

302A and 303A, when the repp features are being produced. The weft figuring on this repp ground is acquired by floating the face weft over a certain number of figuring warp threads, and also by flushing over the same group of threads the ground weft. To get the figuring in warp, the face yarns are allowed to float over both the ground and figuring picks.

When various weave effects are required in the development of the figuring, they are shown on the looming plan, as in the sectional design, Fig. 305. Here the ground of the texture would be in repp, portions of the figuring in warp twill, and portions in a broken twill, showing that decorative patterns are weavable in different weave units, and with the surface effects in a raised quality as in Figs. 302 and 303. This example is drawn to the scale on the point paper of the fabric setting, or of 3 ends of warp to 1 pick of weft in the loom.

273. *Shading Practice in Figuring.*—Ordinarily, the reproduction on a textural surface of decorative forms in light and shade does not result in fitting styles of ornamentation. It is essential that, in originating figured effects in textiles, the fabric should be alike level in structure and in appearance. With the designs composed of shaded objects, the figuring is observed to be more or less detached from the ground of the texture. Sectional parts of the decoration are in shaded tones and others in relief, whereas all parts should be visually and actually in the same plane.

Every variety of line and feature, in naturalistic or in geometric forms, may, however, be faithfully depicted in a textural product, either in monochrome or in colour. The principles of warp and weft interlacing, and of coloured-thread and coloured-shot insertion in weaving, admit of realism in design expression. The delineation of decorative elements in light and shade is, therefore, feasible on woven as on other surfaces—porcelain, paper, etc. When shading is, however, practised in textiles, it is rather with a view of expressing pattern details clearly and effectively than with a view of an exact imitation of floral, plant, and other forms.

It follows that, without tone contrasts, a description of shaded patternwork is possible in the loom. Thus, in developing shaded ornamental types, gradations in warp and weft

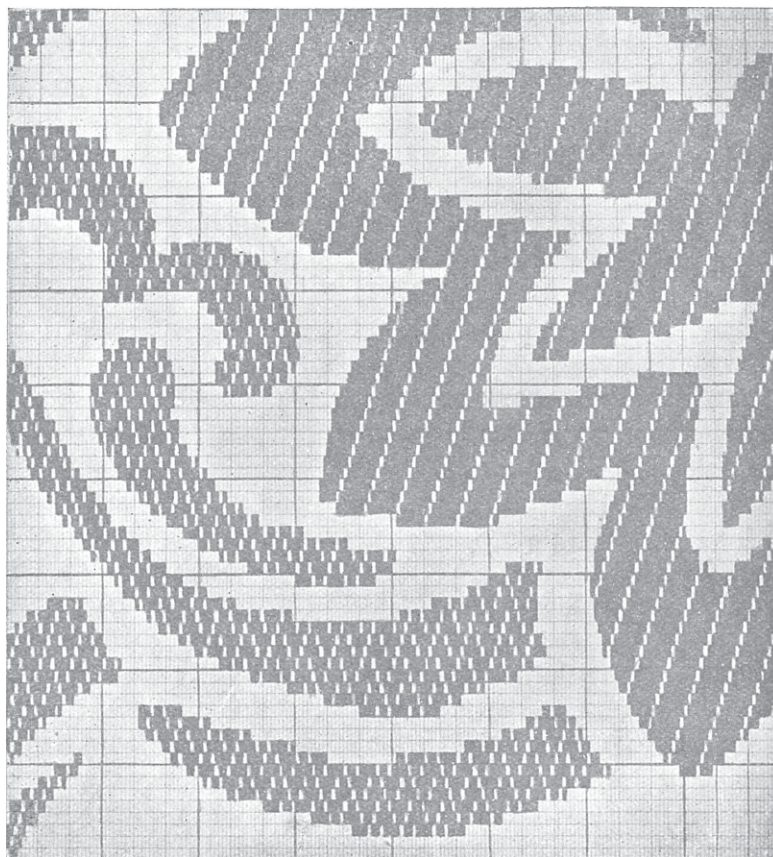


FIG. 305.—FINE-SET MATELASSÉ PATTERN. (*Section only.*)

intersections correspond to gradations in dark and light tones. The ordered or symmetrical grouping of these—as in sateen weaves, Fig. 90—correspond, in textural definition, to the results obtained by stipling, painting, and printing on a smooth, plain material. The shaded portions of the style

in Fig. 286 are not due to any difference in colour tone, but to a difference in the degree in which the weave units employed bring the warp or weft features on to the face of the fabric. The deeper tones are formed in weaves of a weft-face structure, with intermediate degrees of tinting or toning composed of intermediate types of weave.

274. *Scale of Intersections.*—As between the dark tone and the light tint of a colour, intermediate tones and tints are producible, providing the “scale of shades” in such a colour unit, so in weaves between the extreme *warp-face* and the extreme *weft-face* effect, as in sateens, twills, diamonds, etc., a “scale of gradations” in intersection types is obtainable. This is shown in the shaded diagonal in Fig. 90, in which the weaves run from a *warp* effect—giving a light tone in the texture—to a *weft* effect, producing a deeper tone in the texture or *vice versa*. With the weft intersections printed in black, and the warp intersections in white, the shading due to the changes in the weaves *a*, *b*, *c*, and *d*—all constructed on the same sateen base—is clearly observed. The softness and full graded quality of the toning vary with the dimensions of the weave base. The 8-shaft sateen allows of seven degrees of toning, the 10-shaft of nine, and so on. A tone degree is equivalent to a warp or weft intersection, hence the gradations or shading in the design is prescribed by the weave units selected.

The use of other weaves than sateens and twills in developing shaded tones in one colour is illustrated in Figs. 286 and 306. In the design in Fig. 286, the shading is produced in weaves of a twilled mat character, but in the rectangular sections of the style in Fig. 306 it is developed in a diamond type of crossing. The diamond weave in the upper portions of the figuring has a maximum weft float, covering fifteen threads of warp, and in the lower portions a minimum float of three. The tinted gradation is obtained by increasing the repp interlacings surrounding the diamond elements, in which respect the practice differs from that of acquiring textural tone in

warp and weft-face weaves by modifying the system of intersection. As a principle of "weave" shading it is adapted to light textures, and also to compound fabrics in which the yarns, when floating on the face to form the extreme weft effects, are bound regularly into the central part of the structure.

Weave shading is harsher in tone in the coarser, and softer in tone in the finer, set fabrics. The intersection tones are also modified by the depth of contrast between the shade or colour of the warp and weft yarns, but it should be clearly understood that colour contrast is not an essential part of the shaded patterns in textiles as in other decorative ornament. Obviously, in pure white yarns, or in yarns of exactly the same colour in the warp and weft of the design, weaves symmetrically varied in the order in which they give a *warp* and *weft* effect develop a toned textural surface. Shading in woven design may, therefore, be analysed either as distinct from, or as associated with, tone modification as a product of light and shade. It constitutes a scheme and practice in weaving which enables decorative effects to be accurately formed minus contrasts due to colour tinting and toning.

275. *Looming Structure—Shaded Designs.*—In the work of transferring the sketch on to point paper of designs in which the figuring is executed in light and shade, the weave units are accordingly combined to agree with each gradation in tone. The dark tones in the drawing are equivalent to weaves of the maximum weft intersections, and those in light tones to weaves of the maximum warp intersections (or conversely), with the intermediate tones in the sketch corresponding with the intermediate weave structures.

This method of work is practised in preparing all varieties of shaded patterns for the loom, and is observed in the transference of the different effects on to point paper in Figs. 307, 308, and 308A. Thus taking Fig. 307, the small, conventional, floral forms comprised, are, first, clearly defined and distinguished from each other in weave composition; second, the



FIG. 306.
SILK SPECIMEN—SHADING IN DIAMOND-WEAVE STRUCTURES.

darker tones are developed in sateen ; third, the outlines of the flowers are produced in weft floats ; fourth, the structural termini of the leaflets are formed in twilled lines ; and lastly, the shadows and veins on the leaves are expressed in warp

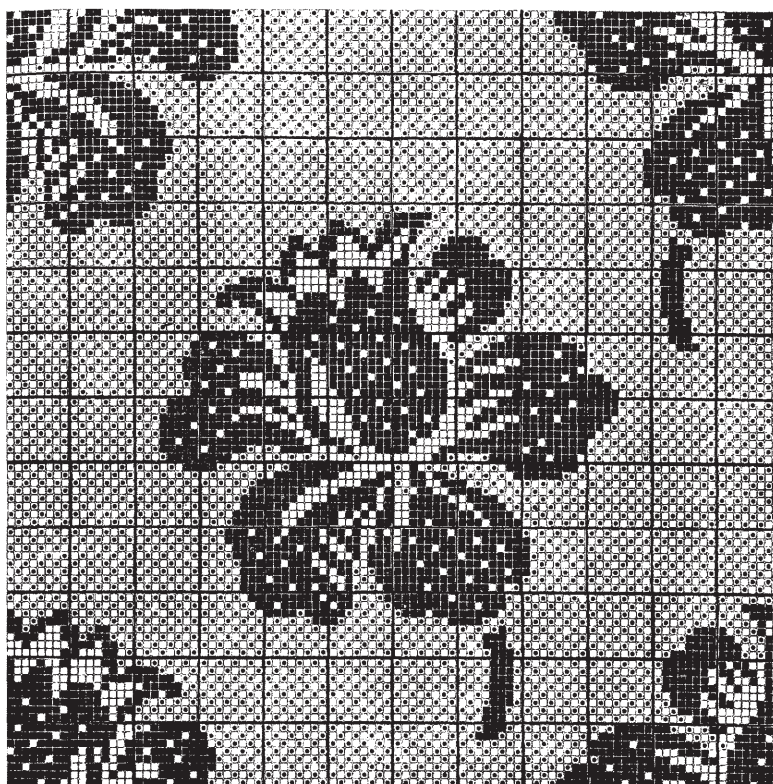


FIG. 307.—ELEMENTARY TYPE OF SHADED PATTERN.

floats and reversed twills. The correct transference of the sunflower type—sectional part of the design shown in Fig. 308—on to point paper imposes the selection and use of a larger assortment of weave units. It comprises extreme light and extreme dark tones. The primary feature to determine is how to acquire these two effects. Taking the 8-end weft sateen to represent the former, and the 8-end warp sateen to

represent the latter, a basis of work is established. Having correctly sketched the decorative forms on point paper and to scale, the outlines are developed in weft lines in perfect conformity with their structure. The more solid or darker

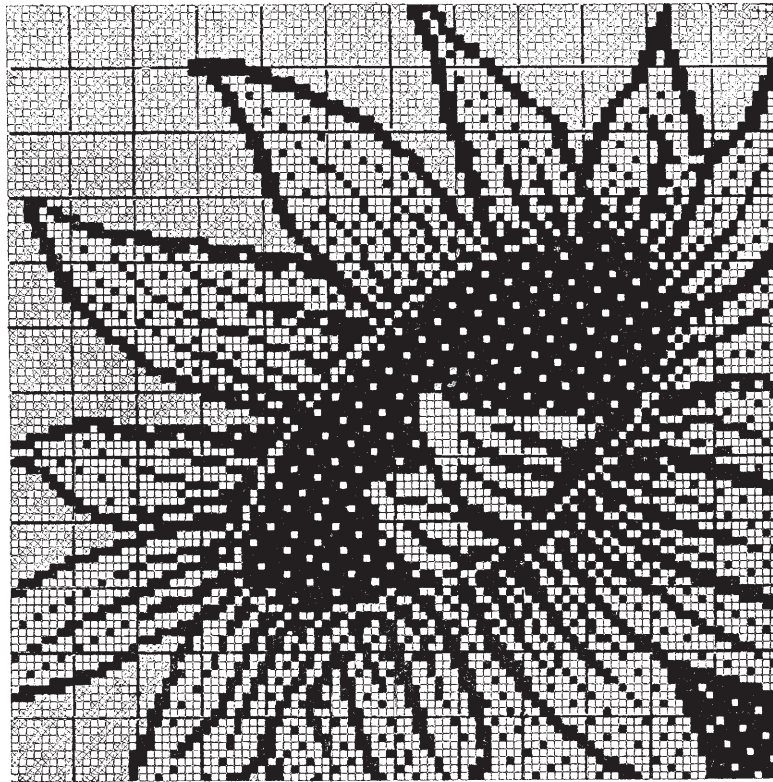


FIG. 308.—SECTION OF SHADED FLORAL DESIGN.

sections are next treated, as, for example, the central portion of the flower, and the stronger lines in the petals. Then follows the definition of the fine and slender details in correct schemes of intertexture.

In the third illustration—Fig. 308A—(one figure of a butterfly pattern, with eight figures in a repeat each differently depicted, and weavable in silk warp and weft yarns) the shading of

the extremities of the wings is developed in weft sateen. The same weave is employed in forming the head, body, and feelers of the butterfly. The half-tones in the wings are expressed in common twill, in which the dark and light colours

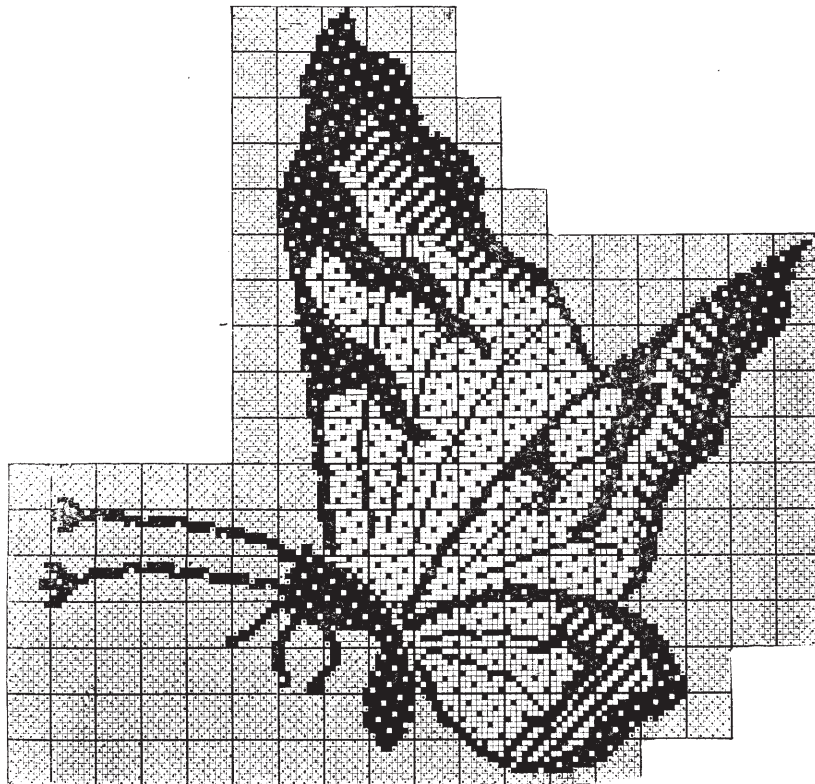


FIG. 308A.—SECTION OF BUTTERFLY PATTERN.

applied in the warp and weft would be equally commingled. For developing these tones in keeping with the delicate markings on the wings, the twilled lines are run in two directions, and joined up with, or mellowed into, the other weave ingredients in the design. The still more delicate lines in the figure are formed in small weft interlacings, again fitting with the warp sateen, which gives the smooth, soft texture of the

wings, and allows of these being distinguished from each other in special weave units.

While the original sketches for shaded textiles may faithfully represent, in tinting and toning, natural and other forms, for looming purposes the composition of the sketches is simplified. The elemental features are preserved and strengthened, but unnecessary lines and tones are eliminated, leaving the patterns structurally adapted for reproduction in a woven fabric.

CHAPTER X

PILE, LAPPET AND GAUZE STRUCTURES

276.—The Characteristics of Pile Manufactures. 277.—Two Systems of Pile Looming and Weaving. 278.—Velveteens. 279.—Ribbed Velveteens. 280.—Weft Plushes and Curls. 281.—Semi-Curl Effects. 282.—Spotting in Weft Plushes. 283.—Curl Spotting—Lambskins. 284.—Warp-pile Principle—Velvet and Terry. 285.—Weave Plans for Warp Pile Goods. 286.—Astrachans—Warp Principle. 287.—Warp Tensioning in Pile Weaving. 288.—Varieties of Figured-Pile Fabrics. 289.—Printed Pile-Warp Figuring. 290.—Terry Figuring. 291.—Terry Pile Figuring on a Crepon Surface. 292.—Velvet or Cut Pile Figuring on Twilled Grounds. 293.—Lappet Weaving. 294.—Swivel and Lappet Effects. 295.—Lappet Effects in Light Textures. 296.—Work of the Lappet Frames. 297.—Two- and Single-Frame Patterns. 298.—Gimped and Waved Designs. 299.—Gauze Principles of Intertexture. 300.—Cross-thread Features—Healding Methods. 301.—Right and Left Whip-Thread Drafting. 302.—Cellular Cloths. 303.—Light Fabrics—Perforated in Structure. 304.—Muslin Striping with Gauze Lacing Threads. 305.—Sateen and Gauze Striping. 306.—Checked Gauzes. 307.—Extra-Weft Spotted Gauze Textures. 308.—Warp Figuring in Gauze Patterns. 309.—Harness Designs in Gauze Fabrics.

276. *The Characteristics of Pile Manufactures.*—In the dress trade, pile-woven goods comprise velvet, *frisé*, velveteen, corduroy, lambskin, and light plush fabrics; and also a variety of fancy and figured textures in which portions of the surface are plain, twill, or sateen, and other portions formed in velvet, looped, or feathery features. A pile fabric is one in which the ground warp and weft yarns are covered with either a fibrous fur or shag, or with buckled, coiled, looped threads. The former may, as in the velvet, project in vertical line from the structural foundation, or it may be laid, as in certain long filament plushes, on the face of the cloth. The latter type of pile may consist of compacted series of bended or looped threads as in terry and *frisé* manufactures, or it may consist, as in woven astrakhans and lambskins, of curled-yarn

effects. Each variety of pile conceals the ground yarns employed in weaving. Velvet and velveteen—in which the pile may closely resemble the fur of the beaver—are illustrative of the cut-pile principle, and curls and *frisés* of the looped pile principle of intertexture.

