 ,, ,, in book muslins, 173
 ,, lace, 331
 ,, of embroidery by swivel, 338, 349
 ,, of weft pile, 382
- Imitation or pseudo-backed cloths, 18
 Advantages and disadvantages of, 18
 Comparative setting of, 21
 of 1-and-1 warp backing, 21
 of 1-and-1 weft backing, 18
 of 2-and-1 warp backing, 21
 of 2-and-1 weft backing, 20
- Increasing the figuring capacity of jacquards (*see* jacquards, increasing the)
- Ingrain, Scotch, or Kidderminster carpets, 200
 Application of colour to, 200, 203, 205, 207
 Card-cutting for, 202, 203, 205, 207, 208
 Double-plain jacquard (*see* jacquard, double plain)
 Figuring with the warp in, 207
 Heald and harness draft for, 203, 205
 Intermingling the colours in, 207
 Methods of designing for, 202, 203
 Methods of producing variety in, 207
 produced in double-plain weaves, 200
 Sectional harness tie for, 207
 Reversible 4-ply, 204
 Weft-face, 203
- Interchanging double-weave figuring (*see* double cloths, figured)
- Interchanging double weaves, 63, 66, 69
 Colouring of, 67, 70
 in the warp, 64, 73
 in the weft, 65, 71
 in warp and weft, 67, 70
- Introduction of extra threads, 1
- Inverted-hook jacquards (*see* jacquards with inverted hooks)
- J
- Jacquard and harness mountings, Special, 156
 combined with healds (*see* jacquard harness and healds)
 ,, lifting rods or bars, 164, 181, 197
 ,, working comber-boards (*see* working comber-boards)
 compared with ordinary mountings, 156
 for book-muslin fabrics, 170, 175
 for cut and looped pile figuring, 410
 for double-plain cloth (*see* jacquard, double-plain)
 for fancy toilet cloths, 209, 212, 215
 for gauze fabrics, 259, 269, 283
 for ingrain carpets, 200
- Jacquard and harness mountings, Special--
 for Marseilles quilts, 212, 215
 for Mitcheline or patent satin quilts, 167, 217
 for tapestry and upholstery cloths, 197, 199
 for Turkish towelling fabrics, 392, 394
 Increasing the figuring capacity of (*see* jacquards, increasing the)
 Pressure harness (*see* pressure)
 Sectional jacquard arrangements (*see* sectional)
 Self-twilling jacquard (*see* jacquard, self-twilling)
 Split harness or shaft monture (*see* split harness)
 with inverted hooks (*see* jacquards with inverted hooks)
- Jacquard, Double-plain, 200
 Arrangement of threads in, 200
 Card-cutting for, 202
 Connection of hooks and needles in, 201
 Limitations of, 202
 Method of designing for, 202
 Method of drafting in, 200
 Operation of jacquard and comber-boards, 202
- Jacquard gauze fabrics (*see* gauze and leno-figured)
 ,, ,, mounting, 258, 269
 ,, ,, Madras (*see* Madras)
- Jacquard harness and heald mountings, 135, 163
 combined with lifting rods, 197
 for Alhambra quilts, 135
 for book-muslin fabrics, 170
 for damask fabrics (*see* pressure harness)
 for extra warp figures, 135
 for extra weft figures, 118
 for gauze fabrics, 258
 for ingrain carpets, 203, 205
 for loose-back toiles, 209
 for Marseilles quilts, 212, 215
 for Mitcheline quilts, 217
 for tapestry and upholstery cloths, 194, 196
 for Turkish towelling fabrics, 392, 394
 for warp pile fabrics, 409, 411, 418, 421, 428
 for Wilton and Brussels structures, 428
 Limitations in, 135, 164
- Jacquard, Self-twilling, 181
 Arrangement of needles, hooks, and lifting bars, 181
 Changing capacity and sett of, 184
 Defect of, 184
 Operation of card cylinder, 184
 ,, twilling needles, 183
 Proportions of hooks to needles, 183
 System of designing for, 184
- Jacquards, Increasing the figuring capacity of, 161
 by combining with a gauze reed, 282
 ,, ,, inverted hooks, 143, 161
 ,, ,, lifting rods, 164, 197

