

there is paint represented, in the present case, by means of shaded squares.

### Extra Weft Figuring.

§ 179. Instead of employing an extra series of warp threads in order to produce additional embellishment in a fabric, this object may be effected by inserting an extra series of picks of weft. The latter method of introducing the extra figuring threads is, of course, a more costly procedure than the previous method, because it involves the use of a loom equipped with a "checking" or shuttle-box motion. Also, additional pattern cards are required for the extra picks of weft. If, in the fore-

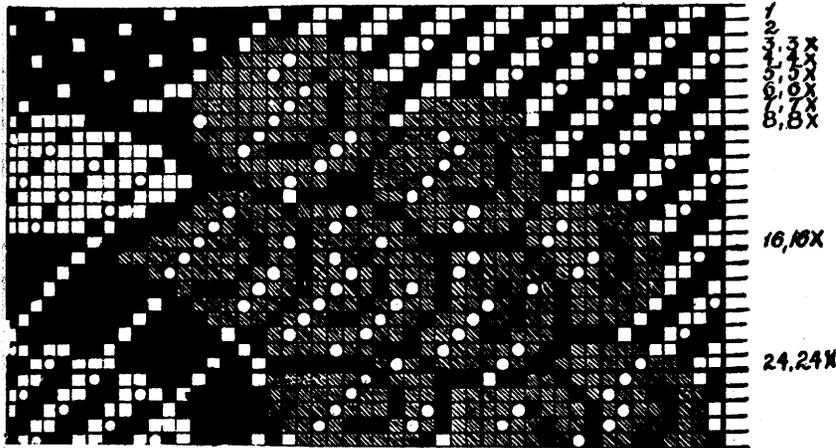


FIG. 551.—Part of applied design illustrating figuring with extra weft.

going description of extra warp figuring, §§ 177 and 178, the terms "warp" and "weft" are read as "weft" and "warp" respectively, the method of figuring with extra weft will be clearly understood.

The method of developing an applied design for an extra weft-figured effect is indicated in the portion of a design, Fig. 551. The fruit is developed with the extra material, and is indicated on design paper by paint represented by shaded squares. Long floats of weft in either series must be bound by

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warp, and not by taking one pick to the back and lifting the other to the face, for similar reasons to those stated with reference to extra-warp figuring, and illustrated at *b*, *b*<sup>1</sup>, Fig. 546. Either series of weft is prevented from floating too far at the back of the cloth by binding over one series of warp threads when the other series is on the face as indicated in the design by paint represented by round white dots.

For the ordinary picks the card-cutter must be instructed to cut paint represented by black and shaded squares; and for the extra picks to cut that represented by black squares, and also the design paper. Paint represented by round white dots must always be missed, for these indicate the binding points of the lower weft, and will, therefore, not be visible on the face of the fabric.

Where the extra weft is indicated in the design, each horizontal space on design paper represents two pattern cards—one for a pick of the ordinary weft, and one for a pick of the extra weft, both of which should bear the same cardinal number; but pattern cards for extra picks should be distinguished from those for ordinary picks by affixing to the cardinal numbers some distinguishing mark, as the letter X.

If the cloth is produced in a loom equipped with a double shuttle box at one end of the sley only, the pattern cards will require to be laced for an "alternate" picking motion to insert two picks of the ordinary weft and two picks of the extra figuring weft alternately. But a superior result is obtained by employing a loom with two shuttle boxes at each end of the sley and equipped with a "pick-and-pick" picking motion, in order that an ordinary pick of weft and an extra pick of weft may be inserted separately in alternate succession, instead of in pairs.

If the loom is equipped with a double box at one end of the sley only, the pattern cards for Fig. 551 must be laced in the following order, namely: 1, 2, 3, 3x, 4x, 4, 5, 5x, 6x, 6, 7, 7x, 8x, 8, and so on, but if weft is inserted pick-and-pick, cards must be laced as follows: 1, 2, 3, 3x, 4, 4x, 5, 5x, and so on.

Some method should also be devised whereby the cloth is taken up at half the usual rate of speed whilst the extra figure

portion is weaving, because the extra picks of weft do not add to the length of the fabric. This object may be accomplished by connecting the stop-catch of the take-up motion to a spare hook in the Jacquard machine (or if all are engaged, an extra hook may be inserted) and holes punched in the extra pattern cards to cause the stop-catch to be raised whenever those pattern cards operate.

## CHAPTER XIII.

## DAMASK FABRICS.

§ 180. Damask fabrics comprise two chief modifications, namely: (1) "Simple" damasks, containing only one series each of warp and weft threads, as exemplified both in worsted and linen table covers, table linen, light curtains and hangings; and (2) "Compound" damasks, containing one series of warp threads and two series of weft threads, namely, "face" and "back" picks respectively, as exemplified in some varieties of furniture upholstering fabrics, curtains and hangings.

Damask fabrics in general are characterised either by warp satin figuring upon a weft satin ground, or *vice versa*, and usually with satin weaves of the same denomination as the 5, 8 or 10-end weaves. Or, instead of reversed satin weaves for the figure and ground portions of the fabric, these are sometimes developed with simple warp and weft twill weaves respectively. And again, a twill weave may be employed for the figure and a satin weave for the ground, as in the example illustrated in Fig. 552 which is taken from a sample of damask fabric containing 39 groups of silk warp threads per inch, with 7 threads in each group, or  $39 \times 7 = 273$  threads per inch, and 100 picks of worsted weft per inch. The figuring is developed with a simple 8-end weft twill on a ground texture of 8-end warp satin.

In addition to the reversing of the same weave or else two nearly similar weaves, for the development of the figure and ground portions of the fabric, in the manner just described, and thereby obtaining a true counterchange of weaves which virtually results in a reversible fabric, those fabrics that are constructed on the true damask principle of weaving are further characterised by a more or less coarsely-stepped

margin of the figure and ground resulting from the method of controlling, by means of the figuring harness, the warp threads in groups of two or more contiguous threads simultaneously, and also of inserting two or more consecutive picks of weft during the operation of each pattern card for the development of the design; although both the warp threads and picks of



FIG. 552.—Compound damask fabric.

weft each interweave independently in some definite order for the purpose of binding both the figure and ground portions of the fabric in the manner described.

It will be seen, therefore, from the foregoing, that damask fabrics differ from brocade fabrics not so much in the general principle of their construction, as in the manner of developing

figure upon them. In brocade fabrics a variety of different binding weaves may be employed both in the figure and ground portions of the fabric. Also, warp and weft may exchange places in any desired manner (excepting when woven with a "split tie-up" as described in § 173), whereas in true damask fabrics a simple satin or twill weave only is employed both for the figure and ground.

Of course, when designing for "brocade-damask" fabrics, in which individual warp and weft threads may interweave in any order, as required, it is a common practice to introduce a variety of different binding weaves in the development of the figure in order to impart additional attractiveness to the design; but these fabrics partake more of the character of brocades than of damasks, and more correctly belong to the former class of fabrics.

§ 181. It is in the special mechanism employed in the production of damask fabrics rather than their construction, that the greatest interest attaches. The extreme fineness of texture that usually obtains in these fabrics, especially those of silk or fine linen containing sometimes as many as 400 threads per inch, places them far beyond the range of the ordinary type of Jacquard machines of reasonable capacity, even for designs repeating on a few inches only, in the fabric. And to equip a loom with a sufficient number of ordinary machines would not only incur enormous expense, but that course would also oftentimes be quite impracticable.

In order, therefore, to overcome these practical difficulties and still enable true damask fabrics to be produced economically, there have been devised many very ingenious methods whereby a considerable number of warp threads may be commanded by a comparatively small number of hooks, needles, or both, in the Jacquard machine. Also, by using each pattern card for several picks in succession, a pattern repeating on a large number of picks may be woven with one-quarter, one-third or one-half that number of pattern cards, according as each of the latter is used for four, three or two picks respectively.

Although each of these several optional methods operate in a different manner in attaining the same result, they are all

based upon the same principle, namely, that of governing the warp threads *en masse* for the formation of the figure; and individually for the purpose of binding the warp and weft threads in some definite order or sequence.

### The Compound Presser Harness.

§ 182. The best known of these special damask equipments, and the one most suited for fabrics of very fine texture, is that known as the "compound presser harness" of which an end elevation and a plan are represented in Figs. 553 and 554 respectively, and of which there are two chief modifications. The prevailing type of "presser" harness, as represented in Figs. 553 and 554, consists of an ordinary Jacquard figuring harness C that operates in conjunction with a heald harness G for binding purposes, and comprising any reasonable number of healds (in the present case—five) according to the binding weave selected. Both harnesses control the same warp threads, but in a different manner. Thus, after passing through the mails H of the Jacquard harness in groups of two, three or more threads together, they are then passed separately through heald eyes G1 to G5 so as to form a five-shaft "straight-through" draft, as indicated in the plan, Fig. 554. The heald eyes are made much longer than usual in order to permit of a full Jacquard shed being formed within them.