The length of the pile is varied with the quality and application of the manufactures. In both the silk and cotton velvet, the pile is of the shortest and closest character. In plushes the pile is longer and less dense, and in curls the pile differs, in closeness of structure and also in measurement, with the thickness or counts of the specially-prepared yarns in which it is developed.

Quality in woven fur is necessarily determined by correctness of manufacture, but, in a particular sense, in velvets, velveteens and corded velvets, by the fineness, density, and length of the fibres of which the pile is composed. Inferior classes of texture may be finished to present the gloss and smoothness of a fabric of a better construction. This is feasible because a velvet pile, comparatively loose in formation and consisting of longer filament than that of a thick-set pile, develops, when laid in the dressing process, a high degree of lustre and softness. Thus, the length of filament in velvet and velveteens may be made to impart visible, but not actual wearing value. Density of pile, combined with fineness of fibre, are the features which produce the most satisfactory grade of these textiles.

277. *Two Systems of Pile Looming and Weaving.*—Pile goods are acquired on two systems of fabric construction and manufacture known as the *warp* and as the *weft* schemes of looming and weaving. Velvets and looped plushes are examples of the first, and velveteens and ribbed velveteens of the second practice. The *warp-pile* textures are two or multi-ply in the *warp*, and the *weft-pile* textures two or multi-ply in the *weft*. To produce the *warp-pile*, one series of threads is interwoven with the weft to give the ground of the cloth, with a supplementary series

of warp ends passing over wires, automatically inserted into and automatically withdrawn from the sheds in the warp during weaving. To produce a *weft-pile*, one series of picks forms, with the warp ends, the ground cloth, and the supplementary series floats loosely but regularly on the surface, the floats of the weft yarn thus formed being severed after the piece is woven.

278. *Velveteens*.—Cotton velvets form the more elementary type of weft-pile fabrics. The principles of their manufacture will be understood from the weave structures at A, B, C, D, E, and F, Fig. 309, in each of which the picks marked in □'s make the foundation cloth, and those marked in ■'s the pile or plush. It will be observed that the latter interlace plain or in simple twilled order. The object of this is to provide "thread races" for cutting, enabling a perfect pile, or one closely resembling the pile got by the uses of wires, to be developed. This arrangement of the warp threads in the weave also reduces the "races" to a minimum number in any build of weft-pile texture. The "race" positions in the plans are indicated by the arrows. Fig. 309A is the weave employed in the production of the lighter makes of velveteens. It is arranged one pick of ground and two picks of floating yarn, and only allows of this yarn passing over three successive warp threads. In plans B and C, the order of shuttling is one pick ground and three picks pile, with the pile picks floating over five threads, and with a plain ground in B and a fine twilled ground in C. A fuller and longer pile is obtainable by the use of weaves D and E, again plain and twilled in the ground, but with the pile shots in D covering seven threads, and in E nine threads. The double binding of the picks in the latter, as seen at the points in ■'s and in □'s, has the effect of making a fast pile, or one securely stitched into the ground. Another method of construction applied in producing the heavier descriptions of fabric, and in which mohair or cotton yarn is applicable in the pile weft, is that given at plan F. The pile picks cover nine threads, and are stitched in 5-end sateen

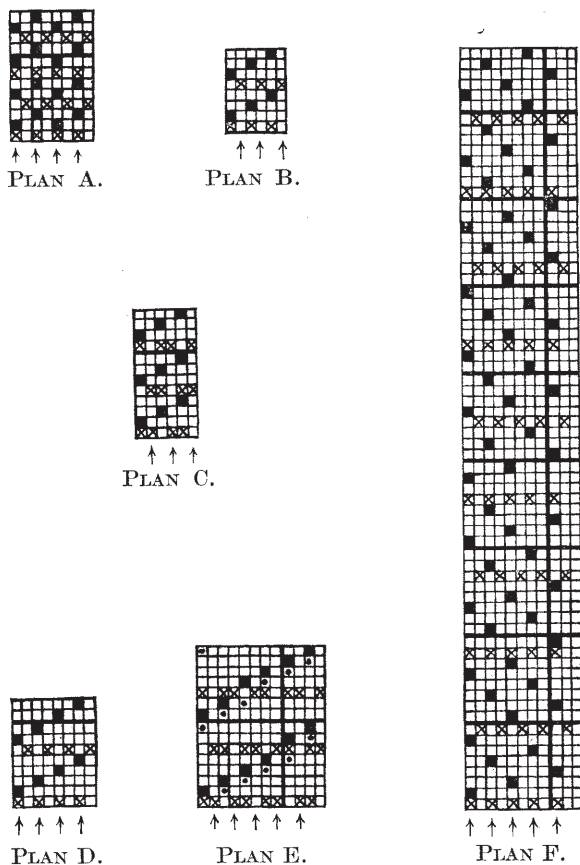


FIG. 309, A TO F (*Marks = Weft*)—VELVETEEN PLANS.

order, with six picks of pile to each shot of ground weft, suitable looming particulars for this example being—

- (1) *Warp* : 2/30's cotton, 32's reed 2's,
Weft : 30's cotton,
 500 to 540 picks per inch.
- (2) *Warp* : 2/34's cotton,
Weft : 20's mohair,
 72 threads and 250 to 300 picks per inch.

Velveteen-pile goods are heavy wefted cloths, and require the warp yarn to be of a good strong quality, and the warp

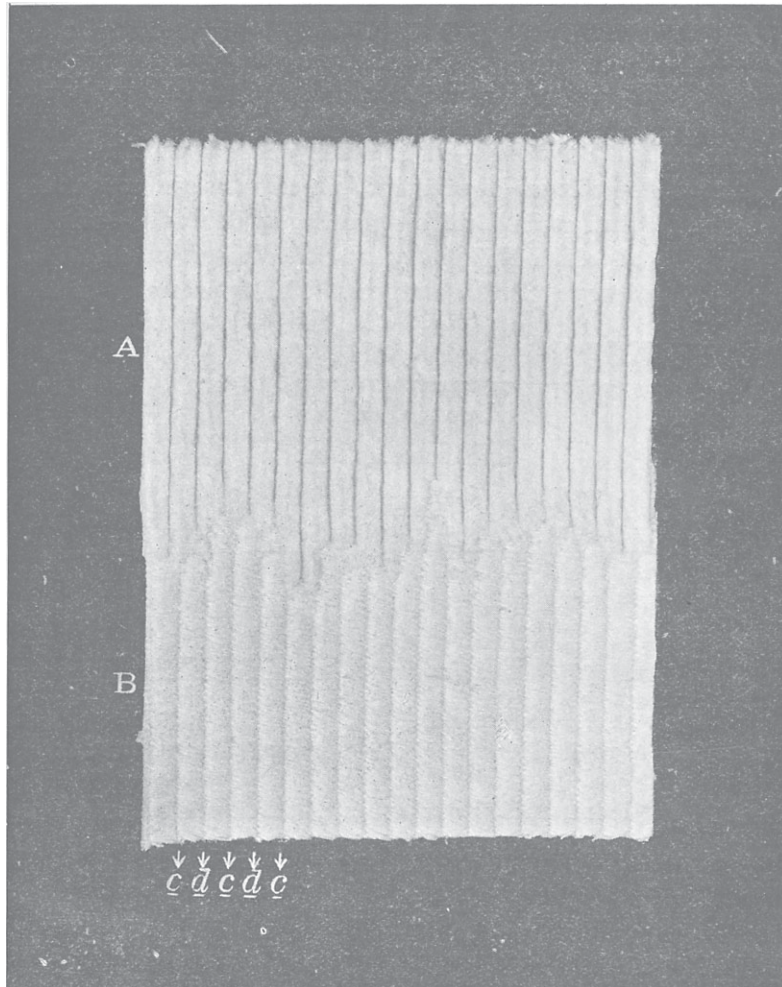


FIG. 310.—SPECIMENS OF “ CUT ” AND “ UNCUT ” VELVETEEN CORDS.

shedding to be accurate and true. Positive tappet looms (Woodroft or Beaumont and Hill principles) are employed. As they are weft-face fabrics, they are not difficult to shed, but the warp is well tensioned to admit of the pile picks being forced into the closest possible relation with each other.

279. *Ribbed Velveteens*.—In weaving ribbed velveteens or corduroys, the scheme of construction, like that in velveteen, results in a firm ground cloth—plain or twill woven—on the upper side of which the pile yarns are floated in bands or stripes lengthways of the textures. The appearance of the

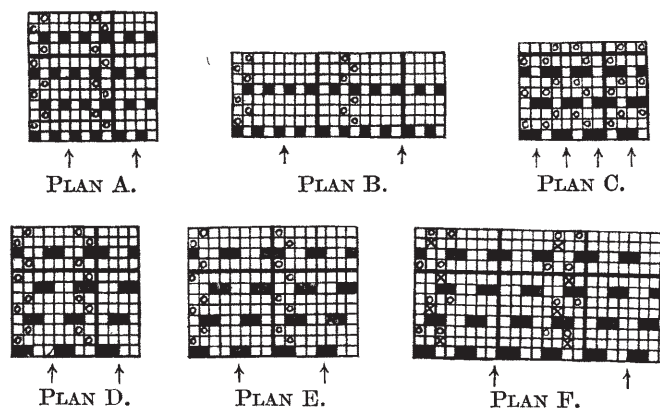


FIG. 311, A TO F (*Marks = Weft*)—CORDED VELVETEEN PLANS.

cloth in the loom, and also when cut, is shown at A and B in the specimen in Fig. 310. The pile picks produce tunnels of surface yarn between the binding points *c* and *d*, which are more clearly defined in the “cut” than in the “uncut” sections of the sample. These surface layers of yarn vary in compactness and in width with the make and style of the cloth produced. The system of weave construction will be evident on examining plans A, B, C, D, E, and F, Fig. 311. The ordinary type, with a plain foundation, is shown in weaves A and B, giving cords or stripes of four and eight threads, respectively, and woven one pick of ground to two picks of pile in A, and three picks of pile to one of ground in B.

The "thick-set" variety of cloth is shown at C, Fig. 312, for which the plan is shown at C, Fig. 311. In this weave the picks marked in \square 's pass over one and three threads. The standard fustian cord—specimen A, Fig. 312—is obtained in plan D, Fig. 311, and in such weaving particulars as 2/24's cotton warp, 34 ends and 200–400 picks of 20's weft per inch, varying with the weight of cloth required. Genoa cords—specimen B, Fig. 312—are woven in the weave illustrated at plan 311E, with the picks floating over six and eight threads, and the fabrics manufactured in similar yarns and setting as the fustian cord. "Constitution" cords are broader ribbed velveteens, made in plans arranged as at 311F, in which the pile picks, marked in \boxtimes 's, are singly stitched, and those marked in \square 's double-stitched. Spotted and simple-figured cords are also produced by reversing the positions of the two series of picks or of the ground and floating weft yarns; so that where the spotted features are developed, the pile picks are taken on to the back of the fabric, while the structure, formed by the ground warp and weft, is brought on to the face.

280. *Weft Plushes and Curls*.—On the weft-pile principle of intertexture, plushes, with a straight or vertical pile, or curls of the astrakhan varieties, are weavable. The pile is neither so closely made nor woven in such fine counts of yarn as in cotton velvets and cords. Mohair and similar sorts of yarn take the place of the cotton pile weft, and woollen as well as cotton is employed in forming the ground of the cloth. For fabrics in which the ground is cotton and the plush mohair, the weave structures are arranged as in plan A, Fig. 313. The pile picks are grouped two-and-one with the foundation picks and interlace in sateen order, the 5-end make having been extended in the threads, and so planned as to allow of these shots being twice stitched, and of their floats covering seventeen threads. The "race" positions for cutting are shown at the foot of the plan.

Other methods of construction are illustrated in Figs. 313B

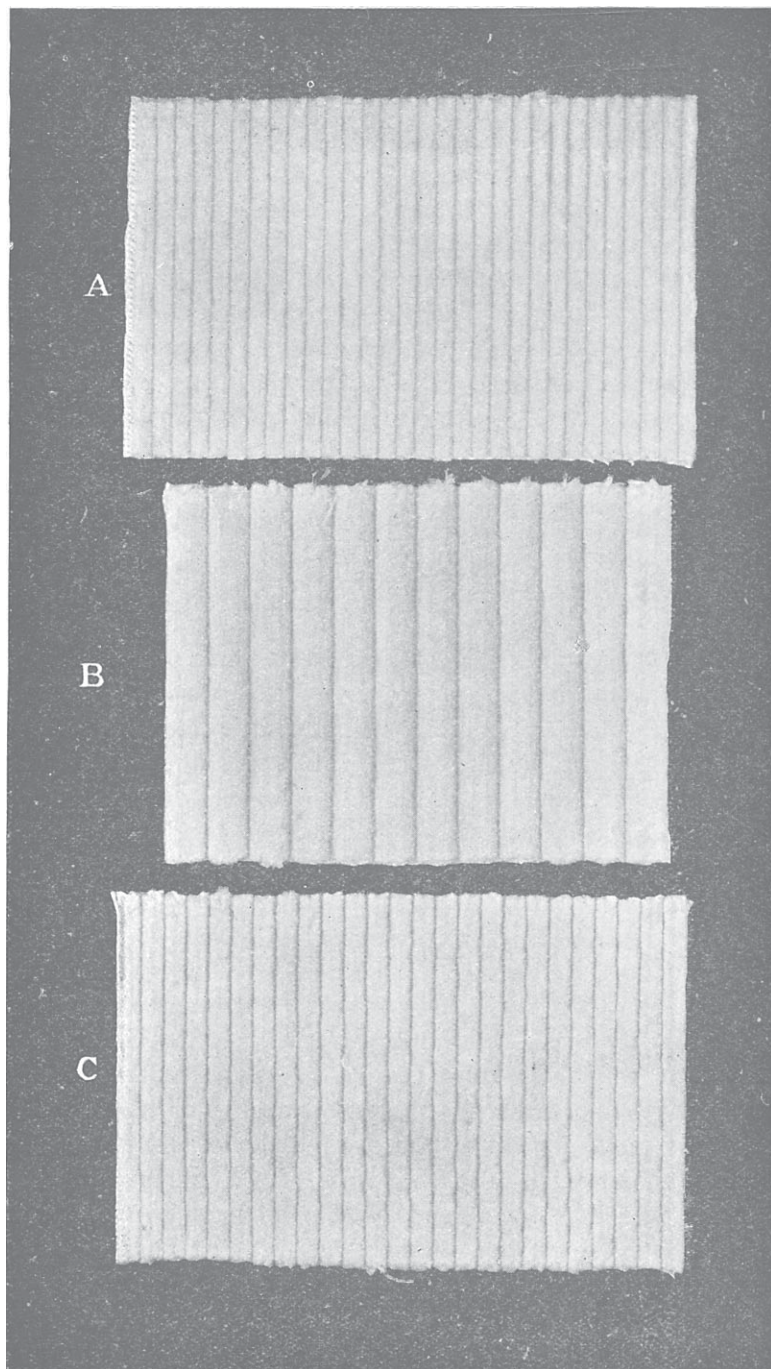


FIG. 312.—“ FUSTIAN,” “ GENOA ” AND “ THICK-SET ” CORDS.

and C, the first producing one length and the second two lengths of plush. The picks marked in ■'s, in plan C, float over nineteen threads, and those marked in □'s over twenty-three threads. Such plans are usable in making curled goods of either a light or medium weight. The curl characteristic is acquired by employing mohair yarn, which, prior to winding for weaving, is wrapped on broaches, and either steamed or boiled for two or more hours.

The pieces in the loom have a level surface, but on the pile picks being cut in the places indicated on the designs, they

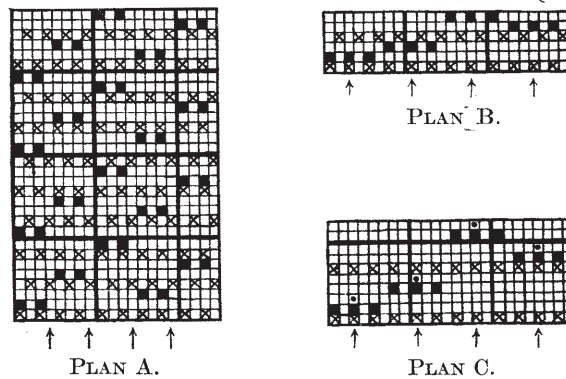


FIG. 313, A TO C.—PLANS FOR WEFT-PLUSH OR WEFT-CURL FABRICS.

buckle, curl, or loop. Assuming, for illustration, the warp to be 2/30's cotton and the weft, for plan B, one pick of 18 skeins wool and two picks of several-ply mohair yarn, and for plan C, Fig. 313—

- 1 pick of woollen,
- 1 " " mohair shade (1)
- 1 " " " " (2)
- 1 " " " " (1)
- 1 " " " " (2)

the ground of the textures would be plain-woven—cotton and woollen—and the curl features would be developed in mohair yarn. The number of picks per inch depends on the quality

and fulness of pile required ; but, in all cases, a firm, fast ground cloth is essential. To ensure this with, say, 32 ends per inch in the warp, there should be a similar number of ground picks, giving in plan 313B, 96 picks, and in plan 313C, 160 picks per inch. The frequency with which the ground shots are inserted binds the pile (which, when cut, would, in a loose texture, be liable to draw out) securely to the cloth. This method of weft setting is applied in producing the straight plush, when the shots per inch must be in keeping with the density of pile desired. In curls, however, the picks per inch are reducible, as portions of the ground of the fabric may be visible or only partially covered with pile yarn, and for this effect thick yarn is used in the pile, with the picks per inch proportionately decreased. Should, for instance, the curls be of the larger variety and formed in a thick yarn, or should they be thinly distributed on the surface and formed in long floats, the woollen yarn used for the ground may be made to develop a special feature on the face of the fabric.