- Jacquards, Increasing the figuring capacity of—
 by combining with ordinary healds (*see*
 jacquard harness
 and healds)
 " " pressure healds, 177
 " " twilling bars, 181
 " " working comber-boards
 200
 " " working comber-boards
 and healds, 167, 212,
 215, 217, 410
- Jacquards, Twin, 157, 161, 201
- Jacquards with inverted hooks, 161
- Card-cutting for, 163
- for Brussels and Wilton carpets, 431
- for double plain cloth, 200
- for gauze fabrics, 280
- for reversible warp-rib structures, 163
- for rib or rep quilts, 220
- for Turkish towelling fabrics, 382
- Object of, 162
- K
- Kidderminster carpets (*see* ingrain)
- Knotted comber-boards (*see* working comber-
 boards)
- L
- Lappet figuring, common wheel system, 296
- Continuous and intermittent combined,
 296, 298
- " spotting by one frame, 307
- " 2-frame design, 310
- " 3-frame design, 314
- " 4-frame design, 315, 319
- Counts of design paper for, 307
- Features of, 296, 298
- Features to note in, 310, 314, 315
- Imitation lace, 331
- Intermittent 3-frame design, 312
- Length of repeat in, 319
- Limitations in, 296
- Method of indicating a pattern groove, 308
- Methods of indicating figures, 307
- " producing diversity, 319
- To find the diameter of a wheel, 316
- Varying the lifts of the ground ends, 331
- " " " needle bars, 332
- Lappet figuring, presser wheel system, 320
- Arrangement of teeth in presser wheel, 323
- Continuous 2-frame design, 322, 325, 328
- " 4-frame design, 326
- in imitation of gauze or leno, 324-328
- Method of indicating a pattern groove, 321
- Styles of presser wheel designs, 321
- To find the length of whip warp, 324
- Waved Russian cords, 328
- Lappet loom mounting, 298
- Common wheel system, 298
- Construction of a common lappet wheel,
 306
- Lappet loom mounting—
- Crossing the needle bars, 315
- Lateral movement of needle bars, 303
- Making needle bars inoperative, 302, 313,
 332
- Maximum concentric width of a groove,
 318
- Methods of increasing length of repeat, 319
- Modification of wheel for opposite hand of
 loom, 306, 310
- Movements in lappet loom, 299
- Position of reed in, 299
- Presser wheel system, 320
- Relation of movement of shifter frame to
 rotation of pattern wheel, 304
- Relative position of needle bars and pecks,
 311
- Rotation of pattern wheel, 300
- Scotch type of, 298
- Spacing the needles in the bars, 319
- Tension device for whip threads, 299
- Timing of motions in, 300, 302, 304
- Vertical movement of pin and needle bars,
 300
- Leno and gauze fabrics (*see* gauze)
- Limitations in book-muslin fabrics, 171
- " double-plain jacquard, 202
- " figured gauze fabrics, 268
- " heald and harness mountings,
 135, 164
- " lappet fabrics, 296
- " Madras gauze fabrics, 288
- " Mitcheline quilts, 219
- " swivel figuring, 345
- Looped or terry pile, 382, 395, 397
- Loose-back toilet cloths (*see* toilet cloths)
- Lyon's velvet, 400
- M
- Marseilles quilts and fast-back toilet cloths,
 211
- Card-cutting for, 211
- Counts of design paper for, 213
- 4-pick structure, 213
- 5-pick structure, 215
- Method of designing for, 211, 215, 216
- Special 5-pick cloth, 215
- System of loom mounting for, 212, 215
- Madras gauze fabrics, 280
- Card-cutting for, 291, 293
- Colouring of, 288
- Complex three-colour design, 292
- Designing for, 287, 291
- Gauze figure on opaque ground, 292
- Methods of varying the density, 288
- Modifications of the structure, 288
- Proportion of cover in, 295
- Single-cover chintzed design, 291
- Structure of, 280
- Reversible in colour, 295
- Madras gauze mounting, 282
- Arrangement of shuttle boxes, 283
- Method of crossing the ends, 283
- " easing, 283