After a shed is formed, the healds occupy three different positions, namely, a "top" position as No. 1; a "neutral" position as Nos. 2, 3 and 4; and a "bottom" position as No. 5, and may be actuated either by means of tappets, a dobbie, or Jacquard hooks B1, which are raised by a griffe A1 operated independently from the griffe A that lifts the figuring hooks B. Each heald is controlled by two hooks which are connected by a cord E supporting a small pulley and hook F. The healds are suspended by cords passing from the pulley-hooks and are pulled downwards, after being raised by means of weights or springs. By lifting two hooks B1 that are connected, a heald is raised to the "top" position; by lifting one hook only it is raised to a "neutral" position; and it remains at the "bottom" if both hooks are left down.

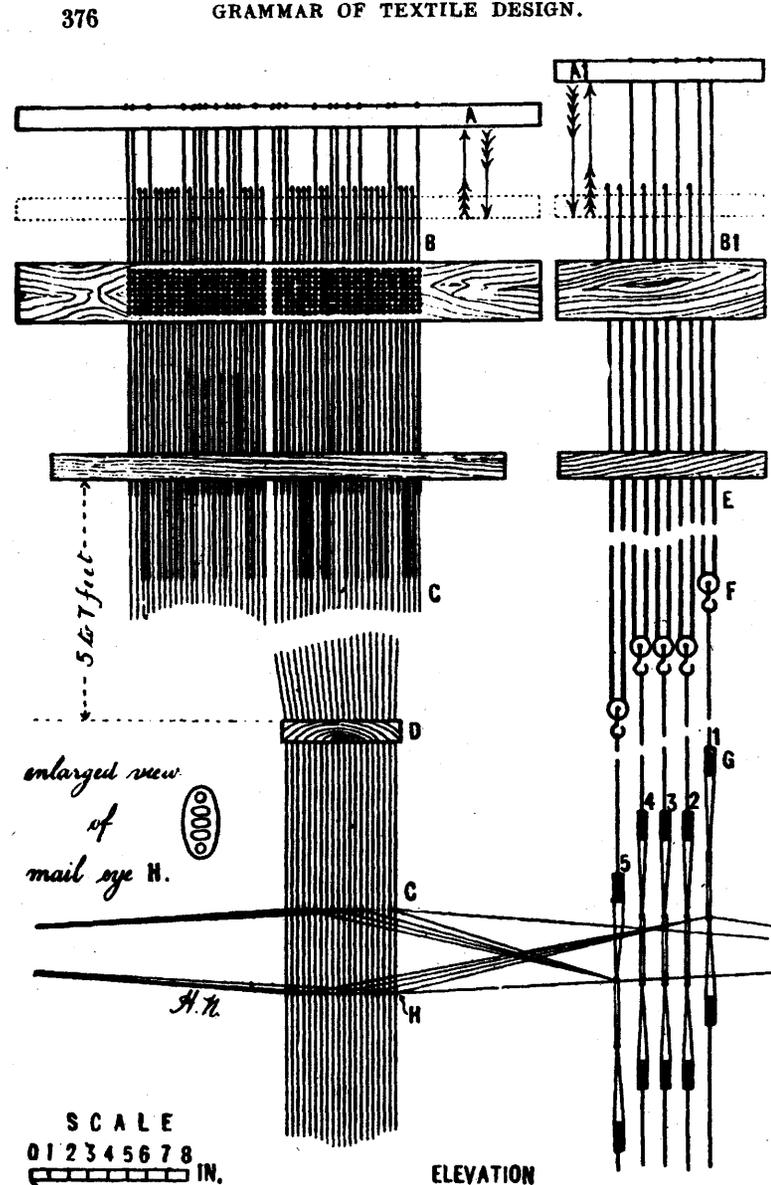


FIG. 553.—Compound presser harness, for damask weaving.

It is the function of the Jacquard figuring harness to form the pattern by raising warp threads *en masse* for the figure, and by leaving them down *en masse* for ground; and it is the function of the healds to produce the binding weave throughout the entire fabric, by raising some of the warp threads that

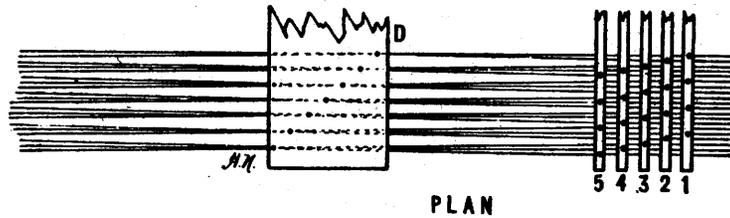


FIG. 554. —Part plan of Fig. 553.

are left down, and by keeping down others that are raised by the figuring harness. This object is accomplished by governing the healds in a manner according to the binding weave desired as a twill or satin weave. At least one heald must be raised and one left down for each pick, whilst the remainder occupy a "neutral" position in order to prevent any obstruction to the figuring shed.

The shedding plans indicating the manner of operating the

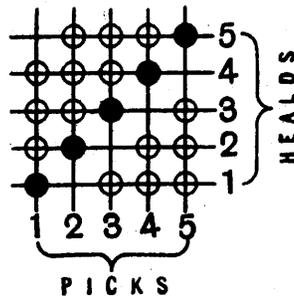


FIG. 555.

healds so as to produce a 5-end twill and 5-end satin weave are indicated in Figs. 555 and 556 respectively. Horizontal lines represent healds, and vertical lines picks of weft. A black spot placed on an intersection of two such lines signifies that the heald must be raised to the "top" position for the

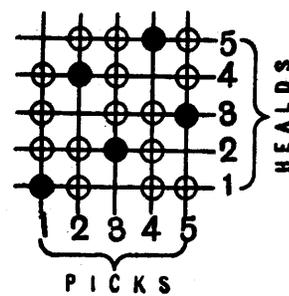


FIG. 556.

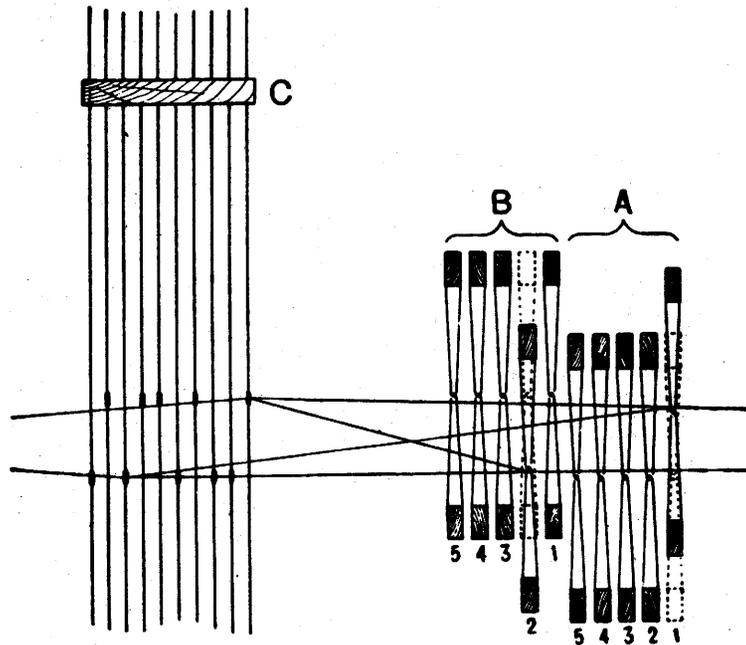
corresponding pick of weft. Also, a circle indicates that a heald must be raised to a "neutral" position; and a blank indicates a heald left down. For example, in Figs. 555 and 556 a black spot is placed upon the intersection of horizontal line No. 1 with vertical line No. 1; and circles are placed upon horizontal lines 2, 3 and 4; whilst 5 is blank on the same vertical line. Therefore, heald No. 1 would be raised to the "top"; healds Nos. 2, 3 and 4 would be raised half-way; and heald No. 5 would remain down on the first pick, and so on.

§ 183. As stated previously in § 180, each pattern card may serve for two or more picks of weft in succession. This is accomplished by keeping the griffes of the Jacquard machine raised for such number of picks as are required to be inserted for each pattern card, and then changing the card for the next series of picks: and as the griffes must be raised for every pick of weft, the changing of pattern cards must be accomplished quickly between the last pick of one pattern card and the first pick of the succeeding card. The lifting cam governing the Jacquard machine should be constructed to effect the change as easily and smoothly as possible, otherwise it will cause considerable vibration to the harness, and consequently bad weaving.