281. *Semi-Curl Effects*.—The use of curled mohair or lustre yarns, admixed with cotton worsted and woollen yarns, results in looped and buckled effects being obtained in the woven manufacture. Even providing the mohair is used as spun, cockled and semi-curved textural details are producible. Thus, in Fig. 298—Paragraph 269—these details are shown to be due to the inequalities in shrinkage value of the worsted and mohair threads of which the cloth is made. One of the textures of this compound cloth consists of the former, and the other texture of the latter yarns, the two textures interchanging from the face to the back position in the production of the design. It was pointed out that, in the scouring treatment the worsted texture contracts evenly, and the mohair texture more expeditiously but unevenly, so that in the process the mohair is drawn into a napped or cockled structure.

Curliness in single-make fabrics—non-plush woven—is obtainable by selecting prepared or unprepared mohair yarns and using these in the weft, with Botany worsted yarns in the

warp. The designs are constructed on the weft principle of figuring, with a warp-face weave in the ground for giving a level cloth, and also one in which the intersections of the weft are barely traceable. In the specimen given of this kind of imitation plush in Fig. 314, the warp yarns are 2/60's worsted, the weft yarns 2/32's mohair, and the ground weave $\frac{3}{1}$ twill. The pattern is woven in floated weft yarn, the flushes varying from three to twelve threads in length. With the floats grouped in regular compact order and covering a fair proportion of warp threads, they give the raised, waved effects, R. When the floats are arranged irregularly and in spotted and detached sections, they produce a species of minute curl, C. The difference, however, between this quality of looped textural surface and that acquired in weaves of a special structure, A, B, and C, Fig. 313—is quite marked. There is strictly, in the ordinary compound make of cloth—Fig. 314—no evenly developed curliness. The mohair weft yarns remain uncut in the piece, or, as shuttled, whereas, in weft plushes, the floats are severed, so that the free ends and the picks form into curls of a definite size and frequency on the surface of the fabric.

282. *Spotting in Weft Plushes.*—For spotted and mottled patterns in weft plushes—either in straight or curled pile—the pile shots are alternately floated on the face and regularly bound into the make of the cloth. The specimen of “straight,” “spread,” or “cut,” pile texture in Fig. 315, is produced in 2/24's cotton, and wefted two picks of cotton, one pick of woollen, and one pick of thick mohair. The picks of the design—Fig. 315A—printed in \boxtimes 's are cotton, those in \square 's woollen, and those in \blacksquare 's in mohair yarn. The woollen picks give a weft-face effect, and are intended to be in a bright colour to tint the groundwork of the plush, and also to conceal the cotton warp and weft. The pile spottings are planned on the 6-end sateen base, the shots marked in \blacksquare 's representing the black mohair picks in the specimen, and the shots marked in \square 's the white mohair plush yarn. Both yarns float equally,

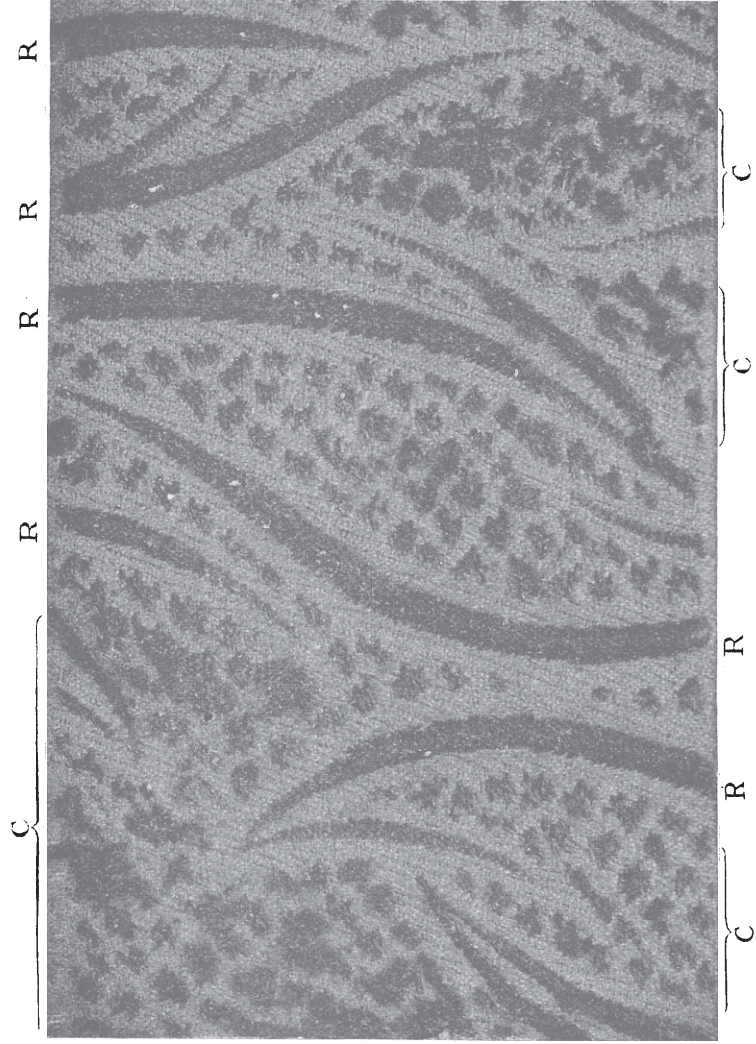


FIG. 314.—SEMI-CURL FIGURED CLOTH.

or over thirty-one ground threads. This length of flush yields a good depth of pile. Surface brushing, when the piece is in a steamed condition, has the effect of straightening and laying the tufts of fibres of which the pile consists in this class of manufacture.



FIG. 315.—WEFT PLUSH—TWO-COLOUR STYLE.

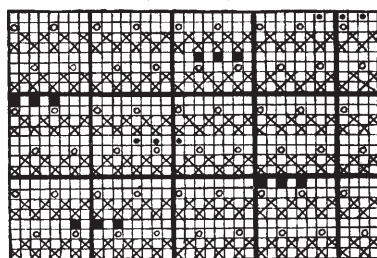


FIG. 315A.—WEAVE FOR FIG. 315.

283. *Curl Spotting-Lambskins*.—In spotting in two or several colours in light curl textures of the lambskin character, the designs are constructed as seen in Figs. 316 and 317. These are the reduced or looming plans. The complete healding draft—Fig. 316A—is supplied for the first plan, and a section

of the healding draft—Fig. 317A—for the second plan. The two plans differ in structural arrangement. Fig. 316 is woven two picks of ground yarn and one pick of curled or flush yarn, and Fig. 317 two picks of ground yarn, one pick of small flush yarn—double six-end sateen, printed in □'s—and one pick of thick curl yarn, printed in ■'s. Opening out the two weaves in accordance with the healding drafts, would show that the ground picks interlace plain, and that the single intersections on the curl picks in Fig. 316 are equal, in the texture, to three and the double intersections to six stitching points; while, in Fig. 317, the double intersections are equal to four and the treble intersections to six binding points in the cloth. When the plans are thus extended, the longer flushes in Fig. 316 cover forty-three, and the

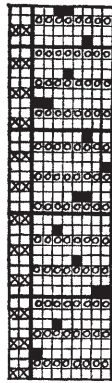


FIG. 316.

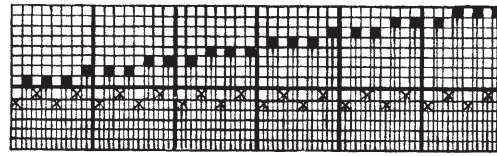


FIG. 316A.

WEAVE AND DRAFT—CURL AND LAMBSKIN TEXTURES.

shorter flushes thirty-seven threads; and, in Fig. 317, the longer flushes cover forty-three and the shorter flushes twenty-one threads.

The designs are producible in such weaving data as given below—

FIG. 316

Warp : 2/30's cotton
 24's reed 2's.
Weft : 2 picks of 2/30's cotton
 1 pick of 8's worsted
 2 picks of 2/30's cotton
 1 pick of 8's worsted.
 2 picks of 2/30's cotton.
 1 pick of 6's mohair (six threads as one)
 84 picks per inch.

FIG. 317

Warp : 2/24's cotton
 22's reed 2's.
 Weft : 2 picks of 10's cotton
 1 pick of 12's worsted or 24 skeins woollen
 1 pick of 6's mohair (six threads as one)
 96 picks per inch.

It will be noted that lambskins and loose-set curl textures of this character are not wefted on the principle followed in

producing a full, close plush. It is not the object in these manufactures to make a close, dense pile but to spot the surface of the fabric with bright curls at intervals. The mohair yarns are used for spotting and the worsted or woollen yarns for developing the napp or curl filament effects. Hence the two yarns in the

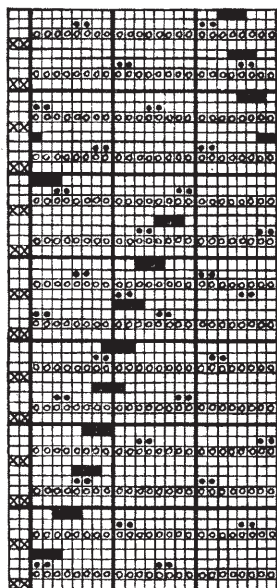


FIG. 317.

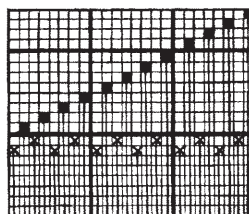


FIG. 317A.

WEAVE AND DRAFT—CURL AND LAMBSKIN TEXTURES.

designs are flushed differently. With the idea of obtaining a close ground napp in Fig. 316, the worsted yarns float to the greater degree, concealing the plain cotton structure, and making a pile of fibre on which the lustrous yarn is formed into distinct curls. On the other hand, in Fig. 317, the lustrous yarn floats to the greater degree, and the worsted yarn is employed for giving a full, short napp in the ground. The curls in this example are developed in inverted twilled lines or in simple details transposed.

These fabrics, and the many varieties of woven lambskins of which they are typical, are made in light and delicate shades, frequently white or cream in the ground. Coloured mohair yarns, especially in light tints, are also used for spotting, but while they result in diversity of textural style, they somewhat detract from the lambskin quality of the cloths.

284. *Warp-Pile Principle—Velvet and Terry.*—As explained, in all classes of *weft-pile* goods the plush is formed by floating certain picks in the weave structure on the right side of a firm-woven cloth. By cutting the floats of these picks in the thread “races” longitudinally, and after the pieces leave the loom, the pile quality and character are obtained. In all classes of *warp-pile* goods the plush is formed in the warp and in the actual process of fabric production. The special warp yarns, used for this purpose, do not float loosely at intervals on the face of the cloth in a like manner to the picks flushing over groups of warp ends in the weft-pile manufactures, but pass over wires, the latter being inserted, in a prescribed order into definite sheds in the warp. Such wires take the place of picks of weft, but unlike ordinary picks or shots, they are withdrawn when the pile ends have been bound by the ground picks securely to the fabric.

In making a cut or velvet pile, the knives at one end of the wires sever the threads of warp transversely as they are forcibly removed from out of the sheds of warp ; or grooved wires may be inserted and a knife run along the groove for cutting the pile ends and converting them into short lengths of filament, vertically projecting from the foundation cloth. For making a terry pile, the threads, on the withdrawal of the wires, form loops of yarn serially arranged from selvedge to selvedge of the piece, the depths of the loops being proportionate to the kind of wires employed.

In either case, it is the passing of the selected warp threads over the wires, and the binding of them, on either side of the wires, into the texture, which produces the pile. This being

so, the quality of pile—its length, closeness and richness—depends, first, on the gauge and depth of the wires ; second, on the frequency of the insertion of the wires into a given portion of the cloth ; and, third, on the set of the fabric and the counts and variety of the pile warp yarns employed.

285. *Weave Plans for Warp-pile Goods.*—The textural plans for warp-pile plushes are compound in arrangement, but elementary in construction. For making a terry or velvet plush, the weave is that shown at A, Fig. 318, in which threads G are the ground and threads P the pile warps, picks 1, 2 and 3 being the ground weft, and W the sheds for the wires.

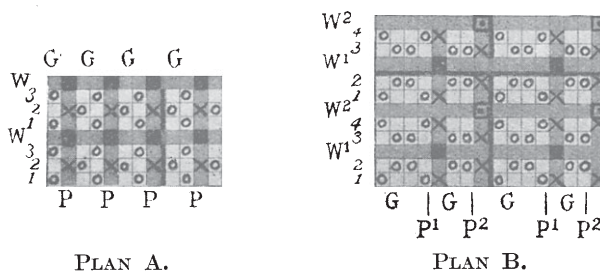


FIG. 318.—WARP-PLUSH WEAVES.—(Marks = Warp lifted).

It will be seen that all the pile-warp ends are lifted and all the ground-warp ends are depressed for the insertion of the wires ; and that the pile yarns are down on picks 1 and 3, or on the picks following and preceding the wires. Further it will be observed that, without the wires being reckoned, the pile yarns interlace $\frac{1}{1} \frac{1}{2} \frac{1}{1}$; the odd ground threads $\frac{1}{1} \frac{2}{1} \frac{1}{1}$; and the even ground threads $\frac{1}{1} \frac{1}{2} \frac{1}{1}$. As suggesting the looming practice for velvet textures in this class of weave structure, the following particulars are given—

- Warp* : 1 end of two-fold cotton,
- 1 „ „ silk (two or more threads in a mail) and
- 1 „ „ two-fold cotton.
- Weft* : 1 pick of cotton,
- 1 „ „ worsted, and
- 1 „ „ cotton.

fixed by the size of the wires, while the method in which the surface of the cloth is covered with the curl effects is controlled by the weave plan. This is constructed on the system shown at plans A, B, and C, Fig. 319. The number of ground threads between the pile or curl yarns differs with the closeness of the curls, and also with the variety of cloth

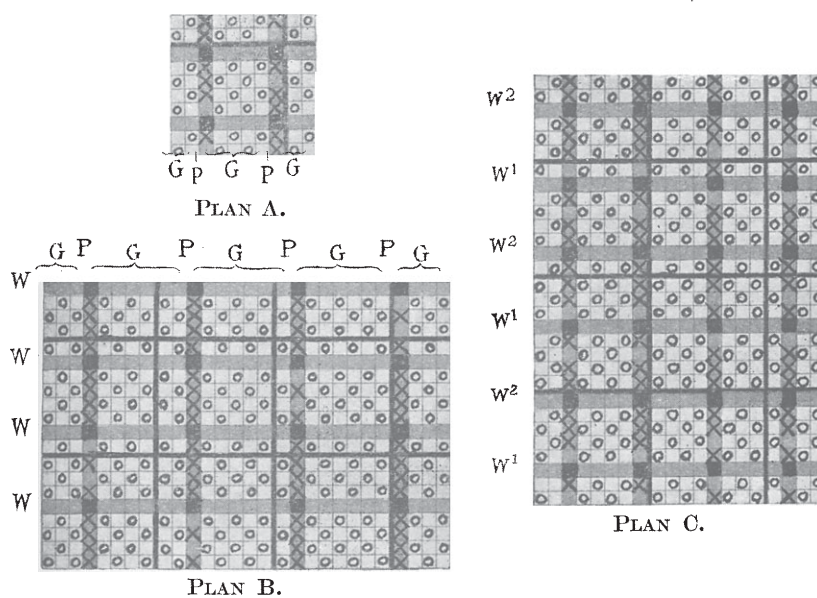


FIG. 319.—ASTRAKHAN WEAVES.—(Marks = Warp lifted).

manufactured. In plans A and C there are four ends of ground to one end of pile yarn, but in lighter textures the proportion of ground threads is further increased. Plan A is the standard weave in making medium weight goods to which such weaving data as the following are applied—

Warp : 2 threads of 2/30's cotton (double)
 1 thread of 12-dram mohair
 2 threads of 2/30's cotton (double)
 1 thread of 6-dram mohair.

West : 6's cotton
 30 ends and shots per inch.

The relative lengths of pile and ground warp yarns for giving a full curl in this setting should be approximately as three is to one.

Plan 319B is illustrative of a second form of construction, that of floating the pile yarns over a larger number of picks, and of providing for a longer structure of curl. It is the type of weave usable when the mohair yarn is printed in two shades, such as black and white, for developing the curls in mingled colouring.

The curl features may, on the warp principle of weaving, be formed in both looped and cut pile as in plan C, Fig. 319. be formed in both looped and cut pile as in Fig. 319C. Here two kinds of wires are used— W^1 and W^2 —for cut and to be better stitched than those passing over W^2 . But this rule is not always observed, for in some makes of these fabrics the pile yarns are stitched on the same system for both the curl and looped effects.

In two-pile effect cloths the character of the plush is varied with the order in which the two types of wires are inserted in the weaving practice.

287. *Warp Tensioning in Pile Weaving.*—The tensioning and delivery of the warp yarns, in pile and plush weaving, require to be accurately adjusted. The ground warp threads are wound on to one beam, and each sort of pile warp yarn on to a different beam. The tension of the first must be uniform and considerable to admit of the construction of a level and firm cloth. That of the pile yarns should also be fixed throughout the operation of weaving, yet the yarns should be intermittently released and tightened for the wiring and beating up of the picks of weft. As the wires are carried forward by the going part pressing against them, the pile yarns are allowed to take up a length equivalent to the dimensions of the wires. For the movement of the going part, when shuttling the ground picks, the pile yarns are normally tensioned. If the yarns are over-tensioned in the wiring, the pile produced has a tendency to draw out. If

insufficiently tensioned, the pile has a tendency to become irregular on the surface. Further, if the pile yarns are incorrectly tensioned for wetting, they become unevenly interlaced on the back of the fabric. In the production of goods having two or more lengths of pile, each sort of pile yarn is run off a separate chain beam. In figured pile fabrics, in which the pile yarns take up differently in the weaving process, they are delivered off double-ended bobbins mounted in a creel, and each bobbin, or miniature beam, is friction-braked.

288. *Varieties of Figured Pile Fabrics.*—The principal varieties of figured pile fabrics include—

(1) Velvet Pile and Cut Plush Fabrics, with printed pile warp yarns for developing the pattern or design features.

(2) Fabrics with an Ordinary Textural Ground and Terry or Frisé Figuring.