Madras gauze mounting—
 Operation of easing bar, 286
 „ gauze reed, 284
 „ picking mechanism, 287
 „ tug reed, 286
 „ uptake motion, 287
 System of drafting, 283
 Mitcheline or patent satin quilts, 216
 Application of colour to, 217
 Card-cutting for, 218
 Counts of design paper for, 219
 Method of designing, 218
 Method of loom mounting, 217
 Production of variety in, 219
 Structure of, 217, 219
 Moleskin, 372, 376
 Moquette (*see* Axminster pile)
 Multiple warp figuring, 146, 198
 in Turkish towelling fabrics, 394
 in Wilton and Brussels pile structures, 394
 Multiple warp and weft figuring, 187, 190
 Multiple weft figuring, 125, 130
 in ingrain carpets, 205, 207
 in Madras muslins, 292
 in tapestry and upholstery cloths, 191, 194, 195
 Muslins, Methods of producing figured, 169
 (*see also* book-muslin, Madras, and lappet)

N

Net or spider lenos, 233, 266
 Bead mounting for, 238
 combined with perforated structures, 244, 246
 Fancy one-doup, 251
 Features to note in, 236
 Figured, 267
 Heald knitting plans for, 250
 Method of colouring, 234
 „ denting, 235, 249
 „ designing, 236
 Point-drafted, 234
 requiring two doups, 243
 spotted with extra warp, 241, 249
 „ extra weft, 242
 Top and bottom-doup pegging plans compared, 235
 Use of one doup and several back-crossing healds, 248
 Varying the lifts of the standard ends, 237

O

Objects of introducing extra threads, 1
 Osman Turkish towelling, 384

P

Panne velvet, 399
 Patent Axminster pile (*see* chenille)
 „ satin quilts (*see* Mitcheline)
 Pegging plans for double cloths, 44, 59, 61

Pegging plans for gauze fabrics, 224, 225
 „ „ treble cloths, 101
 „ „ warp-backed cloths, 15
 Persian style of extra weft figuring, 125
 Pick-and-pick figuring, 120
 Card-cutting for, 120, 121, 123, 124
 Formation of ground weave in, 120
 in split harnesses, 167
 in three wefts, 123
 Method of designing, 120, 123
 „ indicating ground weaves, 121
 Multiple weft Persian style, 125
 Reversible tapestry style, 124
 Reversible weft-face (*see* reversible weft-face)
 Weave shading in, 123
 with warp pile figuring, 422
 Piece-dyed cloths, 11, 63
 Pile cutting wires, 396
 Pile fabrics, Chenille or patent Axminster (*see* chenille)
 Features of, 362
 Figured warp (*see* warp pile figured)
 in which the design is due to colour, 426
 Moquette, or royal Axminster (*see* Axminster)
 Plain velveteen, 366
 „ warp pile, 399
 Turkish towelling (*see* Turkish towelling)
 Warp (*see* warp pile)
 Weft (*see* weft pile)
 Wilton and Brussels (*see* Wilton)
 Planting in extra warp figuring, 145
 „ Wilton and Brussels pile, 427, 433, 434
 Plush fabrics (*see* pile)
 Presser wheel lappet system (*see* lappet)
 Pressure harness, 177
 Changing the sett of, 179
 Defect of, 180
 Form of the healds, 178
 Method of designing for, 179
 „ drafting in, 179
 Operation of the harness and healds, 179
 Principles of stitching or tying (*see* stitching)

Q

Quilts, Alhambra (*see* Alhambra)
 „ Marseilles (*see* Marseilles)
 „ Mitcheline or patent satin (*see* Mitcheline)
 „ Rib or rep, 220
 „ Varieties of, 219

R

Rack and pinion swivel loom (*see* swivel mechanisms)
 Relative position of healds in double cloths, 42
 „ „ „ in gauze weaving, 222, 243
 „ „ „ in warp-backed cloths, 15