The construction of a cam to change the shed after every third pick is demonstrated in Fig. 557. The cam is divided into three equal parts, 1, 2 and 3, each representing one pick of weft. Two-thirds of the third division are employed in closing the shed after the third pick is inserted, and also in forming a new shed for the next three picks. This allows one-third of a pick for the passage of the shuttle through the shed. The cam is constructed to the following data: Centre of cam A, to lowest point L, equals 2 ins.; distance from lowest to highest point C, equals 3 ins.; diameter of treadle bowl J, equals 2 ins. B and D are imaginary lines between which the pin of the treadle bowl moves when the latter is passing from the highest to the lowest point, and *vice versa*.

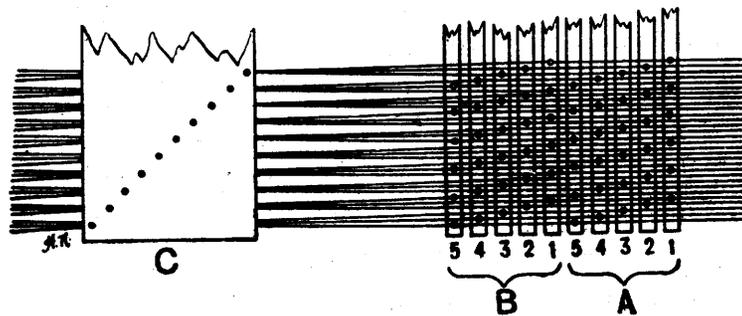
The portion F J of the third division, equal to the two-thirds of a pick, is divided as follows: F G, equal to five-twelfths of a pick, is employed for closing the shed; G H, equal to one-





ELEVATION.

FIG. 558.—Compound presser harness for damask weaving.



PLAN.

FIG. 559.

bind the figured portion of the fabric. The drafting chart for this arrangement of harness is represented in the plan, Fig. 559, in which black dots indicate warp threads drawn *above*, and circles indicate them drawn *below* the clasps. The manner in which the healds must be operated for a 5-end satin binding weave is represented in the shedding plan, Fig. 560, in which black dots indicate healds raised, and circles healds depressed.

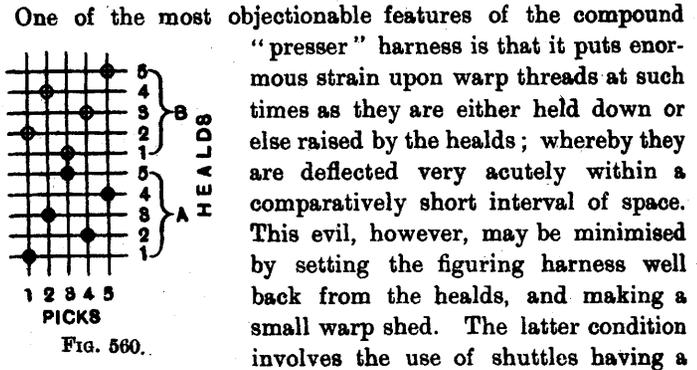


FIG. 560.

### Damask or Twilling Jacquard Machines.

§ 185. These circumstances, combined with the relatively greater expense necessarily involved in the slower production of damask fabrics by means of hand-looms, have given rise to numerous devices to enable these fabrics to be produced both more expeditiously and economically, by means of power-

looms, and without the attendant disadvantages of the "presser" type of harness. These devices consist of a distinctive type of Jacquard machines of special construction, and known as "damask" or "twilling" Jacquard machines, of which there are several different modifications, for each of which their respective inventors claim some special merit over other machines of the same type. But whatever may be the relative merits of these respective machines, none are capable of producing damask fabrics of the extreme fineness of texture or general excellence that is possible with the "presser" type of harness which permits of any reasonable number of contiguous warp threads being controlled by each Jacquard hook and harness thread; whereas single warp threads only are governed by each hook and harness thread of a damask or twilling Jacquard machine of the type indicated.

Many of these special Jacquard machines display a considerable amount of technical knowledge and mechanical ingenuity of a very high order; and although these devices differ in respect of minor structural details, they all embody the same general principles of construction and perform their respective functions in a similar manner. The cardinal features of Jacquard machines of this type consist essentially of (1) the controlling of two or more consecutive hooks by each needle; (2) the controlling of those hooks from two independent sources in such a manner that they may either be raised or left down *en masse*, for figuring purposes, and, at the same time, individual hooks may either be raised or left down independently and in some prescribed order or sequence, for the purpose of binding both the figure and ground portions of the fabric, according to the particular binding weave selected, and quite irrespective of the manner in which the pattern cards have been cut; and (3) the employment of each pattern card for two or more picks in succession.

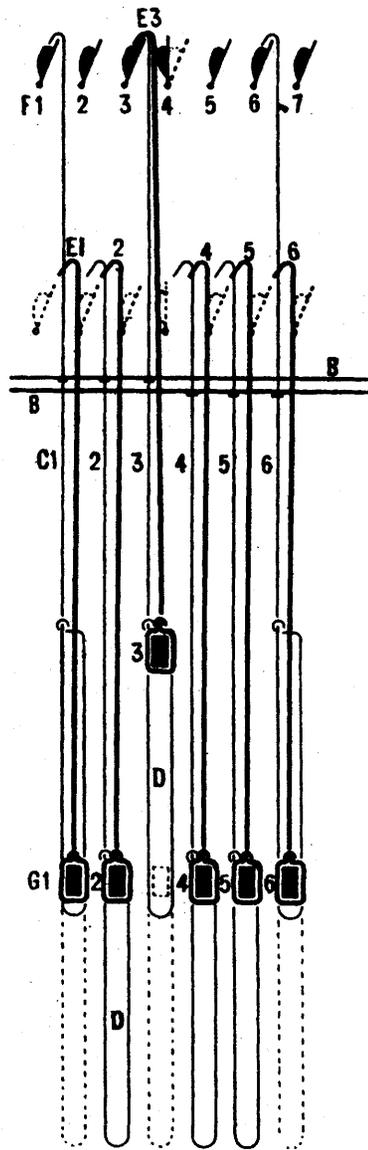
#### The Bessbrook Damask or Twilling Machine.

§ 186. Of the numerous attempts that have been made by inventors and manufacturers to bring the power-loom into successful competition with the hand-loom in the production

of damask fabrics of the correct type, none have met with the same measure of success (in Britain, at least) as that attained by Barcroft's invention, in 1869, of what is generally known as the "Bessbrook" damask machine, which is named after its birthplace in Ireland.

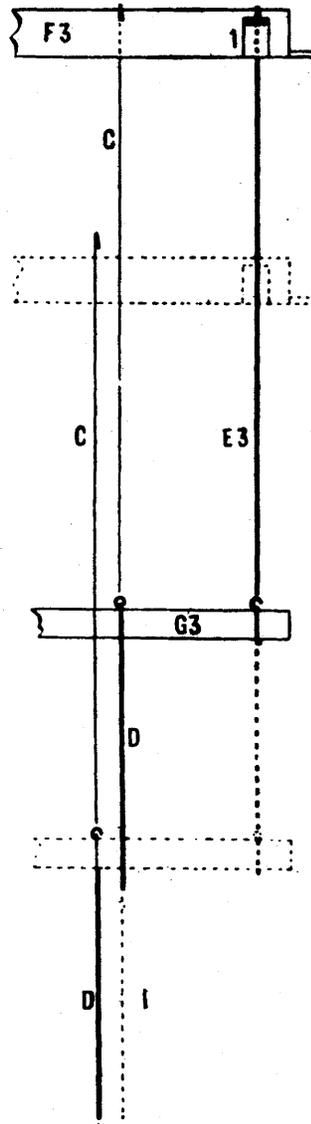
The essential features of this ingenious machine are indicated in Figs. 561 to 563, in which there are represented two needles B, each controlling three consecutive figuring hooks C. In a "straight-over tie-up," each hook C commands a separate warp thread in each repeat of the design; and the hooks controlled by the same needle B command consecutive warp threads. Very long loops D are formed at the bottom of hooks C to receive the twilling bars G, each of which passes through and supports one long row of hooks C. Strong hooks E are attached, one at each end, to the twilling bars G, by which the latter may be raised in order to raise all the figuring hooks C resting upon those bars, although some of the figuring hooks C may have escaped their respective griffe blades F, which are capable of swivelling from their normal inclined position to a vertical one as indicated at F4. The griffe blades F are also provided at each end with a shaped piece of metal I, situated immediately behind the strong hooks E. Thus, when a griffe blade F assumes a vertical position, it has the double effect of leaving down its own row of figuring hooks C, and of pushing the strong hooks E over the griffe blade immediately in front, thereby causing all the hooks in that row to be raised by the corresponding twilling bar, even although some of the hooks C may have been pushed off their own griffe blades by the pattern cards.