(3) Fabrics with a Simple Weave Ground and Cut Pile Figuring.

(4) Fabrics with a Terry Pile Ground and Velvet Pile Figuring or *vice versa*.

(5) Fabrics with a Sateen, Repp or Soliel Ground, and with the Figuring in both Terry and Cut Pile.

(6) Fabrics in which the Figuring is developed in different heights of pile—looped and cut—and with various weave structures forming patterns in the ground.

Different schemes of manufacture are applied in producing these classes of pile goods, which are suitable for mantle as well as dress fabrics. The methods of construction adapted to the lighter makes of cloth will be considered, and so far as they are comprised in Classes (1), (2), and (3).

289. *Printed Pile-warp Figuring.*—This principle of pattern production is practised in the manufacture of velvets and plushes of the simple scheme of construction. The surface effects, both as to pile quality and as to pattern style, are varied and rich in composition. The build of the fabric is usually of the character illustrated in Figs. 318A and B. The velvet pile specimen—Fig. 320—is producible in plan

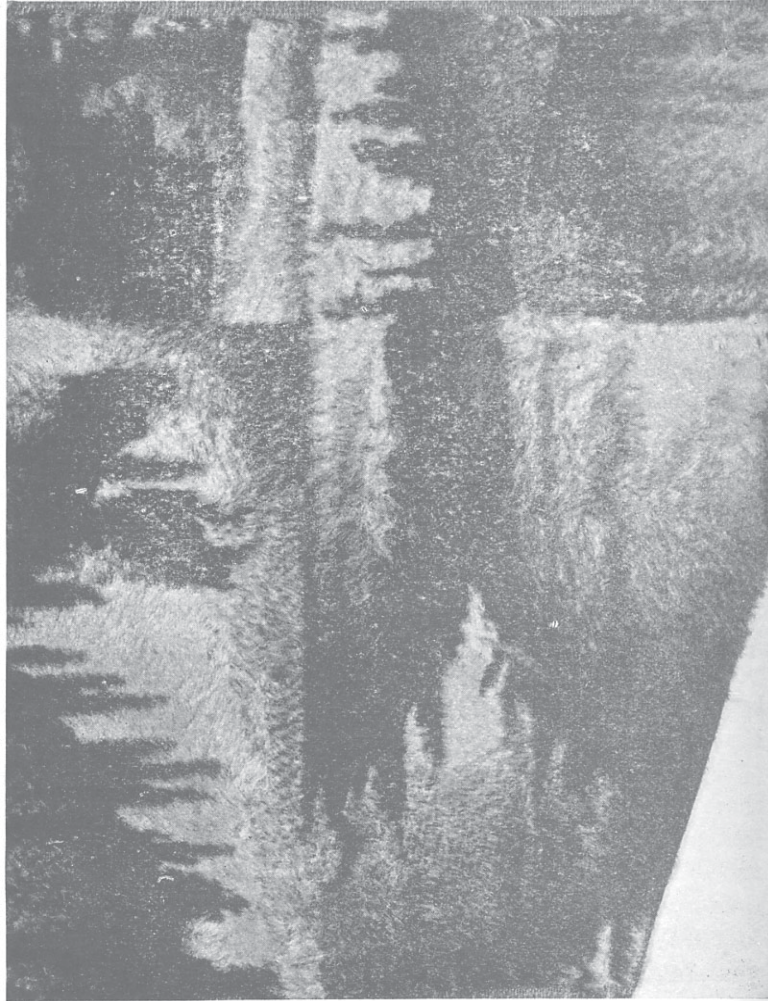


FIG. 320.—PRINTED-WARP VELVET.

A with 120 ground and 60 double-pile ends per inch. The design in this example, and in similar descriptions of velvet or plush, is of the irregular blotched description of figuring so well adapted for getting features, in a pile surface, suggestive of the shaded toning in natural furs. In originating the patterns, all the effects, such as those observed in black, white, and grey tones in Fig. 320, are first drawn in colour to *fabric scale* on point paper. Second, the effects, on each thread in the design thus drafted, are next elongated to the dimensions of such effects in the *warp-yarn scale*, and the design so extended gives the printing scheme.

This method of manufacture and of pattern development, lends itself to the expression of the types of decorative detail suitable for cut pile goods, whether of the velvet or of the mohair plush variety. The velvet structure is used in dress goods and the plush structure in mantle cloths, the latter also in heavier builds of plushes for wraps, rugs, etc. The cut-pile system of weaving imparts softness of toning to the variegated forms in the figuring.

290. *Terry Figuring*.—This is one of the simplest classes of figured pile production. It will be considered in relation to the textural examples in Figs. 321 and 323, one having a twilled ground and woven in worsted yarns, and the other having a silk crepon ground with the pile effects developed in worsted. The pile or plush may be obtained in a different colour of yarn from that applied to the ground portions of the cloth, but such is the distinctive character of the pile figuring from the twilled or other ground surface of the texture, that it is sufficient to emphasize the design elements in both coloured and piece-dyed goods.

The plan of construction of the example in Fig. 321 is given in the sectional designs Figs. 322A and B. As the marks in these plans, and also in those of the series of plans illustrative of figured pile designing, represent weft intersections, it will be understood on examining weaves A and B that when the pile yarns in these textures are not being utilized in forming



FIG. 321.—TERRY-PILE FIGURING ON A TWILLED
WORSTED GROUND.

the figure, they are stitched regularly on the under-surface. Thus, in plan A, Fig. 322, all the threads of both the pile and ground warps are depressed on the wire shots, W, with the pile yarns P interlacing $\frac{1}{7}$, and stitched to the $\frac{2}{2}$ twill ground as in a warp-backed cloth. On the wire sheds in plan B all the pile yarns are lifted, and all the ground warp yarns depressed, with the pile and ground threads intersecting with the shots

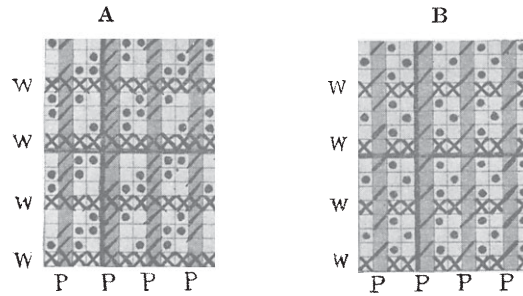


FIG. 322.—SECTIONAL PLANS FOR FIG. 321.
(Marks = Weft Intersections.)

of weft on the common principle of warp-pile construction, or that given in weave A, Fig. 318. The weaving practice adopted in making this type of figured terry is—

FIGS. 321 AND 322A AND B.

Warp : 1 thread of 2/60's worsted shade (1) (ground)
 1 thread of " " " (2) (pile)
 1 thread of 2/60's " " (1) (ground)
 96 threads per inch.

Weft : 2/60's worsted shade (1)
 64 shots per inch exclusive of wires.

291. *Terry Pile Figuring on a Crepon Surface.*—In illustration of the applicability of terry figuring to further classes of dress goods, the crepon ground texture in Fig. 323 will be

examined. It is made in silk and worsted yarns, arranged as below—

Warp : 1 thread of 60's two-fold silk (crepon yarn),
 1 ,, ,, 2/60's worsted (terry and backing yarn),
 1 ,, ,, 60's two-fold silk (crepon yarn),
 108 threads per inch.

Weft : 2 picks of 60's two-fold silk,
 1 pick of 2/60's worsted,
 2 picks of 60's two-fold silk,
 1 pick of 2/60's worsted,
 1 wire.
 72 picks per inch, exclusive of wires.

The crepon effect in the ground or in portions C of the design is woven in a plain silk texture over a plain worsted texture. In the terry effect (marked in ■'s, and in grey in Fig. 323A) the silk threads intersect plain and the worsted $\frac{1}{1} \frac{1}{2} \frac{1}{1}$ between the wires. Further, on the wire shots W in the crepon parts the pile and the ground threads are on the underside of the structure; whereas, in the terry parts, the pile threads are lifted and the silk threads are depressed. The pile yarns, when not figuring on the surface, are making, as shown by the intersection marks in ■'s, a plain texture with the worsted picks. It follows that while the face of the cloth consists of a plain silk ground and worsted pile figure, the back of the cloth is plain in construction in the worsted yarns under the crepon effect, with a plain intertexture in both the worsted and silk threads under the pile effects. The figuring in this specimen is in one colour of yarn, but here, and also in Fig. 321, the pile yarns may be in two shades arranged one-and-one, etc., should a mingled tinted pattern be desired. The relative lengths of the pile and ground warp yarns in Fig. 321 are as 12 is to $5\frac{1}{2}$, and in Fig. 323 as 6 is to $3\frac{1}{2}$. To develop the pile in too long a loop is not a satisfactory practice. It should make a clearly defined terry effect so that this may cover the ground of the cloth, but the loops should be firm and close in structure.



FIG. 323.
SPECIMEN WITH CREPON GROUND AND
TERRY-PILE SPOTTING.

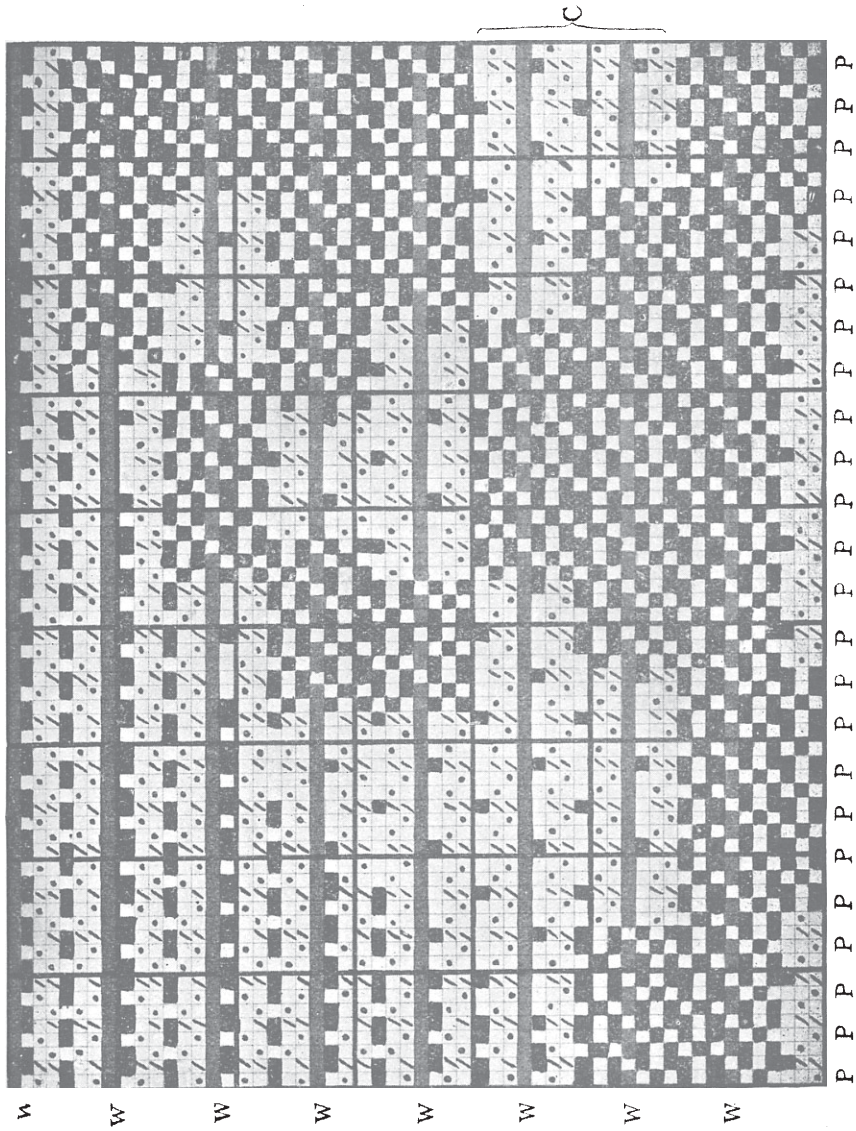


FIG. 323A.—SECTIONAL DESIGN FOR FIG. 323. (Marks = Weft Intersections.)

292. *Velvet or Cut Pile Figuring on Twilled Grounds.*—The pile method of developing the figuring on a twill or common weave ground is illustrated in Fig. 324. For the ground, worsted yarns are used as in the example in Fig. 321, but these are warped and wefted to give a tartan plaid or check, the order of colouring for the checking being—

GROUND WARP AND WEFT—FIG. 324

12	threads of 60's two-fold silk white,
64	„ „ 2/60's worsted green,
16	„ „ 2/60's worsted heliotrope,
8	„ „ 60's two-fold silk gold,
32	„ „ 2/60's worsted green,
16	„ „ 2/60's worsted black,
32	„ „ 2/60's worsted green,
8	„ „ 2/60's heliotrope,
8	„ „ 60's two-fold silk gold, and
84	„ „ 2/60's worsted heliotrope.

The looming arrangement for this example is as follows—

- Warp* : 2 threads of 2/60's worsted, coloured as above,
 1 thread of organzine silk, 3 threads in a mail,
 64 ground and 32 threads (3 as 1) of silk per inch.
- Weft* : 2/60's worsted, coloured as above.
 64 picks per inch exclusive of wires.

Density of pile is got in this setting by having three threads of silk drawn through each mail of the harness, giving the equivalent of 96 single ends of silk per inch in the velvet figuring. The scheme of weave construction is sketched in Fig. 324A. Here, as in the plans for Fig. 321, the pile yarns in the ground of the fabric (section G) stitch on the back, but the pile yarns in the velvet (section V) cover the wires regularly, being stitched on the picks, intervening the wires, with the ground ends intersecting alternately $\frac{1}{2}$ and $\frac{2}{1}$. In this fabric the length of the silk to the worsted yarn is as three to one, giving a soft quality of velvet in the figuring.

It will be observed that the cut pile (compare Figs. 320 and 324 with Figs. 321 and 323) develops the pattern in a richer textural surface than the loop or terry pile. Either one or the other of these principles of looming may be worked into



FIG. 324.
SPECIMEN WITH TARTAN OR PLAID WORSTED-YARN GROUND
AND VELVET-PILE (SILK) FIGURING.

striped styles, having successive lines in the designs in twill, silk figuring, and in pile.

The fourth, fifth, and sixth schemes of fabric construction for figured pile designing are different forms of elaborating the principles defined, and are applied more especially to goods produced for the mantle trade.

293. *Lappet Weaving*.—The use of lappet frames (see reference on page 21), operated in front of the sley or reed, provides for the decoration of the surface of the fabric with a supplementary series of warp threads. These are run off special chain beams conveniently tensioned. The control mechanism for the frames is of two kinds, that of a shaped

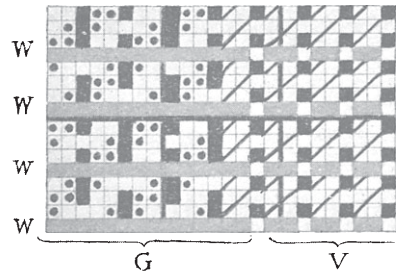


FIG. 324A. SECTIONAL PLAN FOR FIG. 324.

or grooved cam wheel as employed in Glasgow and the districts in which this class of weaving is chiefly practised ; and that of lattice lags revolving on a cylinder, and in which the sections in the lags actuate the levers of different lappet frames. The concentric grooves of the lappet wheel determine the pattern lines as described by the whip threads on the face of the texture ; while the number of grooves on the face of the wheel corresponds to the number of lappet frames employed. The order and length of the pegs inserted in the lags have a similar function as the eccentric forms in the lappet wheel, fixing the stroke or lateral displacement of the frames.

The frames in either system of control are studded with sharply pointed pins from 1 to 1½ inches apart, through the eyes of which the lappet threads pass. Immediately behind

the frames is fixed a shuttle guide or a pinned stave, against which the shuttle runs. This guide, and also the frames, have an up-and-down reciprocating action. On the formation of the shed they rise, enabling the pins in the frame to lift the whip threads so that they form part of the upper half of the shed. Picking takes place at this juncture, after which the frames and the shuttle guide are lowered, the pins and the frames passing in the operation below the warp line or "race" of the going part, and allowing of the sley, in the rear of the shuttle guide, to force the shots of weft into position in the fabric. The frames are thus made to effect the lifting of special warp ends, causing such ends to become units in the upper portion of the shed, and further, to interlace with the picks of weft. In this respect they have a similar movement to the heddles or harness. They do not, however, bring the whip ends into a position where they are covered by the picks, but into a position where the picks float under them, and bind or stitch them into the make of the fabric. The texture is constructed by the ordinary shedding units, with the effects formed by the lappet ends spread and stitched on the face of the fabric thus woven.

For the decorative effects, or for the development of the pattern produced by the whip threads, the frames are laterally displaced at stated periods, and as determined by the control mechanism. This displacement occurs when the lappet frames are out of the warp, that is, when they are below or above the warp line. Either of these practices may be followed, for the frames may be mounted *over* or *under* the warp, but the latter position offers advantages in weaving, in so far as the attendant can repair broken threads, etc., as readily as if the loom were ordinarily geared up.

294. *Swivel and Lappet Effects*.—In some senses, lappet patterns resemble those producible by swivel shuttles. They are added decorative elements and may be inserted into the cloth in detached or spotted units, as in sections A and B and C and D of the lappet specimens in Figs. 326 and 330. Whereas,

however, the swivel is a shuttling appliance and produces the design by means of extra shots of weft which interlace with the warp yarns in the same way as in making a common fabric structure, the lappet is purely a *warp* principle of intertexture. The design forms are developed by the lappet yarns being stitched, after traversing a definite width of the cloth, into the groundwork. Fig. 325 is a magnified specimen of a plain, cotton texture, swivel spotted. Part A is a section of the face and part B a section of the reverse side of the pattern. Here the swivel picks S are seen to intersect the warp ends in plain and also in flushed order. On the right side of the texture only the spotting details are visible, but on the underside (part B) the trailing shots, when not used in making the face effects, are observed. In lappet work the spotting threads, though warp, run in a line with the picks of weft when producing the decorative effects. They do not interlace in plain, twill, or other order with the picks, being merely stitched by them to the fabric. As in swivel weaving, these pattern-producing yarns may trail loosely between one row of pattern elements and another, or as they would in developing the spottings in Fig. 330. With the frames operating from the lower position, on the completion of one series of such spottings, they are withdrawn from the warp and retained inactive until required for making the second series of figured details. By this arrangement, the floating ends, between one row of effects and another, are on the reverse side of the cloth. Hence, after the piece is woven these loose ends may be cut off, leaving the spotting edges perfect.