- Relative position of healds in warp pile weaving, 400
- Rep or rib quilts, 220
- Reversible centre-stitched double cloths, 94
- „ figured tapestry cloth, 124, 193
- „ „ warp-rib fabrics, 163, 220
- „ warp-backed cloths, 14
- „ warp-face figured cloths, 147
- „ warp pile cloths, 404
- „ weft-backed cloths, 8
- Reversible weft-face figured cloths, 126
- Card-cutting for, 129, 131
- Construction of weaves for, 128
- Features of, 127
- Method of designing in full, 128
- „ „ simplified, 129
- „ „ strengthening, 130
- Treble-wefted, 130
- Reversible weft pile fabrics, 379
- Royal Axminster pile (*see* Axminster)
- Rug and shawl fabrics (*see* reversible weft-face)
- Russian cords, 230
- „ waved, 328
- S
- Scotch carpets (*see* ingrain)
- „ lappet wheel loom (*see* lappet)
- Sectional jacquard and harness arrangements, 156
- Card-cutting for, 160, 163, 189, 191
- Designing for, 159
- for double-plain cloths, 159
- for ingrain carpets, 207
- for reversible warp-rib fabrics, 163
- for tapestry cloths, 199
- for Turkish towelling fabrics, 394
- for warp pile fabrics, 419, 421, 423
- for Wilton and Brussels pile structures, 429
- Object of, 156
- Special connection of hooks and needles, 158
- „ draft of the warp threads, 159
- „ tie of the harness, 157
- Self-twilling jacquard (*see* jacquard, self-twilling)
- Setting of backed cloths, Comparative, 18
- Shading weaves in pick-and-pick figuring, 123
- Shaft monture (*see* split harness)
- Shaker motions, 225, 227
- Slackener or easer, 223
- „ „ for warp pile, 402
- Special jacquard and harness mountings (*see* jacquard and harness)
- Split harness or shaft monture, 164
- Card-cutting for, 165, 167
- Double and treble-scale, 165
- Object of, 164
- Operation of lifting rods, 164
- Pick-and-pick figuring in, 167
- Prevention of long floats, 166
- Specially arranged for tapestry cloth, 197
- System of designing for, 165
- Spotting in double plain cloths, 75
- Stitching double cloths, 25, 26
- by interchanging the threads, 65, 69, 75, 81
- by means of cutting threads, 68
- Defective methods of, 51
- Double, 4, 41, 46, 47
- Effect upon number of healds, 45
- Features in, 47
- in irregular order, 48, 57, 60
- in plain or alternate order, 34, 47, 63
- in sateen order, 31, 34, 37, 41, 44, 46, 47, 51, 55
- in twill order, 28, 33, 35, 42, 46, 51, 52
- on alternate threads, 31, 38, 49
- on consecutive threads, 36
- Relative firmness in, 5, 34
- wadded with warp, 91
- „ weft, 88
- Warp and weft methods compared, 27, 36
- wefted in even picks, 36
- with centre ends, 93
- „ picks, 95
- Stitching or tying, Principles of, 2, 26
- by means of special ends, 93, 117
- „ „ picks, 95, 144
- Defective methods of, 6
- Double, 4
- Effect of, on number of threads in repeat, 4
- in cut double cloths, 65, 68
- in centre-stitched double cloths, 93, 95
- in extra warp figuring, 137, 144
- „ weft figuring, 113, 116, 117
- in irregular order, 6
- in plain or alternate order, 6
- in sateen order, 4, 6
- in treble cloths, 98
- in twill order, 3, 4
- on two consecutive threads, 5
- Production of pattern by, 137
- Relative firmness of, 5
- Selection of suitable positions for, 2
- Stitching warp-backed cloths, 13
- Effect of, on draft, 18
- „ number of threads in repeat, 16
- in irregular order, 16
- in plain order, 15
- in sateen order, 15, 16
- in twill order, 14, 15
- Method of selecting the ties in, 16
- on alternate picks, 15
- on two consecutive picks, 16
- wadded with weft, 23
- with special weaves, 17
- with stripe face weaves, 18
- Stitching weft-backed cloths, 7
- Defective methods of, 9, 11
- Effect of, on draft, 12
- „ on number of threads in repeat, 10
- in irregular order, 11
- in plain order, 10
- in sateen order, 8, 9
- in twill order, 7, 9