The griffe blades F are oscillated from their normal inclined position to a vertical one by means of a series of bars 5, Fig. 563, which bars are provided with several notches J that are cut at regular intervals apart, and which take over the ends of the griffe blades F. These bars 5 are fixed above, and at one end of the griffe blades F, and are operated by means of a series of iron pegs fixed in the barrel N, in order to move the griffe blades in such a manner as will cause the figuring hooks C to be raised or else left down according to the binding



END ELEVATION

FIG. 561.  
Showing construction of Barcroft's (Bessbrook) damask twilling Jacquard machine.



FRONT ELEVATION

FIG. 562.

weave desired. The interval—measured in rows of hooks—between the notches J, and also the number of bars used, determines the number of warp threads and picks upon which the binding weave may repeat. Thus, for a 5-end twill or satin weave, each bar 5 commands one griffe blade out of five; therefore, five, or a multiple of five, bars will be required.

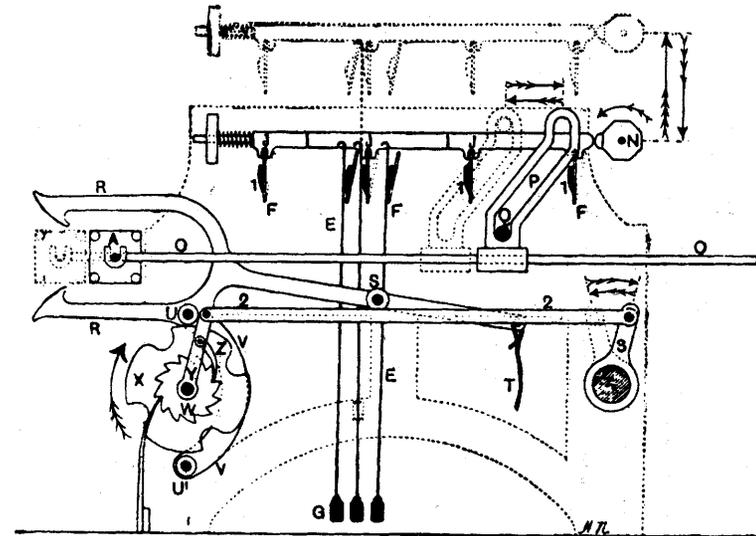


FIG. 563.—End elevation of Barcroft's (Bessbrook) damask twilling Jacquard machine.

Also, for an 8-end weave eight bars will be required, with each bar commanding every eighth griffe blade.

Only such binding weaves may be employed as will repeat on the number of warp threads that corresponds with the number of rows of hooks C, or any measure of such number. For example, if there are 24 rows of hooks—as usually exists in Jacquard machines employed in the linen damask trade—in that case binding weaves repeating on 3, 4, 6, 8, 12 and 24 warp threads may be employed. The number of griffe blades F must exceed the number of rows of hooks C by one blade, which is an extra blade, introduced solely for the purpose of pushing the strong hooks E, in the last row, over the last

griffe blade proper, whenever the first griffe blade is vertical; whereby all the hooks C in the last row are raised, and all those in the first row are left down. Thus, if it is required to make an 8-end weave with a Jacquard machine containing 24 rows of hooks, the first bar 5 must command griffe blades Nos. 1, 9, 17, and also the extra blade 25.

As the Bessbrook Jacquard machine is single-acting, the griffe blades F, along with the bars 5 and the barrel N, rise and fall, also the card cylinder A moves inward and outward for every pick of weft inserted. At each ascent of the griffe blades, the barrel N is turned so as to bring a fresh set of pegs to act upon the ends of the bars 5, whereby, as the griffes ascend, other rows of hooks C are raised and left down respectively, in order to produce the binding weave; although each pattern card may continue to serve for two or more picks of weft in succession.

The card cylinder is moved outward and inward by means of bowls Q acting, as they ascend with the griffe, upon swan necks P, which latter are secured to rods O carrying the card cylinder.

By a very ingenious arrangement, the card cylinder may move outward and inward any number of times before it is turned to bring a fresh pattern card to operate upon the needles. This is accomplished by causing a tappet X to move turning catches R, R1, fulcrumed at S, so that the cylinder escapes them as it moves outward. But on the last pick of each pattern card, either the upper or else the lower catch is brought into action, according as the cylinder is required to turn forward or backward respectively. Two bowls U, U1 are also carried, one above, on the hook R, and one below the tappet X, at the end of arm V.

Thus, if the card cylinder is required to turn forward, the bowl U rests quite freely upon the tappet X; but if the cylinder is required to turn backward, the bowl U1 is held upward against the tappet by pulling down a cord T by means of a spring. The tappet represented in Fig. 563 is constructed to change the pattern cards after three picks of weft have been inserted. The elevations put the catches out of action for

two picks, and the depressions put a catch into action for one pick, to change the pattern card. The tappet X makes one revolution for every four cards, or twelve picks; and is turned by means of a ratchet wheel W which is moved one tooth for each pick of weft by means of a pawl Z which is carried by an arm Y fulcrumed on the tappet pin, and oscillated by means of a shaft 4, operating through the medium of an arm 3 and a link rod 2.

#### Method of Preparing Applied Damask Designs.

§ 187. The preparation of designs to be reproduced either by means of a compound "presser" harness, or a damask twilling machine, is extremely simple, and demands very little technical knowledge combined with good draughtsmanship. This is due to the fact that a designer for such fabrics has to consider only the ornamentation of these fabrics, apart from their structural features, which are predetermined, and therefore entirely dependent upon the mechanism governing the warp threads, which circumstance greatly simplifies and expedites the work both of the designer and the card-cutter.

Each vertical space on the design paper represents such number of warp threads as are grouped together; also each horizontal space represents a pattern card and, consequently, such number of picks as may be inserted for each card.

When preparing an applied damask design, the designer does not indicate the actual interlacement of the individual warp and weft threads, as when preparing a design for a brocade or other fabric of simple structure, and in which the warp and weft threads may be interwoven in any desired order; but he merely indicates the manner in which the Jacquard hooks are to be raised and left down respectively, by painting up the design *en bloc* and without indicating any binding weaves whatever. Such a design, therefore, is not a plan of the fabric, indicating the manner in which warp and weft threads are interlaced, but simply a block plan of the general scheme of decoration.

The method of preparing a damask "block" design is demonstrated in Fig. 564, whilst the actual order in which the warp and

weft threads interweave in the fabric is indicated in Fig. 565, which represents the warp threads governed in groups of three, and with three picks of weft inserted for each pattern card for figuring purposes; but with a reversed 5-end satin binding weave for the figure and ground portions of the design.

As a consequence of controlling the warp threads in groups of three and also inserting three picks of weft for each pattern card, a somewhat coarsely "stepped" margin is imparted to the figure and ground. This "stepping" is relatively more or less pronounced according to the number of warp threads controlled by each hook of the Jacquard machine, and also according to the number of picks inserted for each pattern card.

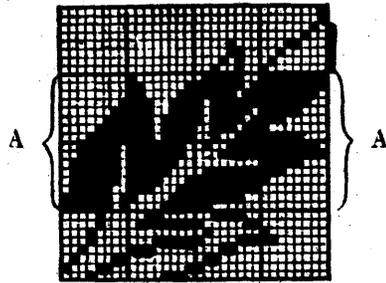


FIG. 564.—Part of an applied design *en bloc* for a damask fabric.

Care should be taken to obtain a suitable ratio between the number of threads controlled by each hook and the number of threads per inch; and also between the number of picks inserted to each card and the number of picks per inch in the fabric, in order to avoid causing the margin of the figure from appearing too coarsely stepped. The means adopted for binding the separate threads of warp and weft in a damask fabric is also detrimental to the formation of a clearly-cut and sharply-defined outline of the figure, particularly when the margins are not exactly parallel with the warp threads or picks of weft. This difficulty arises in consequence of the binding points occurring with such perfect regularity over the whole of the fabric that many of the binding points encroach upon the extreme margins both of the figure and the ground in many places

where they are quite unnecessary, thereby causing the figure and ground to blend one into the other, and thus producing an indistinct marginal outline.

As it is impossible, however, excepting with diaper patterns, to ensure the "checking" or "locking" of marginal binding points uniformly, the warp and weft threads are therefore liable to slide out of their proper place from causes previously explained in § 176, and illustrated in Figs. 541 and 542.