295. *Lappet Effects in Light Textures.*—On this principle of figuring and spotting light-woven textures—muslins, crêpe de chine, and gauzes—as well as firmer makes of fabric, may be ornamented. Moreover, the lappet patterns may be either loosely or closely designed and constructed, and yet produced on a delicate and compactly-interlaced structure. This is the case in the example given at Fig. 11, Chapter I, where a

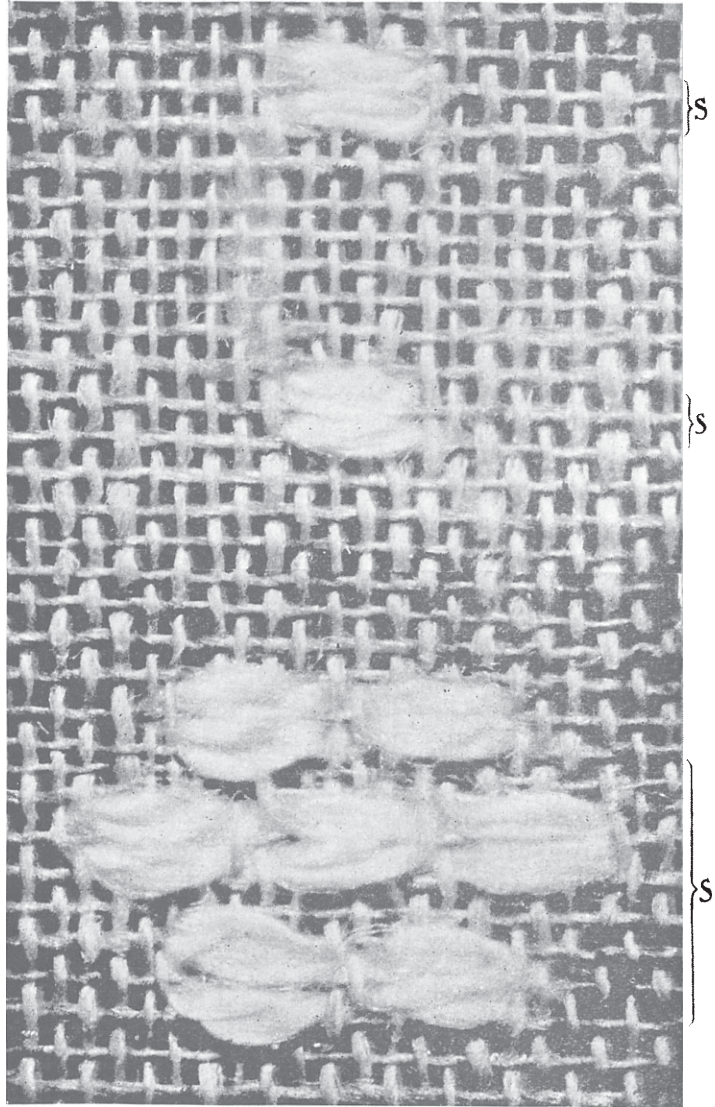


FIG. 325, PART A.—SWIVEL-WOVEN SPECIMEN.

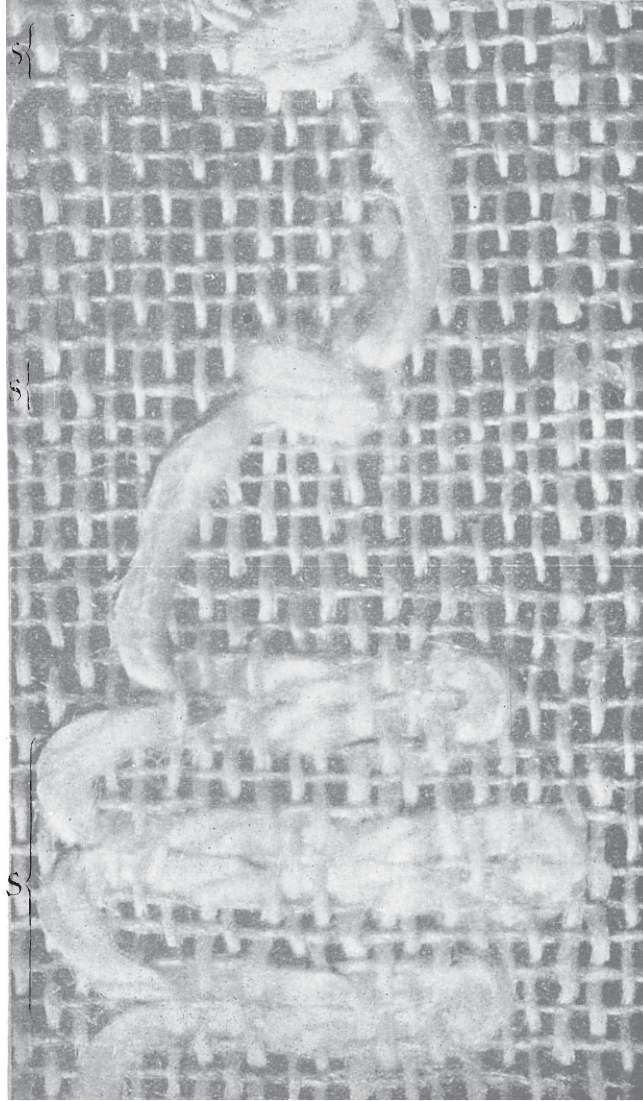


FIG. 325, PART B.—SWIVEL-WOVEN SPECIMEN.

cotton muslin (80 ends and 52 picks per inch) is decorated with a comparatively thick-yarn pattern, made by the employment of three lappet frames, one for striping A, a second for lines B, and a third for the waved types C, between the two lines of effects A and B.

While lappet patterns are restricted in character and style of figuring, the method of their production is economical as

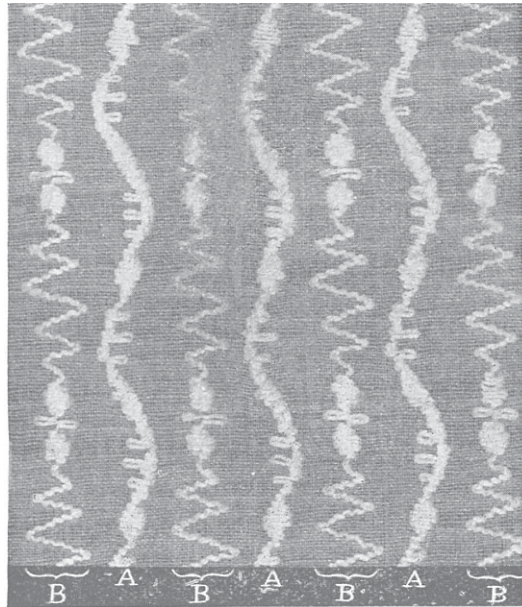


FIG. 326.—TWO-FRAME LAPPET-WOVEN SPECIMEN.

compared with that of extra shuttling. Whether the effects are in one or in two or more colours—(Figs. 326, 329, 330, and 332)—they involve no additional weaving cost beyond that due to the use of two or three lappet frames. The actual cost of fabric production is limited to the set and build of the cloth and to the mounting comprised in the use of several whip-yarn beams and lappet frames.

As seen from the specimens, the pattern features appear to have a weft structure though developed by warp threads.

They closely resemble needle or stitched work, the whip threads bending at the edges in a gimped or vandyked way. Textural decoration, rather than precise design definition, is obtained. Certain simple pattern forms are producible, but these are strictly stitched surface work. It is this factor

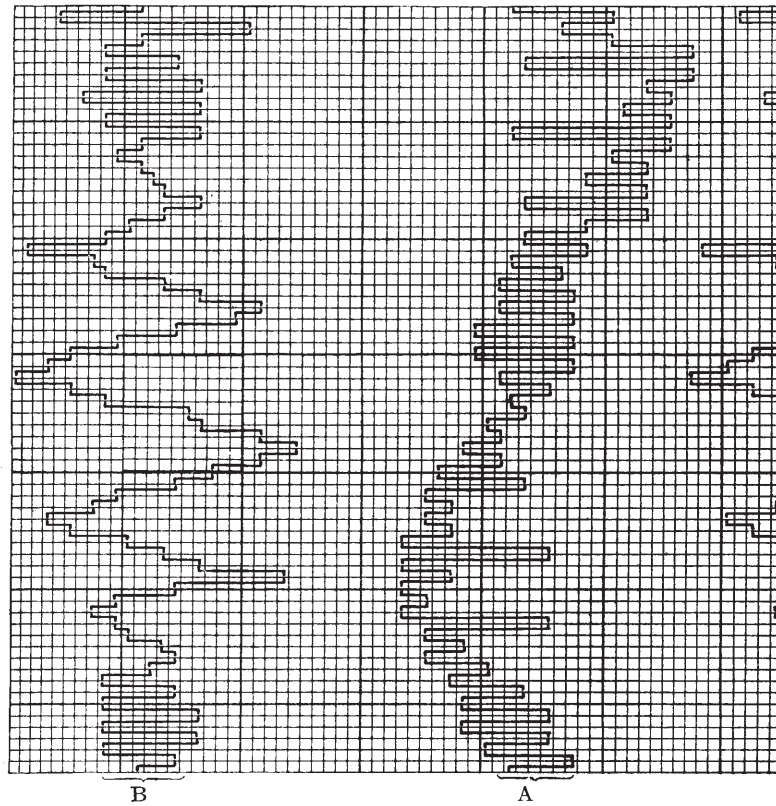


FIG. 326A.

which gives the lappet principle of design its distinctive toning, and renders it peculiarly suited for the lighter makes of blouse textures in both cotton and silk yarns.

296. *Work of the Lappet Frames.*—For each form of effect a lappet frame requires to be employed—each frame, and the whip threads which it receives, being under a separate scheme

of mechanical movement. This will be evident on referring to Fig. 326, for which the design is sketched on "dent" paper at Fig. 326A. The waved striping A and the spotted striping B are here different in formation, hence one frame with the traverse of the lines seen in section A of the plan, and a second frame with the traverse of the lines seen in section B, would be employed. The smaller frame movements correspond with the shortest horizontal lines (equal two dents in Fig. 326A) and the larger frame movements correspond with the longest horizontal lines (equal 15 dents). The double action of the whip threads, first, in traversing given widths of the fabrics and acting as shots of weft; and, second, in rising, when the course of the thread is changed, and acting as threads of warp lifted for binding with the shuttle yarns, is now apparent. In this design, one whip thread controlled by one needle in the frames gives the effects in A, and a second whip thread controlled by a needle of the second frame gives the effects in B. The number of repeats of the effects is therefore the result of the number of pins in the respective frames, and of the width of the piece. The accurate mounting and gauging of the needles are important technicalities. The bars or frames are measured and marked according to the dimensions of the pattern repeat in the set of the reed. In employing several needle bars, the spacing of the combined sets of needles is denoted on a lath of the same length as the bars. On this improvised scale, the position in the loom of each frame is marked, which enables their relative setting to be correctly established.

297. *Two- and Single-Frame Patterns.*—With one frame simple varieties of figuring, such as that illustrated in Fig. 327, are workable. In this example the connection of one row of details with a successive row by the whip thread describing the zig-zag line obviates the cutting away of otherwise loose yarn between the spottings, and produces an additional decorative feature in the cloth. Whatever arrangement of lines is possible within the movements from

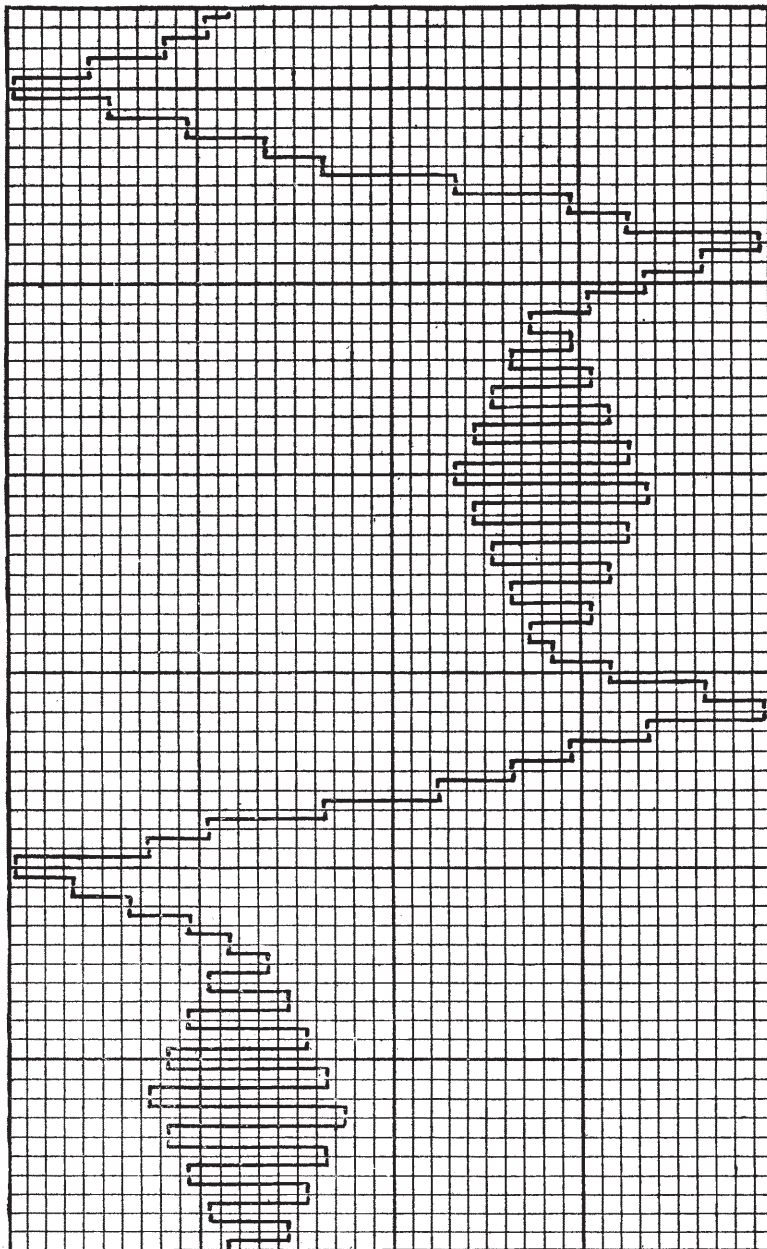


FIG. 327.

centre to centre of a frame, such lines are transferable on to the fabric surface. The order and grouping of such lines follows the rule of weave construction. The designs may also be made on the same principle as ordinary warp and weft patterns by taking each thread on the point paper as the equivalent of a dent, and each pick on the point paper as the equivalent of a single lateral displacement of the frame. The order of wefting, relative to the actuation of the lappet

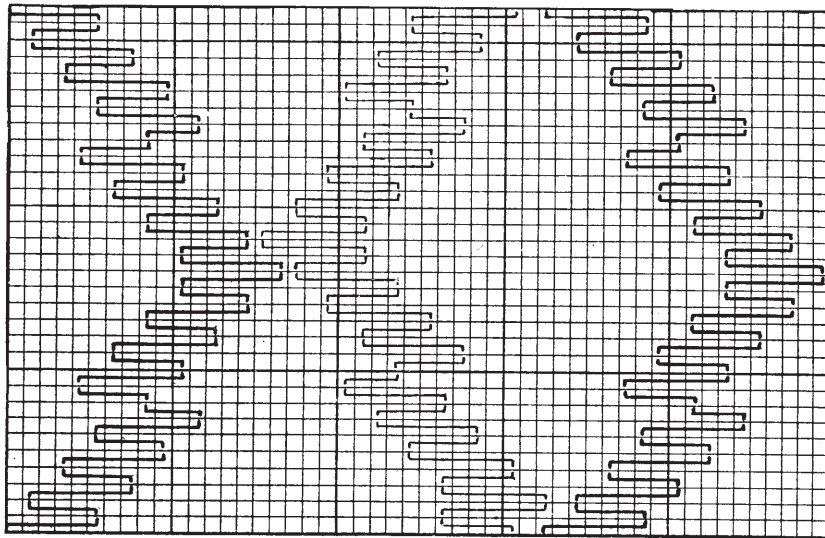


FIG. 328.

frames, is, however, changeable with the fineness of the ground texture, and the sort of lappet style desired.

Two frames provide for the production of reciprocating pattern forms or for the production of diamond and lozenge-shaped figures. An illustration of this type is given in Fig. 328, which suggests the basis on which the style in Fig. 11 (Paragraph 16, Chapter I) is constructed. The configuration of the initial lines in this specimen is first determined, as in originating diamond figures, and second this line is inverted by the action of the second frame, weaving the two effects



FIG. 329.
TWO-FRAME AND TWO-COLOUR
LAPPET TEXTURE.

in one or two colours, or with two or more lines in one colour and a third line of effects in another tint of lappet yarn. Style diversification is acquired by using differently coloured whip threads in each frame. Fig. 329 has been thus produced, the waved line A being in gold whip yarns, and the waved line B in white whip yarns. Taking the pattern lines to be the

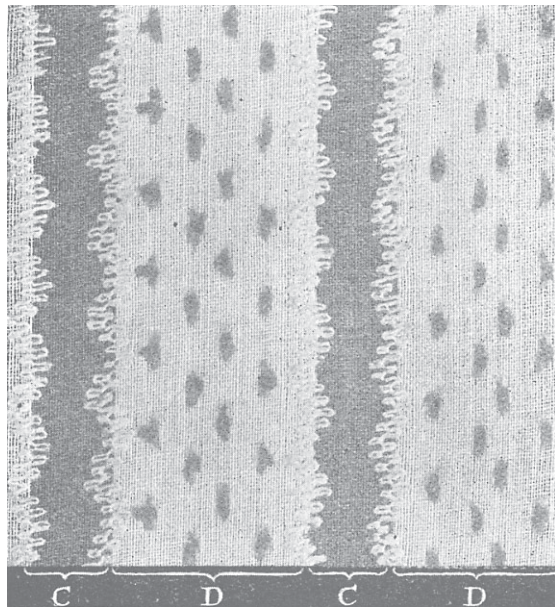


FIG. 330.—LAPPET AND SWIVEL-WOVEN TEXTURE.

same in character, if the lines were coloured in separate tints the design composition would be greatly varied. Moreover, each series of pattern features, such as A or B, Fig. 329, may be differently tinted. For the effects A, two or more colours of whip yarns are usable, producing the same design details in distinct tones in the fabric. Colour assortment and grouping on this system may be practised in modifying the effects of any particular scheme of frame movements.