- Stitching weft-backed cloths—
 Method of selecting the ties in, 11
 on alternate ends, 9
 on two consecutive ends, 9
 wadded with warp, 21
 with special weaves, 12
 with warp-face weaves, 10
- Stripe weaves backed with warp, 18
 " " weft, 12
- Swivel figuring, 334
 All-over, 345
 Card-cutting for, 337, 342, 343, 346
 Comparison with embroidery, 335
 " " lappet figuring, 335
 Detached swivel figures, 337
 Imitation of embroidery, 338, 349
 in combination with ordinary figuring, 343
 in one kind of weft by two shuttles, 344
 Purpose of, 334
 Special style of, 339
 with two or more wefts, 341
- Swivel mechanisms, Power loom, 349
 All-over figuring style, 349
 Circular style, 358
 Formation of intermediate figures, 337, 358, 360
 General description of movements, 336
 Limitations of, 345
 Rack-and-pinion style, 355
 Relation of pitch of shuttles to repeat of jacquard, 336
 Tensioning of swivel weft, 351, 362
 which govern picking of fly shuttle, 353, 354, 356
 which operate swivel shuttles, 351, 354, 358, 360
 which raise and lower carrying frame, 351, 354, 356
- Systematic construction of double cloths, 55, 57, 59
- T
- Tapestry and upholstery cloths, 186
 Application of colour to, 186, 187, 190, 194, 195, 199
 Card-cutting for, 124, 189, 191, 193, 194, 197, 199
 Classes of, 186
 Counts of design paper for, 194, 195
 Double and treble-plain, 187
 Heald and harness draft for, 194
 in double plain and weft or warp figure, 154, 190
 in warp pile (*see* Wilton and Brussels pile)
 Method of designing for, 193, 194, 195, 199
 Pick-and-pick wefted, 120, 167
 Reversible, in pick-and-pick wefting, 124
- Tapestry and upholstery cloths, Warp-face, 198
 Sectional harness tie for, 199
 Method of designing for, 199
- Tapestry and upholstery cloths, Weft-face, 191
 Figuring with the harness threads in, 193
 Heald and harness draft for, 194
 Intermingling of weft colours in, 194
- Tapestry and upholstery cloths, Weft-face—
 Reversible and non-reversible, 193
 Special jacquard and harness mounting for, 196
 Specially stitched, 195
- Tapestry pile carpets, 437
 Beaming the pile warp for, 442
 Bleeding of colours in, 438, 443
 Comparison with Brussels and Wilton structures, 437
 " " chenille Axminster structure, 444
- Cut pile cloths, 443
 Dipping the printing pulley, 440
 Formation of double shed in, 443
 Heald drafting for, 442
 Method of designing for, 438
 " weaving, 443
 Particulars of, 443
 Preparation of pile yarn for printing, 438
 Printing drum, 438
 " operation, 440
 " pulley, 440
 Process of rubbing, 441
 Processes that follow printing, 441
 Scale-board, 440
 Sizes of printing drums, 438, 439
 Structure of, 442
- Terry or looped pile, 382, 395, 397
 " motions, 385
 " towelling (*see* Turkish towelling)
- Toilet cloths, Fancy, 208
 Classification of, 209
 Fast-back (*see* Marseilles quilts)
 Half-fast back, 210
 Harness and heald mounting for, 209
 Loose-back, 209
 Method of designing for, 209
 2-pick structure, 209
 3 and 4-pick structures, 210
- Top and bottom douping, 221, 235, 278
- Treble cloths, 2, 96
 Advantages of, 96
 arranged 1 face, 1 back, 1 centre, 96, 101
 " 1 face, 1 centre, 1 face, 1 back, 104
 " 2 face, 2 back to 1 centre, 105
 Construction of drafts and pegging plans for, 101
 Methods of designing for, 99, 101
 Stitched by means of backing ends, 106
 Systems of stitching, 98
 with centre fabric as wadding, 106
- Treble-plain figured cloths, 187
 Treble-scale harness (*see* split harness)
- Treble-wefted figured reversible cloths, 130
- Trevete, 396
- Turkish towelling fabrics, 382
 Application of colour to, 387, 389, 391
 Beaming the warps for, 387
 Card-cutting for, 393, 394
 Comparison with true warp pile, 395
 Counts of design paper for figured, 393
 Designing for figured, 392, 393
 Double-face weaves, 383, 384, 391
 Features of, 382