The character of these defects will be clearly comprehended by a parallel reference to Figs. 565 and 566; and also by care-

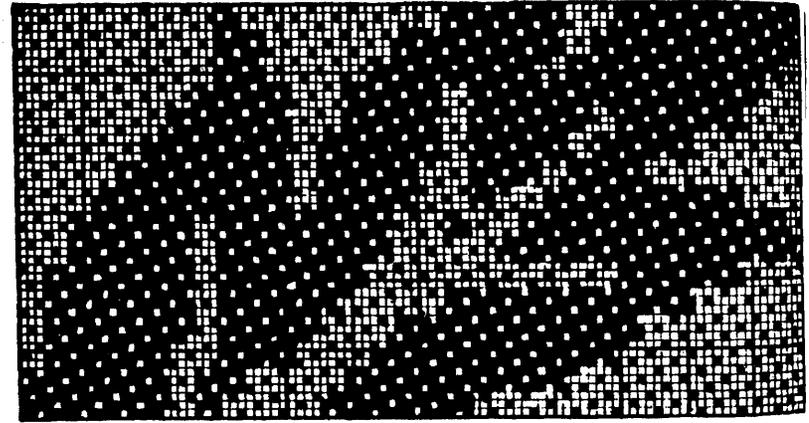


FIG. 565.—Showing structure of damask fabric with figuring as at A, Fig. 564.

fully examining a damask fabric. The design represented in Fig. 566 indicates the manner in which the same portion of design, as that represented *en bloc* in Fig. 564, would be developed if it were to be woven by means of an ordinary Jacquard harness, having independent control of each warp thread and if a pattern card were employed for each pick of weft inserted, and also provided that the design were required to occupy the the same number of warp threads and picks of weft as that represented in Fig. 565. And although these designs are exactly similar in other respects, there is a marked contrast in their respective margins of the figure and ground of which the outlines in Fig. 566 have a much finer stepping and smarter

appearance than those of Fig. 565. It will also be observed in Fig. 566 that the binding points have not been allowed to encroach upon the margins of the figure and ground, excepting where they were absolutely necessary in order to prevent too long floats. Also opportunity has been taken to "check" wherever it was necessary, in order to preserve a clear outline by preventing a jagged margin.

§ 188. The proper counts of design paper to employ for an applied damask design is not determined according to the ratio of warp threads and picks of weft per inch in cloth, as is the



Fig. 566.—Showing structure of ordinary simple brocade fabric with figuring as at A, Fig. 564.

case for simple fabrics generally; but according to the number of groups of warp threads and the number of pattern cards representing one inch of cloth. Thus, assuming a design is to be made for a fabric containing 114 warp threads per inch, with 3 threads grouped together, and 100 picks per inch, with 3 picks to each pattern card, the ratio of hooks and pattern cards per inch would be in the ratio of 38 to 33 respectively. Therefore, if the needles of the Jacquard, by which the design is to be woven, are eight rows deep, then—38 (hooks per inch) : 8 (hooks in a bar) : : 33 (cards per inch) : 7 (cards in a bar) nearly. In this case, therefore, the proper counts of

design paper to use would be that ruled with  $8 \times 7$  squares in each bar.

When damask fabrics are woven by means of the compound "presser" harness, and with more than two warp threads drawn through each mail eye, it is usual to employ what are termed "decked" mails, one form of which is illustrated (detached) in Fig. 553. Each warp thread passes through a separate division in the mail, whereby they are prevented from twisting around each other between the back rest of the loom and the heald eyes; and shedding by the healds is facilitated.

The weight of lingoes attached to the bottom of harness threads must be suited to the counts and strength of warp threads, and also to the number of threads drawn through each mail eye. Strong or coarse yarn, also mails controlling a greater number of warp threads, will require relatively heavier lingoes than are required for fine yarn, or for mails controlling a lesser number of warp threads.

With a compound "presser" harness, the same set of pattern cards may be employed to weave fabrics having a different number of warp threads and picks of weft per inch from that for which the pattern was originally intended. This is accomplished by increasing or reducing the number of threads in some or all of the harness mails, and also by inserting more or less picks for some or all the pattern cards. Care must be taken, however, if any of these courses are adopted, to maintain the same ratio between the number of Jacquard hooks and pattern cards per inch as that for which the design was originally set out; otherwise the pattern will be distorted. These advantages, however, are not possible with special damask Jacquard machines of the type described in §§ 185 and 186.

§ 189. Unlike that of brocade and similar fabrics of simple structure the stability of damask fabrics is entirely unaffected by the character of the design, by reason of the absolute uniformity of texture both in the figure and ground portions. This structural feature permits of the successful reproduction of almost any kind of pattern, whether of a geometrical or a floral character.

In most fabrics of simple texture it is important that large masses of figure should be avoided with the object of preventing structural weakness; and also that the figure should be distributed over the surface as uniformly as possible to ensure uniform tension upon warp threads; but these considerations do not apply to damask fabrics for reasons just stated.

The following is a comparison of the number of pattern cards and Jacquard machines required to produce a design repeating on the same number of warp threads and picks, to be woven (1) either by means of the compound "presser" harness or a damask machine; and (2) by means of an ordinary single-thread brocade harness.

Assuming, in the first case, that a Jacquard machine with 408 needles is employed—all of which are used in a full repeat of the pattern—and that each needle corresponds to five warp threads; also that the pattern repeats on 408 pattern cards, each of which represents three consecutive picks of weft, the total number of warp threads on which the design will repeat is  $408 \times 5 = 2040$ ; and the total number of picks is  $408 \times 3 = 1224$ .

Now, in the second case, five similar Jacquard machines would be required, each with three times as many pattern cards as in the first case. Therefore, the number of pattern cards required would be  $5 \times 3 = 15$  times as many, or a set of  $408 \times 3 = 1224$  cards for each machine and a total of  $1224 \times 5 = 6120$  cards, with a corresponding amount of time, labour and expense incurred in designing, cost of pattern cards, card-cutting, lacing and wiring. Over against these items, however, if a "presser" harness is employed, there is the extra cost of the heald harness and other incidental accessories; or, if a damask machine is adopted, the extra cost of this must be taken into consideration.

#### Compound Damask Fabrics.

§ 190. Compound damask fabrics comprise two distinct varieties, namely, (1) those produced with an additional series of weft threads, and (2) those constructed with two distinct

series both of warp and weft threads with the object of producing textures of greater strength, bulk and weight, whereby they are adapted more suitably for the specific purposes for which they are chiefly intended to be applied as, for example, curtains, hangings and furniture upholstering fabrics of that variety sometimes popularly described as "French tapestry". In both of these varieties the extra series of weft threads constitute "backing" picks only, with the primary object of imparting to the fabrics additional firmness and stability. These extra picks of weft play no part whatever in the scheme of decoration, as they consist of strong and full-bodied threads of linen with the object of ensuring a firm foundation texture which is not so liable to stretch.

In the second variety of these fabrics the extra series of warp threads is employed for binding or "stitching" purposes only, and, like the extra picks of weft, they play no part whatever in the development of the design. In fact, when viewed obversely, compound damask fabrics are, to all outward appearance, exactly similar to those of simple construction that are produced from only one series each of warp and weft threads: and it is only by close inspection that their compound structure is revealed. This close similarity of the two varieties of damask fabrics arises in consequence of the "backing" picks of weft being concealed so effectually at the back of the fabric, and also by being dyed the same colour as that of the "face" warp threads.

The warp threads of compound damask fabrics usually consist either of organzine silk, or else spun silk, of one colour; whereas the "face" picks of weft consist of "tram" silk of a different colour, to produce an agreeable contrast between the figure and ground portions of the fabric. Also, if an extra binding warp is employed, it should be of exactly similar material and of the same colour as the "face" or figuring warp threads; and each series of warp threads requires to be wound upon a separate warp beam in order to allow for the different rates of contraction by each series during weaving, and which are in the ratio of about 8 of the "face" warp to 9 of the binding warp, or 100 to 112·5 respectively.

The warp threads are controlled in groups for the development of the pattern, and individually for the purpose of interweaving them into the body of the fabric in some definite order. Also, two picks of weft are inserted for each pattern card, namely, one face and one back pick alternately: thereby requiring a loom provided with two shuttle boxes at each end of the sley, a shuttle-box motion, and also a pick-and-pick picking motion.

§ 191. The structure of a typical example of the first-named variety of compound damask fabrics is demonstrated by the

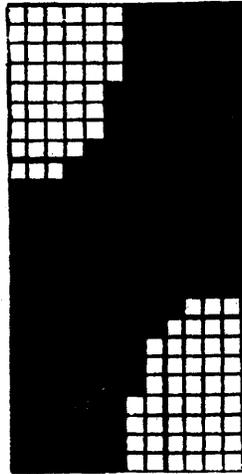


FIG. 567.—Part of block design for compound damask fabric, Fig. 552.

aid of designs and sectional diagrams of cloth as represented in Figs. 567 to 569, and of which Fig. 567 indicates a portion of a design prepared *en bloc* in the usual manner. Each vertical space on the design paper represents four warp threads, and each horizontal space, two picks of weft, namely, a face and a back pick.