298. *Gimped and Waved Designs.*—Gimped and waved-line types of design are shown in Figs. 330 and 332. Those in the

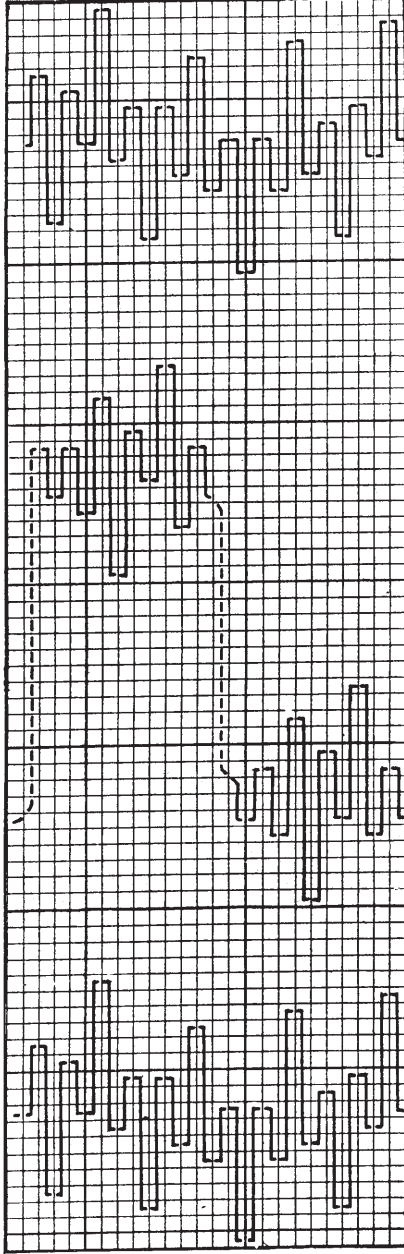


FIG. 331.

former, with also a sectional part of the spotted striping, are outlined on dent paper at Fig. 331. The dotted line, connecting the two spots together, is the portion of the whip thread which would be removed after weaving. By employing a front and back frame the duplicated waved line stitching, at C in Fig. 332, has been acquired. Another characteristic

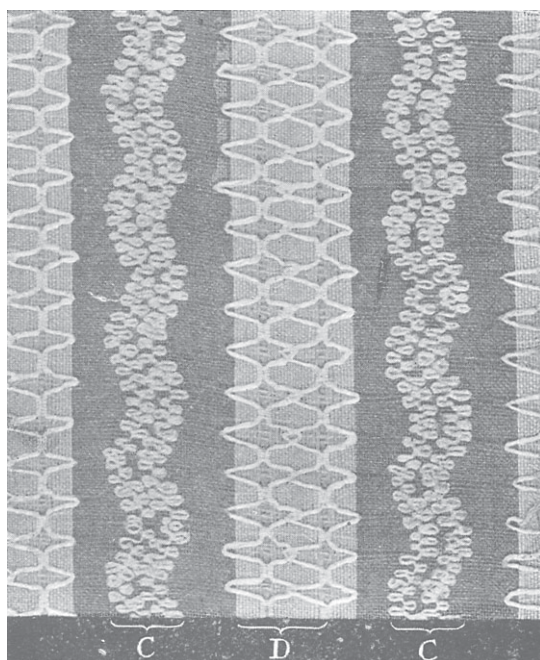


FIG. 332.—LAPPET AND GAUZE STRIPING.

noticeable in this specimen is the crossed whip-thread features in portion D, resulting in an effect similar to that obtained in gauze heald-shaft mountings. Where the spaced lines occur in this pattern—formed by allowing vacant reeds in the sley—the whip ends of the two frames come together without crossing, whereas, in the intermediate portion of the striping, the lappet ends bind with each other. More accentuated waved lines than observed in this example, are fashioned by

using a special cord yarn. This yarn is not bound into the fabric by being crossed with the weft, but is secured thereto by the lappet end with which it is combined. The latter moves in the formation desired, or as fixed by the plan, and carries the cord yarn with it.

Several methods of diversifying lappet styles, in addition to that of originating new pattern forms, are practised—first, different coloured whip threads may be employed on the same frame as explained; second, the spacing of the needles may be modified giving one repeat of the pattern in broader features than another; third, in multi-frame designing the relative positions of the needles in the frames may be interchanged; fourth, particular frames may be rendered inoperative for definite periods in weaving; and, fifth, two or three of these practices may be amalgamated.

299. *Gauze Principles of Intertexture*.—As pointed out in Paragraph 15, Chapter I, in the gauze principle of weaving, certain threads of warp are made to partly wrap or twist round adjacent threads of warp singly, in pairs, or in selected groups. What actually occurs in the weaving of the fabric is the lifting of the “doup” or “whip” threads on the respective sides of the stationary or standard threads, and the binding of the two sets of warp yarns in this relation by the shots of weft. Leno is commercially a texture in which the open effect is apparent, but not necessarily a gauze structure as understood by the raising of the “whip” threads in alternate order on each side of the stationary threads. In the leno, as strictly defined, a plain pick is inserted between each cross-binding of the threads, whereas, in the true gauze, there are no such plain interlacing picks, but only the picks inserted into the cross sheds of the warp.

The fundamental principle of intertexture, in gauze weaving, is for the picks of weft to cover all the stationary ends—or, inversely according to whether the texture is woven face or back up—and to float under all the doup or crossing threads, as seen in the sketches of the gauze and cellular make of

fabric at F, Figs. 334 and 335. The doup threads D in both these textures are bound to the ordinary warp threads S, by rising successively on the right and left of the latter, and by the picks securing them in these positions.*

300. *Cross-Thread Features—Healding Methods.*—To obtain these cross-thread results, a particular form of duplicated heald is employed, that shown at H¹, Fig. 333A, and the threads of warp are healded in a special way. The doup or slip is attached to the front standard H², and may be operated independently of, or in combination with, this shaft. In the “bottom doup” arrangement the slip heald is connected with the lower portion of H². Both the upper and lower slip-heald arrangements are largely employed. A drawback in “bottom douping” is that the fabric is produced reverse side up, and should the slip healds break, repairing is not so conveniently done as in “top douping.” Moreover, with the top doup the fabric is woven face up, rendering faults and irregularities in weaving at once visible. In addition, the angle of the threads formed in developing the cross sheds is less acute in the employment of the top than of the bottom doup, and this reduces the strain on the warp yarns in the construction of the cloth.

The method of healding, and plan of construction, are exemplified in Figs. 333 and 334, and also in the sketch of the shaft mounting for plain gauze in Fig. 333A. Referring to Fig. 333, the ordinary threads S pass under the vibrator, slackener or easer V, and over the warp rest WR, thence through the healds of the regular heddle H³. The doup threads D pass over the vibrator V and WR, through the healds of the back standard H⁴, under threads S and through the doup healds H¹. The warp yarns are thus divided into two classes, those healded straight or threads S, and those double-healded or threads D, with the doup ends crossed under the stationary ends between the back standard H⁴, and the front standard and slip or doup, shafts H² and H¹. The

* Gand's *Cours de Tissage*, Nesbit's *Grammar of Textile Design*, and Schams' *Handbuch der Weberei* contain useful diagrams of Gauze Mountings and Textures.

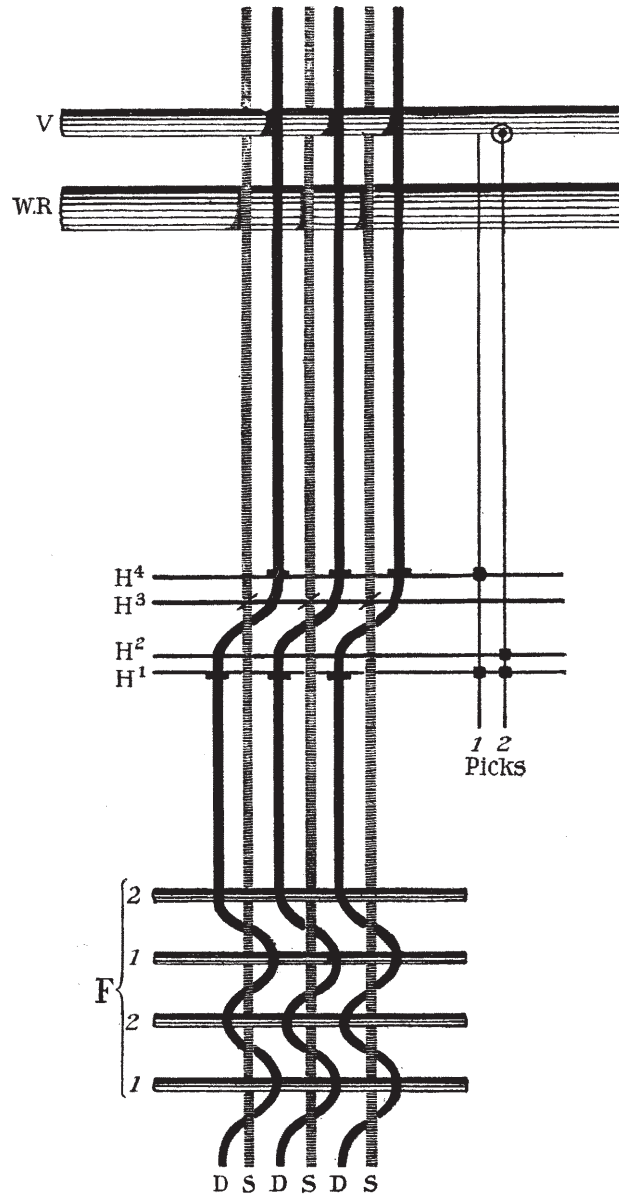


FIG. 333.—GAUZE MOUNTING AND FABRIC.

lifting of the back standard produces an "open" shed with the threads D raised on the right of threads S, or it produces the shed for pick 1; and the lifting of the front standard produces a "cross" shed with the threads D raised on the

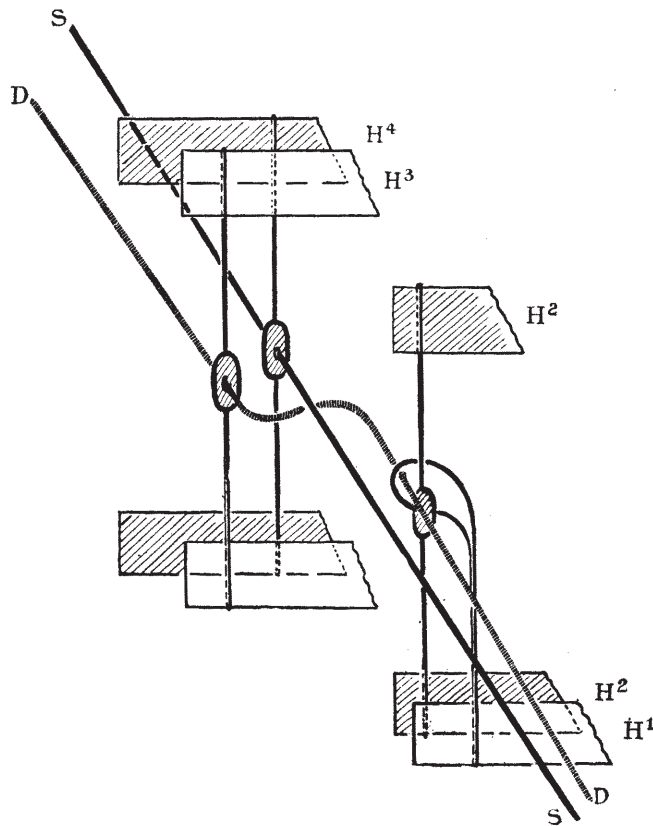


FIG. 333A.—HEALD-SHAFT MOUNTING—PLAIN GAUZE.

(With threads D drawn through threads H³ and H¹.)

left side of threads S, or the shed for pick 2. Necessarily, in forming the "cross" sheds there is more strain put on the warp than in forming the "open" sheds, and in order to ease the formation of such sheds, the slackener or vibrator V is raised with the front standard and slip shafts. This is shown in the weave plan indicated on the lines corresponding to

shafts H¹, H², H³, and H⁴, and also on the line of the vibrator bar V. Marks, representing "lifts," give, on pick 1, the slip H¹ and back standard H³ raised; and, on pick 2, the doup and front standard shafts, H¹ and H², and the slackener raised.

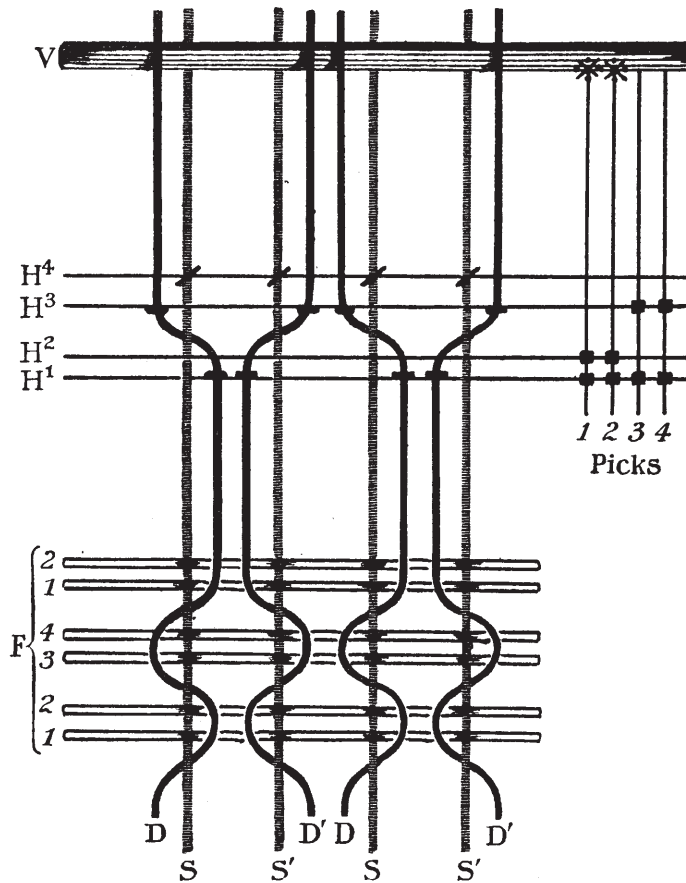


FIG. 334.—HEALDING DRAFT AND PLAN OF CELLULAR FABRIC.

301. *Right and Left Whip Thread Drafting.*—When healding or drawing-in the warp, the doup threads may be passed either to the left or to the right of the stationary threads in the intervals between the back standard and the front standard; or such threads may be alternately passed on one or the other

side of the stationary threads. In the arrangement for the two-pick in a shed cellular cloth in Fig. 334A (warp 2/30's cotton, weft 15's cotton with 30 threads and 50 picks per inch), the doup threads are heald in both directions relative to the ordinary warp threads, or as sketched in the diagram of the mounting for the cloth at Fig. 334. Here threads S pass through the healds of H^4 (ordinary heald), and the douping threads D through the healds of H^3 (back standard) underneath and to the right of threads S, and the doup threads D^1 through the healds of H^3 , and under and to the left side of threads S^1 . Left and right intercrossing of the threads in this manner gives a double curve to the doup yarns and yields a cellular cloth structure. As in Fig. 333 the weave plan—Fig. 334—is

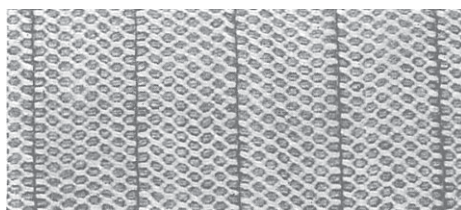


FIG. 334A.—CELLULAR CLOTH.

shown on the heald and vibrator lines. This shows H^1 , H^2 , and V as lifted for making the cross sheds or picks 1 and 2, and H^1 and H^3 as lifted for the reverse sheds or picks 3 and 4.

302. *Cellular Cloths*.—A variation of the cellular type of fabric is sketched in Fig. 335. It is weavable in the same shaft mounting as Fig. 334A, but with a different order of shedding and shuttling. Picks 1 and 2 correspond in interlacing with the same picks in Fig. 334, but on picks 3, 4, 5, 6, and 7, the doup, as well as the stationary threads, are intersected plain. For obtaining these effects it will be observed that in the plan the back standard is lifted with the doup shafts on picks 3, 5, and 7, and the regular heald shaft lifted on picks 4 and 6. From the diagram it will be understood how the gauze structure may, as required, be combined with a plain-woven structure.

It should be noted that the practices in healding and in shedding described involve the reeding of each group of yarns, making the gauze effect, in one dent.