- Turkish towelling fabrics—
 Figuring with one series of pile threads, 393
 „ two series of pile threads, 391
 Formation of the pile in, 382
 Heald-and-harness mounting for, 392, 394
 Mechanisms used in weaving, 385
 Methods of heald-drafting and denting, 385
 Mixed colour effects in, 394
 Movement of reed in weaving, 387
 Object of terry motion, 382
 Ornamentation of, 387
 Osman structure, 384
 Particulars of, 385
 Sectional jacquard arrangement for, 394
 Single-face weaves, 384, 393
 Stripe and check dobby patterns, 389
 Tension on pile warp, 387
 Weaves used for, 384
 with cross-borders, 385, 387, 389
 Twin jacquards, 157, 161, 201
 Tying or stitching (*see* stitching)
- U
- Upholstery and tapestry cloths (*see* tapestry)
 Utrecht velvet, 402, 405
- V
- Velvet (*see* warp pile)
 Velvetten (*see* weft pile)
 Vertical hairline in double plain, 70, 78
 Vesting styles, 75, 153
- W
- Wadded cloths, Warp-backed, 22
 „ Weft-backed, 21
 Wadded double cloths, 88
 Arrangement of threads in, 88
 Drafting in healds, 92
 Object of, 88
 with warp, 91
 with weft, 88
 Wadding threads, Backed cloths with, 21
 „ Double cloths with, 88
 „ in toilet cloths, 209
 „ in Marseilles quilts, 211, 215
 Warp-backed cloths, 13
 Advantages and disadvantages of, 13
 Arrangements of ends in, 13
 Beaming and drafting, 15
 Combination of single and warp-backed weaves, 147
 Figured reversible, 147
 Imitation or pseudo (*see* imitation)
 Method of designing, 13
 „ selecting ties for, 16
 Position of healds in, 15
 Reversible, 14
 Warp-backed cloths, Setting of, 18
 Special examples of, 17
 Standard weaves in, 16
 Stitching (*see* stitching warp-backed cloths)
 wadded with weft, 22
 with backing ends interwoven with wadding weft, 23
 with stripe face weaves, 18
 with warp pile face, 403
 Warp-face figured reversible fabrics, 147
 „ weaves backed with weft, 10
 Waved Russian cords, 328
 Warp pile fabrics, 395
 Astrakhan, 403
 „ imitation, 405
 Classification of, 398
 Colouring of, 406
 Comparison with Turkish towelling, 395
 Construction of weaves for, 400
 Double-plush weaving, 404
 Form of the pile wires, 396
 Formation of the pile, 395
 Ground weaves for, 397, 399, 400, 407
 Hand-cutting wires, 396
 Heald-drafting for, 400, 407
 in cut and looped pile, 404, 406
 Length of the pile, 396
 Lyon's velvet, 400
 Materials used in, 395
 Ornamentation of, 405
 Power cutting wires, 396
 Printing and embossing, 405, 406
 produced without wires, 405
 Ratio of threads and wires, 397
 Reversible, 404
 Slackening bars for, 402
 Structure of, 397
 Take-up of pile warp, 397
 Utrecht velvet, 402, 405
 with all the pile over each wire, 398-401
 with backed and double foundation cloths, 403
 with half the pile over each wire, 402
 with the pile fast, 399, 400, 401, 402, 404
 with the pile loose, 398, 400, 401, 403
 with two heights of pile, 404, 406
 with 2 picks to each wire, 398, 402
 „ 3 „ „ 399, 403
 „ 4 „ „ 401, 403
 Warp pile fabrics, Figured, 408
 Card-cutting for, 410, 412, 415, 417, 418, 419, 420, 422, 424, 425
 Combination of cut and looped pile, 408, 424
 „ pile and double plain cloth, 419
 „ „ figured warp rib, 417, 424
 „ „ weft figure, 423
 Counts of design paper for, 409, 415, 417, 425
 Creeling of pile threads, 411, 427
 Heald and harness drafts for, 409, 411, 418, 421, 425
 in which the design is due to colour, 426
 Method of designing for, 409, 411, 414, 418, 420, 422, 425
 Methods of card saving, 410, 412