The actual order of interweaving the warp and weft threads is represented in Fig. 569 (A) in which the black squares indicate warp threads raised over face picks, and shaded squares warp threads raised over back picks. In the figured portion of the

fabric the warp is raised *en masse* on the face picks; but one warp thread in sixteen is left down in the manner indicated in Fig. 568, in order to bind the weft at the back of the fabric and thereby prevent it from floating too freely on that side.

In the ground portion of the fabric one warp thread in every eight is raised for the same picks, in order to produce an 8-end weft satin binding weave on the face side. The warp threads are raised *en masse* over the back picks throughout; but one warp thread in eight is left down in order to produce an 8-end weft satin binding weave on the reverse side of the fabric.

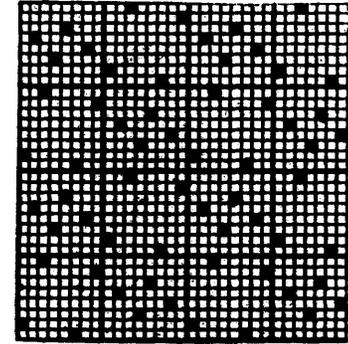


FIG. 568.—Plan of binding weave employed for binding the coarse back picks of weft in compound damask fabrics, Fig. 552.

The face weft may be bound in any desired manner when at the back; but care should be taken to select some method of binding that will ensure a uniform rate of contraction of warp threads; otherwise more tensile strain will be imposed upon some warp threads than upon others during weaving. Also, the binding points should be inserted only where the warp threads have been left down on the corresponding back picks, as indicated by the letters H, in Figs. 569 (A) to 569 (D). A diagram representing a longitudinal section of the fabric as it would occur at E, Fig. 569 (A), is indicated in Fig. 569 (B); whilst transverse sections at F and G, Fig. 569 (A), are indicated in Figs. 569 (C) and 569 (D) respectively.

Compound damask fabrics of the second-named variety are

scarcely distinguishable from those belonging to the first-named variety, in consequence of figuring warp threads and binding warp threads being exactly similar. On removing the

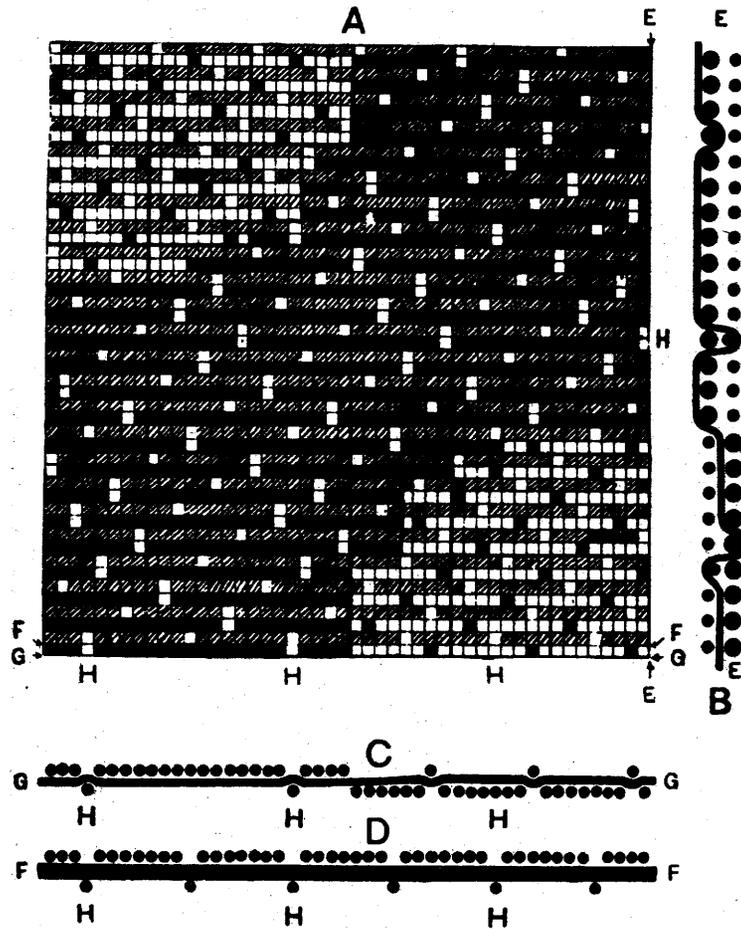


FIG. 569.—Showing actual structure of compound damask fabrics, Fig. 552.

threads from the actual fabric, however, the binding warp threads reveal a more wavy appearance than that of the figuring threads, due to their greater rate of contraction during weaving.

In the example selected for description, there are four

figuring warp threads, controlled by the same *hook* of the Jacquard machine, to one binding warp thread. These are drawn

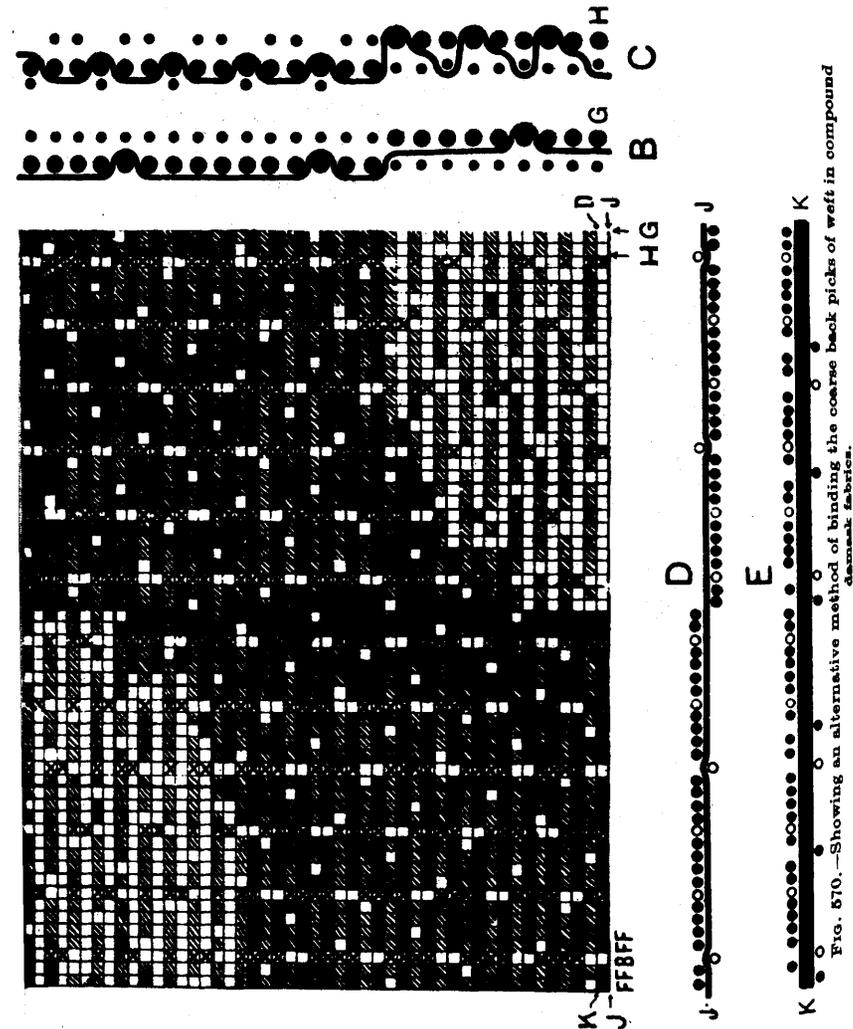


FIG. 570.—Showing an alternative method of binding the coarse back picks of weft in compound damask fabrics.

through the mail eyes of the shedding harness and between the dents of the reed, in the order of two face, one back and two

face threads uniformly, as indicated by the letters FFBFF in Fig. 570 (A), which indicates the actual order in which the warp and weft threads interweave in the fabric for the portion of the block design represented in Fig. 567. Black squares in the design, Fig. 570 (A), indicate figuring warp threads raised over face picks, and shaded squares indicate those threads raised over back picks; whilst crosses indicate binding warp threads raised over *both* series of weft threads. Figuring warp threads are raised or left down, *en masse*, according to the design, for the face picks, which never interweave with figuring warp threads, as observed in the sectional diagrams, Figs. 570 (B and D).