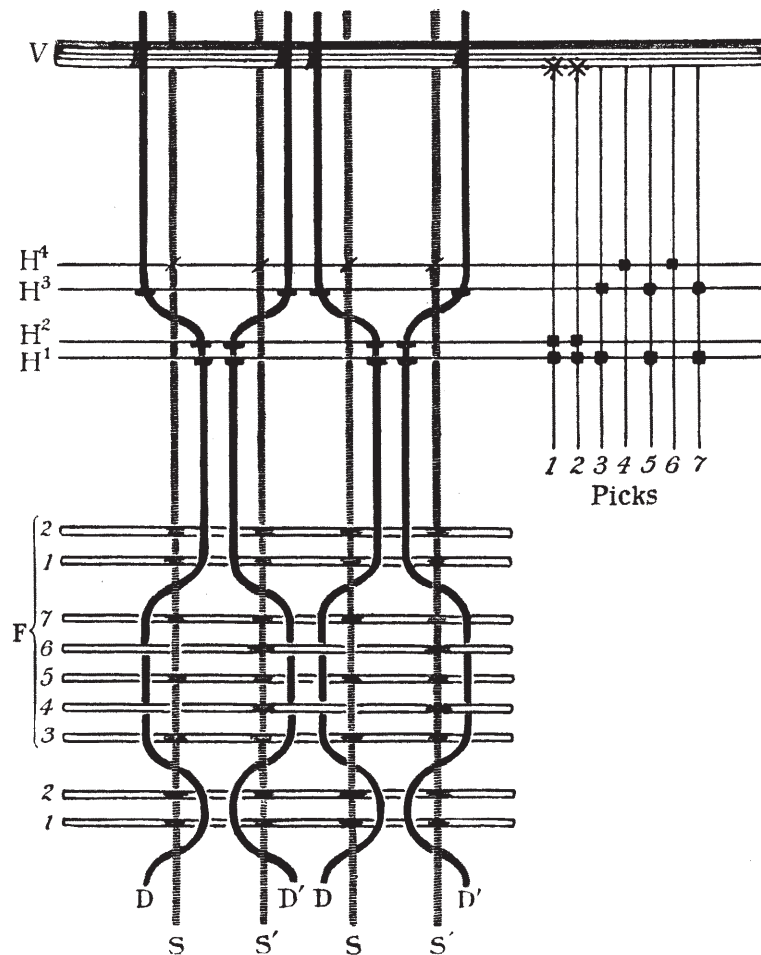


FIG. 335.—DIAGRAM OF CELLULAR MAKE OF GAUZE TEXTURE.

character of the gauze is emphasized in special makes of textures by allowing vacant dents between different sets of gauze ends.

303. *Light Fabrics—Perforated in Structure.*—It is now

evident that cross or gauze weaving enables fabrics of a semi-transparent, as of a more or less perforated structure, to be produced. In the ordinary build of cloth, compactness or closeness of thread interlacing is synonymous with firmness of cloth construction or build. The greater the frequency with which the threads of warp interlace with the shots of weft, the higher the tensility and wearing strength of the fabric woven. To modify or impair these conditions implies the production of a lighter, but also of a more flexible and flimsy make of texture. As the interstices between the crossing of the yarns become better defined, the more readily may the threads be unravelled and disarranged.

On the gauze principle of textural formation, visible spaces occur between the warp and weft threads, and yet the fabrics are firm, fast, and durable in character. The lacing, gauze, or leno yarns in the warp, intertwine (as explained in Paragraph 299) with adjacent threads, and form in the cloth a species of netted or honeycomb effect. The texture may be gossamery and flimsy as in the gauze muslin, but the threads retain their normal positions under tension, friction, and strain. The ordered arrangement of the yarns, as fixed in the process of weaving, is more prominent than in the common types of fabric. For this reason leno threads are inserted into light goods for preserving the lines of the pattern, especially when these lines are obtained by combining closely-interlaced with loosely-interlaced or unintersected details, as in the check specimen in Fig. 336. There being no warp threads in parts C and D of this fabric to intercross with the weft shots C¹ and D¹, if the picks were not bound at the edges of lines A and B by leno-woven threads, they would be easily disturbed and made to leave, in the wear of the fabric, the positions assigned to them in the process of weaving. The higher crossing efficiency of the gauze, as compared with the ordinary principle of thread interlacing, is seen in this example, where the gauze threads compactly bind or knit the edges of the open or loosely-woven pattern features.

In fine silk and cotton goods, as also in cloths made of thicker yarn counts, the gauze practice is adapted to the manufacture of fabrics with a pierced structure and successively close and open in thread composition.

It is this possibility of making a well-arranged and permanent fabric build which is open in character or with spaces between the crossing of the threads, which renders the leno scheme of looming so effective in producing the lighter varieties of woven manufactures. Three examples of such goods are given in Figs. 337, 338, and 339. Section A of the first specimen contains 36 ends per inch of 2/80's cotton, wefted with 40's single cotton and 60's silk, with 62 picks

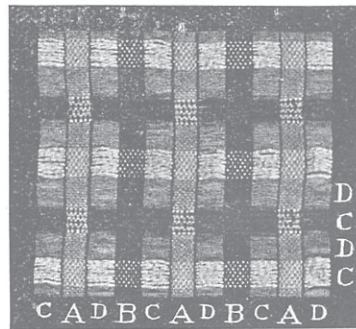


FIG. 336.—CHECK WITH SECTIONS EDGED WITH GAUZE THREADS.

per inch. As a texture, it is perforated and apparently flimsy in structure, but in reality quite as durable as the closely set stripe B with 140 threads per inch. The method of thread interlacing is that of the simple gauze (Fig. 333) so that the intertwining of the warp yarns for the insertion of the picks of weft knits the two thread units into a fast make of fabric.

The employment of 2/20's cotton yarns, and crossing them on the system indicated in Fig. 338, bends the shots of weft out of the true horizontal line, and leaves open spaces between both the threads of warp and the picks of weft, resulting in a texture composed of semi-circular pattern forms. The plan of construction here is that shown in Fig. 338A. Two pairs

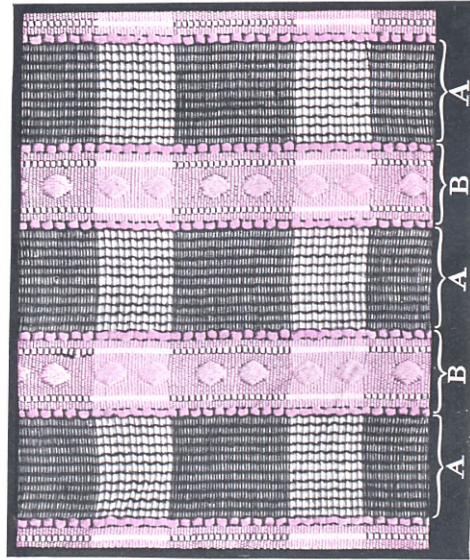


FIG. 337.
MUSLIN GAUZE WITH FIGURED-WARP
STRIPE INSERTION.

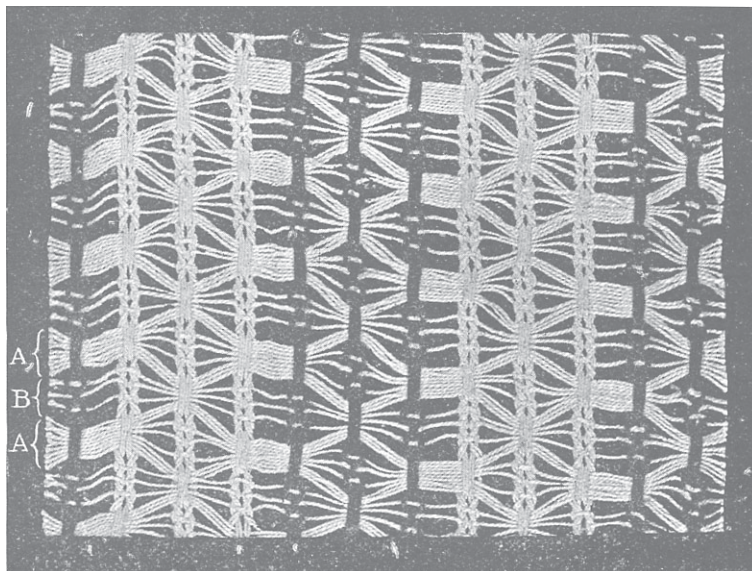


FIG. 338.—OPEN GAUZE STRUCTURE.

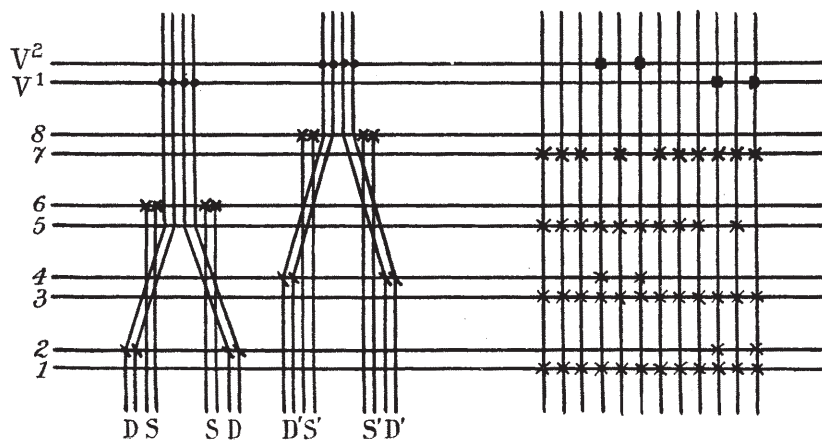


FIG. 338A.

of doup threads, D, D^1 , wrap with pairs of standard threads, S, S^1 , in interchanged positions, and also in two directions as denoted in the heading draft and plan, and as observed in the specimen. In parts A, Fig. 338, the crossing threads are bound by eight shots of weft, and in parts B by picks alternately intersecting with the threads. It follows that in section B the picks are separated and spread, while in section A they are compacted and forced into waved-line contact with each other. As the two sorts of textural effects counter-change with each other in the length and width of the fabric, successive close and open interlaced features result. The example is illustrative of the extent to which the picks of weft

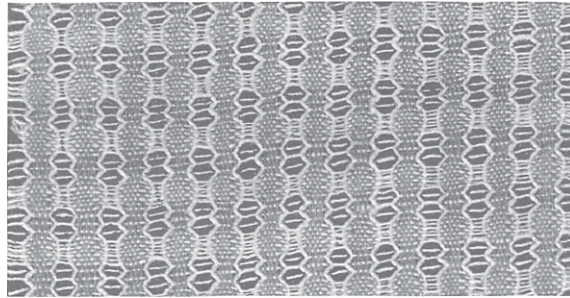


FIG. 339.—NETTED EFFECTS IN GAUZE TEXTURE.

may be drawn out of the straight-line position in cross weaving, and also of the degree of thread spacing producible in an evenly formed and symmetrical make of cloth.

The textural elements described in reference to Figs. 337 and 338 are solely due to the gauze principle of intersection, but in Fig. 339 plain effects alternate with leno or gauze effects. The grey stripings, being in plain, and the white stripings in gauze, the whip threads permit the curved displacements of the yarns observed in the specimen, and also in Fig. 339A. By omitting dents between the whip yarns in the respective lines of effect, the elongated perforations in the fabric are exaggerated. The binding of the doup ends, where crossing, slightly reduces the closeness of the picks. On the

intervening picks, the gauze ends bind plain with the ends in the grey stripings, as will be noticed in the sectional drawing of the yarns in Figs. 339A.

304. *Muslin Striping with Gauze Lacing Threads.*—The pattern in Fig. 340 is typical of the manner in which the whip-threads, in cross sheddings, are made to retain the shuttling yarns in the identical relation given to them in the weaving

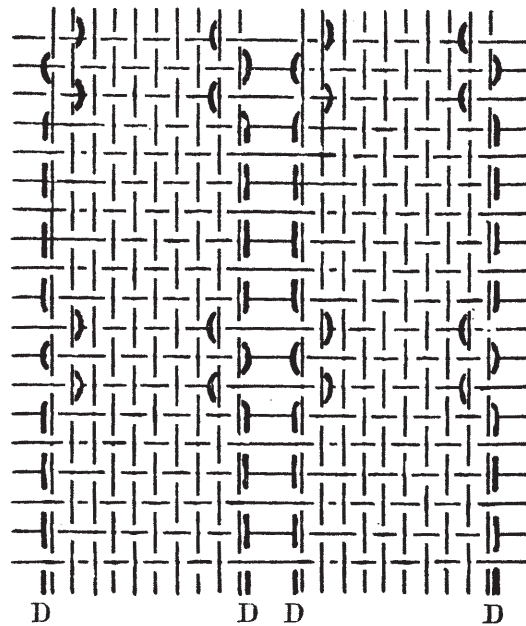


FIG. 339A.

operation. In the specimen, the sections in plain, and also those in lacing, are forcibly developed by the intermediate sections in loose picks of weft obtained by vacant splits in the reed. The method of loom mounting followed in making such styles is illustrated in Fig. 340A. The doup threads, being woven plain on the picks intervening the cross sheds as in Fig. 339, are in such parts of the design alternately lifted by the shaft 7 and by the front doup shaft 2 through which they are drawn. The close character of the plain

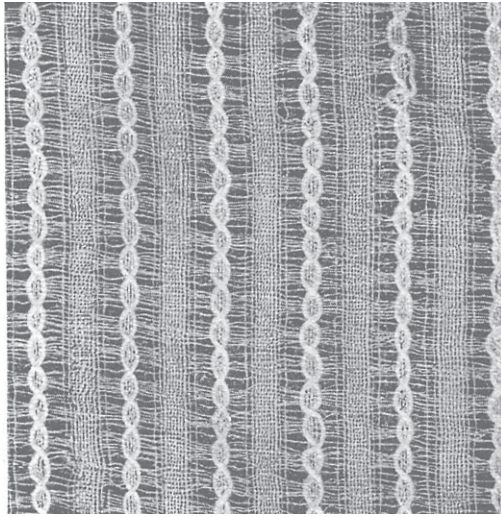


FIG. 340.—GAUZE AND DENTED STRIPING

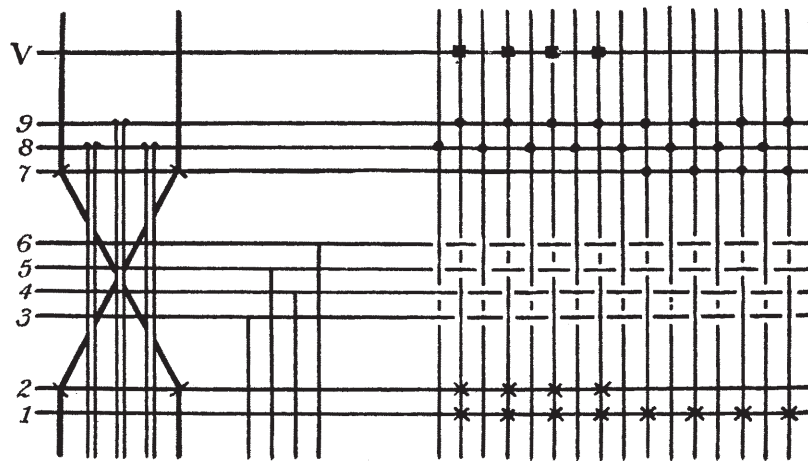


FIG. 340A.

stripes is caused by the warp threads in these portions of the pattern interlacing in pairs. The plain weave is healded on to four shafts in 4-end sateen order, for easing the shedding in weaving, and for ensuring the ready construction of a correctly woven piece.

305. *Sateen and Gauze Striping*.—Fine striped goods are

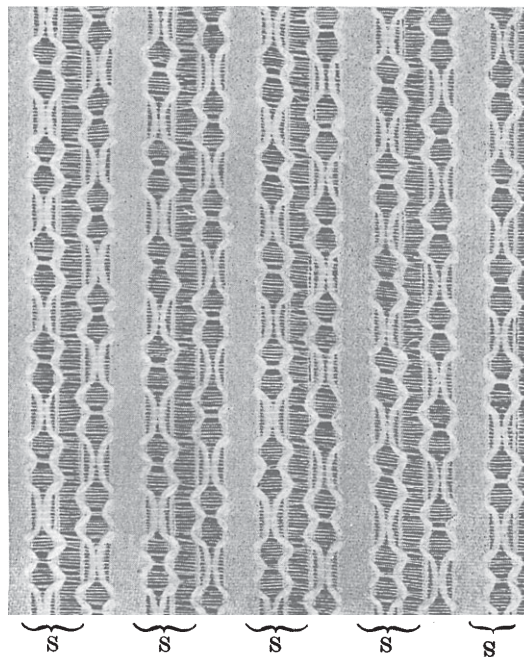


FIG 341.—GAUZE AND DENTED TEXTURE WITH SATEEN STRIPING.

produced, in which mercerized cotton or artificial silk threads form sateen lines, as in the smartly-developed pattern in Fig. 341. Successive lines are also combined, on this principle, of leno, plain and sateen effects, and also of effects obtained by open denting. The reeding—number of threads in a split—is made to agree with the production of an even texture. This example averages 60 ends per inch in the sateen, and 8 whip and 32 standard ends per inch in stripings S. Between the

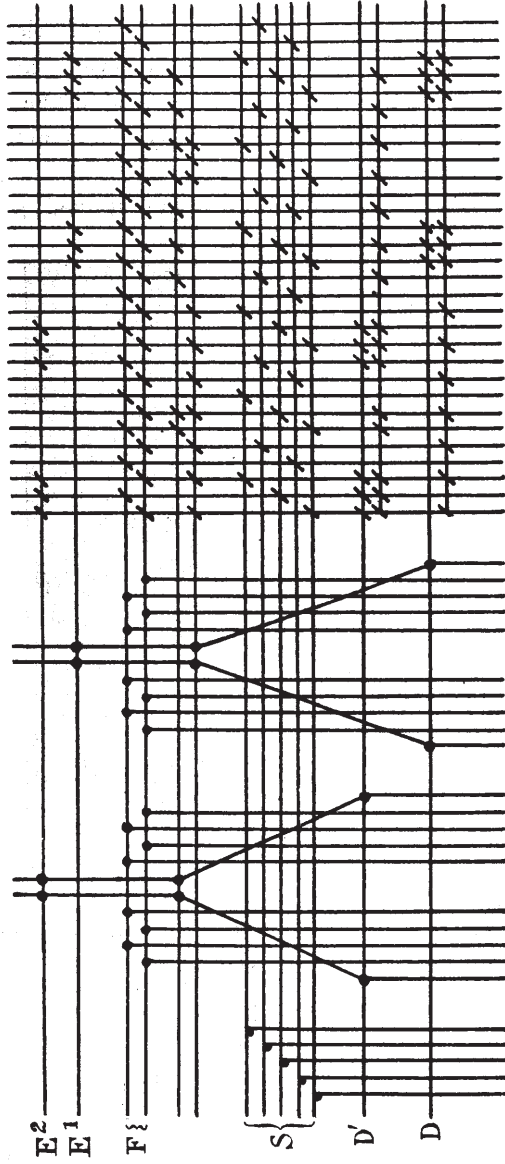


FIG. 341A.

crossing of the leno threads, the picks are unintersected, but formed in straight lines, being held in this relation by the four standard threads, woven plain, and by the wrapping of the latter with the gauze threads. The design, as seen from Fig. 341A, contains 30 picks in the round. Two doup shafts, D, D¹, and two slackeners, E¹, E², are necessary for giving the two lines of gauze work. The plain ends, with which the doup threads wrap, are on the two back heddles F, and the sateen striping ends on the central shafts S.