When the back picks are inserted, all the figuring warp threads are raised *en masse*, excepting one in every eight which is left down in order to produce an 8-end binding weave with those picks. The binding warp threads and the face picks produce a 3-end weft ( $\frac{3}{8}$ ) twill for the ground portion, and a 3-end warp ( $\frac{3}{1}$ ) twill for the figure portion of the fabric. This object is effected by raising every third binding warp thread in the ground portion, and leaving down every third warp thread in the figure portion, in respect of the face picks only. But in order to prevent the risk of two separate and distinct cloths being formed in either portion of the fabric, the binding warp threads also interweave with the back picks in order to produce a 3-end ( $\frac{3}{1}$ ) twill throughout the fabric, as indicated in the design, Fig. 570 (A) and the sectional diagrams Figs. 570 (B, C, D and E).

## CHAPTER XIV.

### ALHAMBRA AND KINDRED FABRICS.

§ 192. The term "Alhambra" is a descriptive trade name employed to distinguish a well-known type of textile fabrics comprising several varieties that are chiefly produced in relatively coarse and heavy cotton textures of an inferior and cheap class that are sold under a variety of fanciful names, and employed extensively as counterpanes or bed-quilts. Fabrics of this type assume various modifications, but they are all characterised by certain essential and distinctive features by which they may be distinguished from other types. As a general rule, they are characterised by a somewhat coarse and heavy texture of uniform structure, based upon the plain tabby or other elementary weave, to constitute a firm foundation texture with which is freely interwoven a supplementary series of figuring warp threads of coloured yarn, introduced for the sole purpose of embellishment. Thus, if the figuring warp threads were removed entirely from an Alhambra fabric, there would still remain a perfect and substantial foundation fabric of simple texture devoid of decoration.

The foundation texture in Alhambra and similar fabrics is usually composed of relatively fine warp threads of bleached yarn, termed the binding or ground warp, which interweaves in a specific and uniform manner with relatively coarse and soft bleached weft, to give body and weight to the fabric. Figuring warp threads vary in counts and character in different fabrics, and are distributed uniformly either alternately with ground warp threads or else in pairs or groups of three or more in alternation with single ground warp threads, according to the particular style and quality of cloth. In the production of the more common variety of Alhambra fabrics, of which a

typical example is represented in Fig. 571, figuring warp threads of relatively fine yarn are passed together in pairs



FIG. 571. —Alhambra counterpane fabric—fine texture.

through the respective mail eyes of a Jacquard harness by which they are governed; after which the respective pairs of threads are passed, along with a ground warp thread, between successive dents of the reed. The object of passing two or

more figuring threads of finer yarn, instead of one thread of coarser yarn, through each mail eye of the figuring harness is to develop a more solid and compact figure, by the spreading of the several threads which more effectually cover the weft and thereby produce a fabric having a finer and superior appearance. Figuring and ground warp threads each require to be wound upon separate warp beams to permit of their different rates of contraction during weaving.

The interlacement of ground warp threads and picks of weft in a specific and uniform manner, in order to develop a foundation texture of simple construction, is a circumstance favourable to the economical production of Alhambra fabrics, as it enables ground warp threads to be governed by means of healds which, by operating in conjunction with a Jacquard harness, constitute a compound harness. The number of healds required is determined by the particular weave constituting the foundation texture, and may be of any practicable number which may be situated either before or behind the Jacquard harness, and operated by means of tappets.

When preparing an applied or working design on squared paper ready for card cutting, for an Alhambra fabric of the usual variety, as represented in Fig. 571, it is only necessary for the designer to consider the figuring warp without paying any attention whatever to the ground warp which interlaces with weft in a systematic manner. The development of an Alhambra design is demonstrated in Fig. 572, which represents an actual portion of the design for the example of cloth represented in Fig. 571. After painting up the design according to the required scheme of decoration, the figure and ground portions are then developed with suitable binding weaves of tabby, twill, satin, diamond or other appropriate weave, primarily with the object of stitching or binding the figuring warp threads to the foundation texture, in order to prevent them from floating too freely on both the face and back of the fabric; and incidentally to impart character and interest to the design. By skilful treatment and a judicious selection of binding weaves suited to the different parts of a design, in order to emphasise its principal features and to subordinate others according to

their relative importance, a design that would otherwise be insipid and characterless may be greatly improved.

§ 193. With the object of conveying to readers who are unfamiliar with Alhambra fabrics a conception of their character

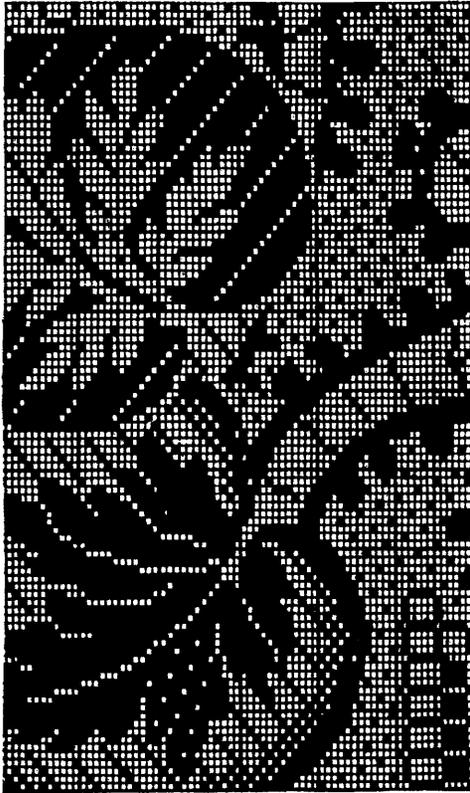


FIG. 572.—Part of an applied design for Alhambra fabric, Fig. 571.

and texture, the accompanying data and other particulars relating to the construction of the several examples of these fabrics will be helpful. Thus, the sample of cloth represented in Fig. 571 contains 29 pairs (58 single) of coloured figuring warp threads of 16's ordinary twist; 29 white ground warp

threads of 2/40's yarn; and 24 picks of 2½'s soft bleached weft per inch. During weaving, the contraction of the figuring warp is 10 per cent. and of the ground warp 22½ per cent. approximately, of the original warp length—*i.e.*, 111 and 129 yds. of the respective warps would contract to 100 yds. in cloth.

The counts of design paper required for an Alhambra design is determined by the ratio of mail eyes contained in, say, one inch width of the Jacquard harness, to the number of picks per inch in the fabric. Example: The design for the cloth represented in Fig. 571 is to be reproduced in cloth by means of a 600's Jacquard machine, with hooks and needles each disposed in twelve long rows. The figuring harness contains 29 mail eyes per inch, and the cloth is to contain 24 picks per inch. The correct counts of design paper, therefore, is that ruled with 12 by 10 squares, as indicated in Fig. 572.

It is also important, at this stage, to direct attention to a disfigurement which is liable to occur in Alhambra fabrics during weaving, and one that may be prevented if the necessary precaution is observed when preparing the design. The disfigurement referred to is that caused by binding warp threads lying athwart figuring threads, or else separating them (if two or more figuring warp threads pass through each mail eye of the Jacquard harness) instead of being covered by them, when the latter are raised or depressed singly for binding purposes. This tendency arises in consequence of the figuring and ground warp threads that pass through the *same dent* of the reed being raised or depressed *together*, instead of *oppositely*, at the points where these blemishes occur.

This evil may be avoided by disposing, as far as practicable, *all* single binding points of the various binding weaves, both in the figure and ground portions of the design, so that all those in the figure portion will be disposed on the same "tab" or "shed" uniformly, and all those in the ground portion disposed on the opposite "tab" to that selected for the figure portion. That is to say, if warp threads are required to be raised singly, over only one pick at a time, those over alternate picks of weft should be, say, *odd-numbered* warp

threads only; while those over intermediate picks should be *even*-numbered warp threads. Also, those threads that are left *down* for the alternate picks should be even-numbered threads, whilst those left down for the intermediate picks should be odd-numbered threads. The observance of this simple precaution, when preparing a design, permits of the operation of pattern cards being adjusted in relation to the shedding by the healds, to ensure that when figuring warp threads are either raised or depressed singly, for binding purposes, in the manner just described, they will interweave on the opposite "tab" or "shed" to that of their respective fellow-binding warp threads that are in the same dent of the reed, and so remove the cause of the evil consequences just indicated.

*Note.*—In the technical phraseology of textile designers, the word "tab" (an abbreviation of "tabby," signifying the plain or calico weave) is used to denote both the odd series and the even series of a group of threads (when applied to either series separately), as the "odd tab" and "even tab"; which terms indicate that one line of a warp shed is formed by *odd*-numbered warp threads only for alternate picks of weft, and by *even*-numbered warp threads only for the intermediate picks of weft.