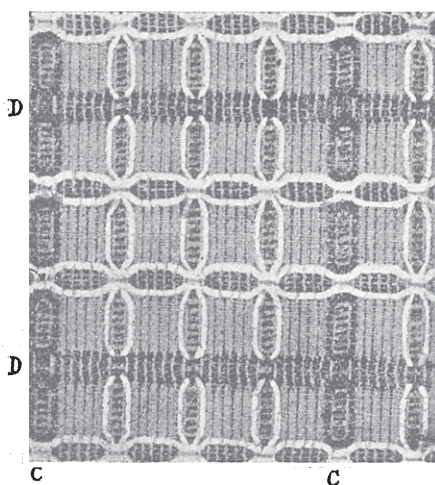


FIG. 342.—GAUZE CHECKING.

306. *Checked Gauzes*.—Checked gauzes—in which the thick leno threads and picks are made to give semi-circular forms of pattern—are produced in designs arranged on the system sketched in Figs. 342A and 343B, the healding draft and weaving plan respectively for the style in Fig. 342. Parts A in the draft, and also in the full looming design, yield the finer, and parts B in the more open, crossing details. Additional prominence is given to the checking lines in this instance by inserting dark ends and picks into the warp and weft of portions C and D of the fabric, which yarns contrast forcibly with the small and thick light yarns making other

sections of the pattern. As will be observed from the healding draft, the whip threads in A work in pairs with the standard threads, but in B three whip threads intertwine with two stationary threads. The actual bending out of the straight

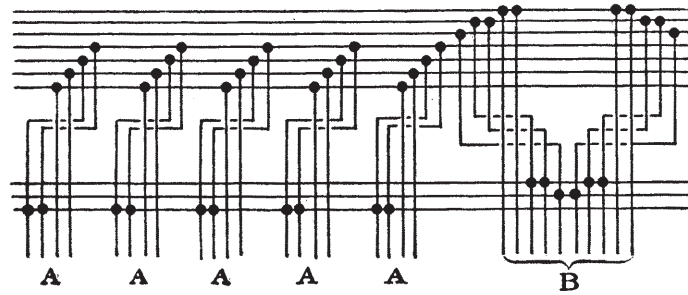


FIG. 342A.

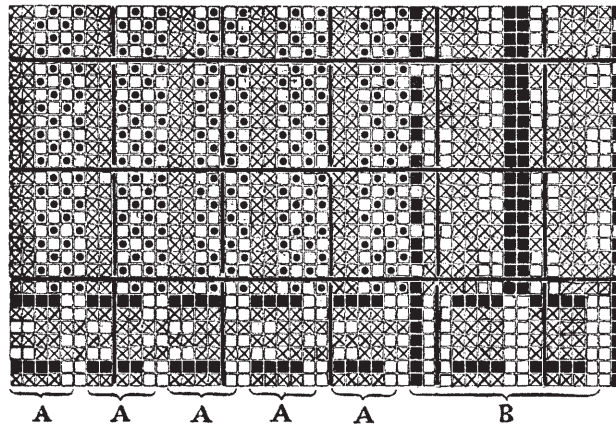


FIG. 342B.

line of the thick picks is accentuated by the weave plan or by the structural interlacings marked in \boxtimes 's. While the method of operating the slackener or vibrator is not shown here, nor in Figs. 343A and B, it will be understood that such vibrators would be employed and are raised for the cross sheds in weaving the goods.

307. *Extra Weft Spotted Gauze Textures.*—Extra weft spotting in gauze cloths is obtained by the same designing practice as in ordinary makes of fabric. The lappet principle is also utilized for developing spotted and trellis-like figuring. The spotting may be swivel inserted, or woven into the pattern by using extra shuttling. If by the latter method, the loose



FIG. 343.—EXTRA-WEFT SPOTTED GAUZE CLOTH.

shots on the back of the fabric would be removed after the weaving. The full design, with the extra spotting picks inserted, is given for the specimen in Fig. 343, at Fig. 343A, but, as is obvious from the healding draft, Fig. 343B, the pattern is weavable on seventeen shafts. Two doup heddles are used, namely, one for the whip thread wrapping round the six ends interlacing plain, and the other for the whip threads forming the gauze effect with the ends on shafts eight, nine,

twelve, thirteen, sixteen, and seventeen. Sections A should be repeated twice on both sides of section B. The thick douping threads are 3/20's cotton. The rest of the yarns are 2/40's, with 66 threads and shots per inch. The extra picks are

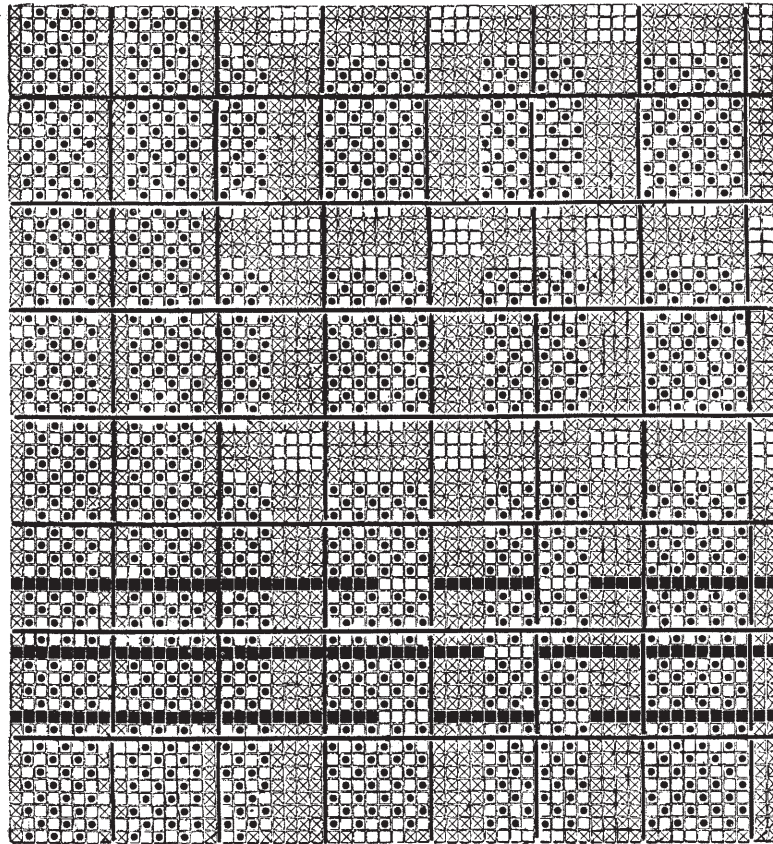


FIG. 343A.

marked in ■'s, and float under the threads of warp when not producing the spotting, or to the extent indicated in the plan in which the marks represent threads depressed.

308. *Warp Figuring in Gauze Patterns.*—Figuring in special warp yarns, in both dobbie and harness mountings, is done

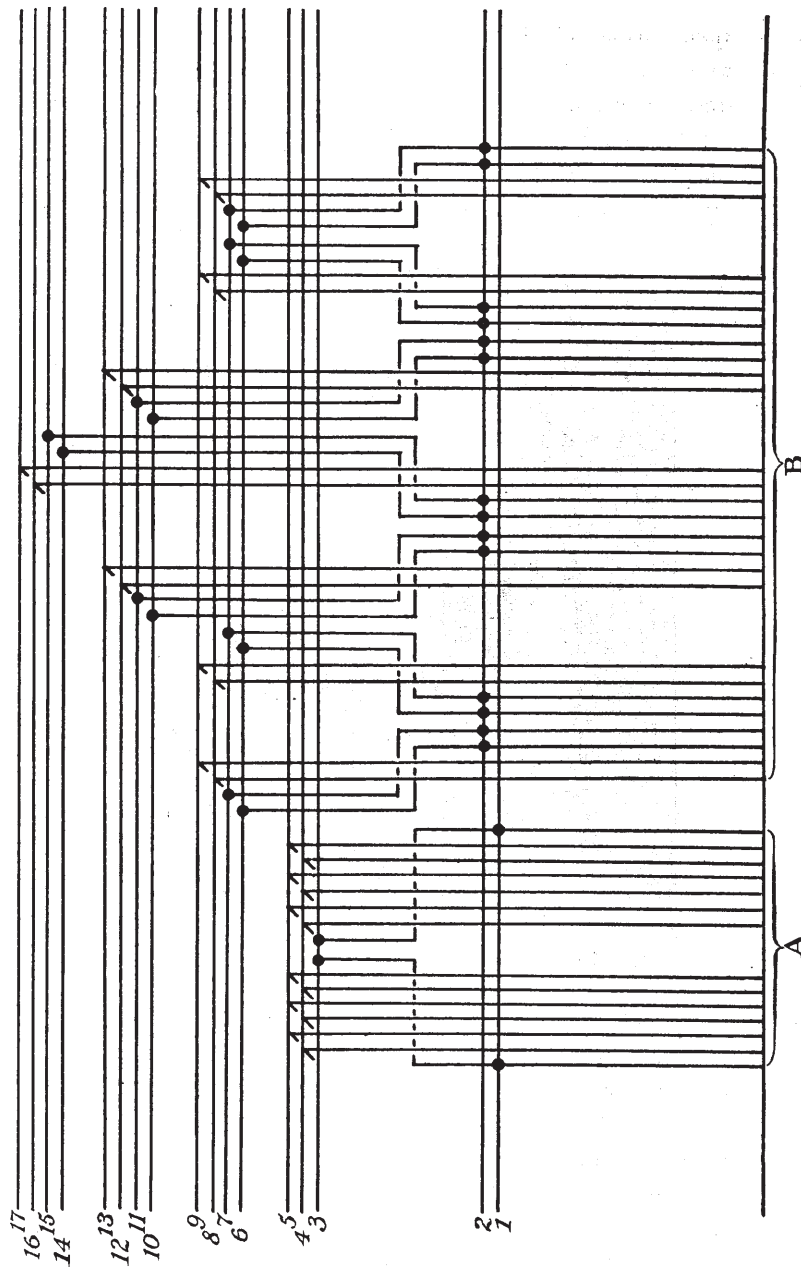


FIG. 343B.

in striped gauze cloths. It is a designing practice which consists in combining two or several systems of fabric construction. Each species of pattern forming the different lines in the style may be a distinct make of texture. Considering, for example, the specimen in Fig. 344, it is composed of plain, warp-figured and gauze elements, with each element specially



FIG. 344.—WARP-FIGURED GAUZE STRIPE.

set in the reed. Sections A have 16 threads per $\frac{1}{4}$ in., and sections B 32 ends, while sections C are produced by having four ends in one dent, two dents vacant and four ends in the fourth dent. The gauze threads interlace as sketched at Fig. 344A, wrapping with three plain lacing ends. The figured features are developed in extra warp yarns on a plain ground, or on the system given in Fig. 344B. For weaving the pattern, 20 shafts would be employed for striping B,

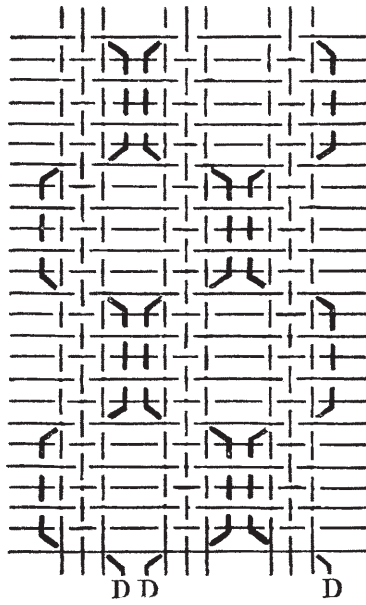


FIG. 344A.

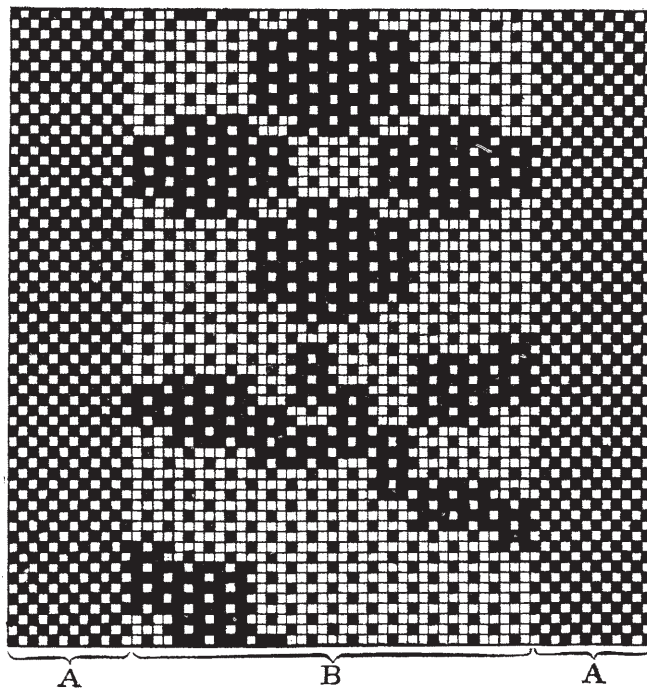


FIG. 344B.

or for actuating the figured warp, two shafts for the plain ground or stripings A, and two doup shafts with two vibrator bars for striping C.

In more decorative designs, harness mountings are used

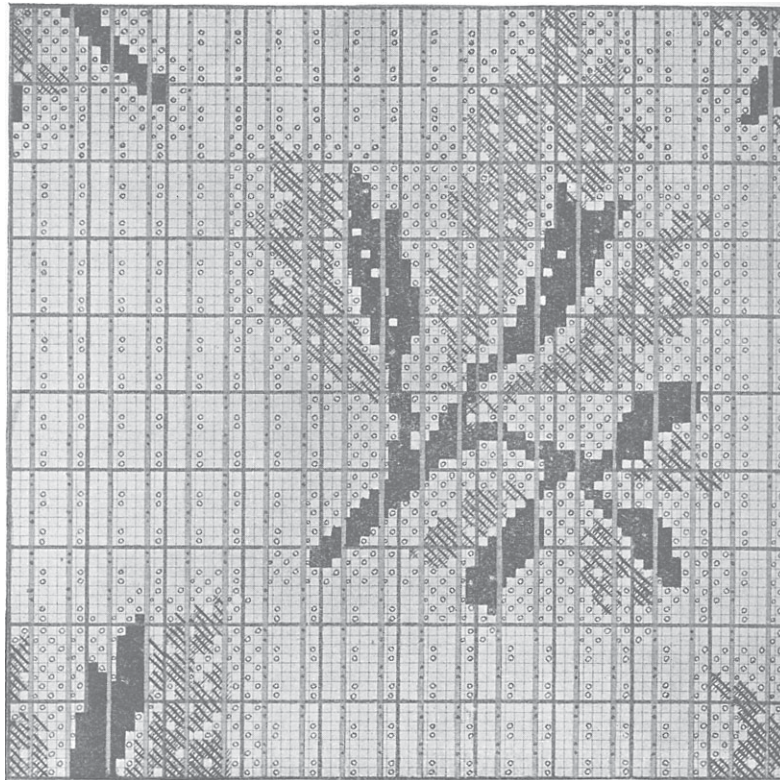


FIG. 345.—GAUZE FIGURED DESIGN FOR HARNESS MOUNTING.

for the figured portions, with shafts for the leno or gauze, lifted by special wires in the Jacquard machine, but depressed by springs, weights or under-motions.

309. *Harness Designs in Gauze Fabrics.*—Gauzes of the brocade variety are woven in Jacquard looms. One portion of the harness is worked in the ordinary manner, and a second

or front portion of the harness carries the slip mails, providing for warp drawing-in being done thus—

Thread 1			through mail 1 of the back portion and also through mail 1 of the slip or front portion of the harness.
Thread 2	,,	,,	2 of the back portion of the harness.
Thread 3	,,	,,	3 " " " " " " "
Thread 4	,,	,,	4 " " " " " " " and also through mail 2 of the slip on front portion.
Thread 5	,,	,,	5 of the back portion of the harness.
Thread 6	,,	,,	6 " " " " " " "

This groups the cross wires in the machine in regular order—1, 2, 3, 4, 5, and 6. Six wires control four warp threads, which implies that they lift and lower both the stationary and doup harness cords, and may be arranged on point paper as in the simple form of design in Fig. 345. The drafting of the pattern, as far as the figured elements are concerned, may, therefore, be effected as in preparing plans for a straight harness mounting. The example has the spotting woven in warp and weft effect surrounded with bands of plain, while the ground is in leno, due to the slip threads rising on the two sides of the stationary yarns when lifted by the back and front portions of the harness respectively. In producing the figured portions of the designs, the slip harness remains inoperative.

The tensioning of the doup threads, in such harness weaving, may be done by passing them through mails weighted by lingos and arranged in a supplementary comber-board, fixed in the rear of the harness, or by means of vibrator bars. Harness gauze weaving is also practised in combination with pile and various types of warp and weft ornamentation, in which compound systems of warping, shuttling, and of loom mounting, are applied. For the dress trade, figured-gauze work is mainly confined to the lighter builds of cloth, more especially as composed of silk, cotton, and admixtures of silk and cotton yarns.

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