§ 194. An example of another variety of Alhambra fabric which illustrates a slight departure from the more common variety described previously is that represented in Fig. 573. The only difference between these two varieties arises from figuring warp threads of relatively coarse folded yarn being passed separately through each mail eye of the figuring harness, thereby causing the figure to appear coarser and in greater relief than if several figuring threads of finer yarn were passed together through each mail eye. This fabric contains 17 figuring warp threads of 3/14's yarn; 17 ground warp threads of 20's T.; and 23 picks of 5½'s bleached soft weft per inch; producing a comparatively light, open and soft texture, suitable for the summer season.

§ 195. Another variety of Alhambra counterpanes, sold under the trade-name of "Trellis" quilts, is represented in Fig. 574.

These constitute a distinct modification of that type of fabric, as they differ in several respects from those of ordinary construction. Fabrics of this class are characterised by a lattice or chequered figure, developed by means of a series of distinctive warp threads and picks of weft disposed separately at regular

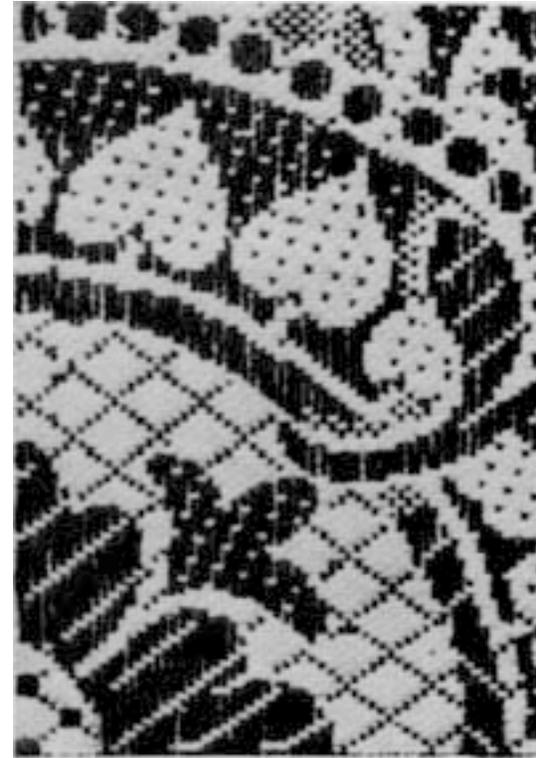


FIG. 573.—Alhambra fabric—coarse texture.

intervals apart to form squares; and, further, by the margin of figure and ground stepping in unison with those squares. In the present example of cloth the squares occur at intervals corresponding to the space occupied by six dents of the reed (and, therefore, six mail eyes of the figuring harness) and seven picks of weft.

This object is attained by disposing coloured warp threads, of relatively fine yarn, in groups of three threads, through five out of every six consecutive mail eyes; whilst a bleached folded thread is passed through every sixth mail eye, uniformly, to mark the vertical divisions; and also by inserting a distinctive pick of weft at intervals of seven picks, uniformly, to mark the horizontal divisions. Both kinds of figuring warp threads are delivered from the same warp beam; and only one kind of weft is employed. The foundation texture of "Trellis" quilts also differs slightly from that of ordinary Alhambra fabrics by having two fine binding warp threads situated between each group (or mail eye) of figuring warp threads, and contained in the same dent of the reed, in order to constitute one pair of threads. These warp threads are governed by means of four healds, and interweave in pairs for six out of seven consecutive picks of weft uniformly (in order to produce a foundation texture based on what is termed the double plain or tabby weave), but for every seventh pick of weft a warp shed is formed by raising all alternate ground threads and depressing all intermediate ones uniformly across the fabric. Therefore, the tappets by which the healds are actuated will not require to be constructed with more than seven picks to the circuit.

The pattern is developed by raising or leaving down-figuring warp threads *en masse*, as required, in groups comprised by six or a multiple of six mail eyes, always either commencing or else ending with a thick white folded warp thread. When a figuring warp shed is formed, it remains open for six consecutive picks of weft, but for the seventh pick, uniformly, all figuring warp threads that were raised for the six previous picks are depressed, whilst those that were depressed are raised for that pick of weft, and so on continuously—hence the development of the trellis or lattice effect characteristic of this variety of Alhambra fabrics.

These circumstances not only greatly facilitate the preparation of designs for these fabrics, by dispensing with the necessity of introducing binding weaves to prevent long floats of figuring warp threads, but they also provide an opportunity whereby

considerable economy may be effected in the manufacture of such fabrics. Thus, by employing a Jacquard lifting cam constructed to keep the griffes raised, and the card cylinder out, for six consecutive picks, and then to change cards for the seventh pick, two pattern cards only could be made to serve for seven picks of weft.

Or again, still further economy could be effected by employing a special "twin-hook" or "terry" Jacquard machine of the type illustrated in Fig. 422, or its equivalent, constructed with two complete sets of hooks (with one set reversed, or turned away from the card cylinder) controlled by one set of needles, but with each set of hooks commanded by a separate set of griffe blades. The griffe blades would be operated in a contrary manner, so that one set would be raised for six picks and left down for one pick of weft uniformly. By adopting this course, only one pattern card would be required for every seven picks of weft.

The example of trellis cloth represented in Fig. 574 has required a harness containing 26 mails per inch to produce it. Five-sixths of the mails each contain a group of three coloured warp threads of 16's T., and one-sixth of the mail eyes each contain one thread of 3/20's bleached yarn. There are 52 ground warp threads (26 pairs) of 2/40's bleached yarn, and 38 picks of 5's soft bleached weft per inch. The contraction of figuring warp threads during weaving is 5 per cent., and of ground warp threads 22½ per cent. approximately of the warp length.

§ 196. By means to be described presently, several efforts have been made to modify Alhambra fabrics so as to develop the pattern by dense masses of figure and ground, unbroken by binding weaves of any description: but in consequence of the additional cost of production, and structural imperfections, to which the modification gives rise, they are not successful. This modification is effected by inserting, at regular intervals, supplementary picks of fine weft of the same colour as figuring warp threads, and causing them to interweave with those threads on the tabby principle, to prevent them floating too freely. The extra picks of weft may be inserted separately at intervals of, say,

four coarse picks, which would require the use of a loom furnished with a pick-and-pick picking motion, and a loom sley with two shuttle boxes at each end.

A more economical, though less satisfactory, method, however, would be to insert two consecutive fine binding picks in opposite tabby sheds of the figuring warp threads, at intervals of eight

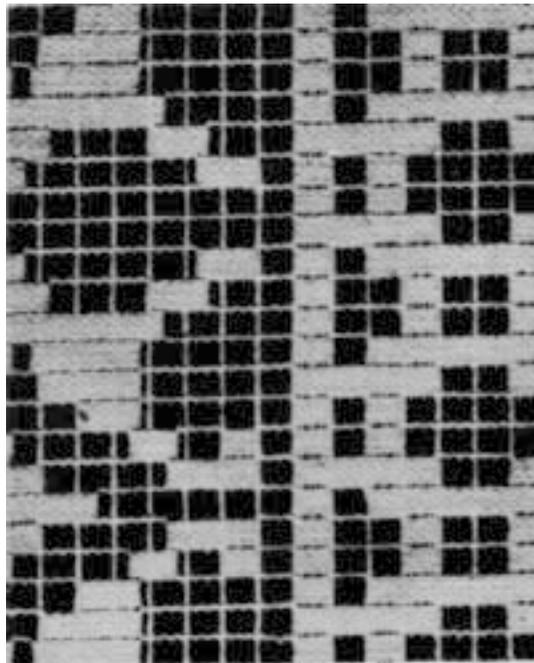


FIG. 574. —Modified structure of Alhambra fabric.

coarse picks; thereby requiring a loom with two shuttle boxes at one end of the sley only, and an ordinary picking motion. Whichever of these alternative methods is adopted, the shedding of figuring warp threads, for the fine binding picks only, may be more economically effected by a form of "presser harness," in which odd and even-numbered harness threads respectively pass through two separate comber-boards. By forming knots on the harness threads, immediately above the comber-boards,

and raising these alternately for consecutive picks of fine weft, the latter become interlaced with figuring warp threads on the tabby or calico principle, whereby the binding of those threads is effected mechanically, without having recourse to binding weaves, which frequently disfigure a design, and so tend to detract considerably from its artistic merit.

#### Figured Repp Fabrics.

§ 197. A variety of fabric bearing a somewhat similar character both in appearance and construction to those of Alhambra fabrics, and also belonging to the same class of domestic goods, is sold under the description of "repp" quilts or counterpanes, of which an example is represented, photographically, in Fig. 575. These fabrics are characterised by two distinct series of figuring warp threads of different colours, which may either be of the same or different counts of yarn; and either one or two series of picks of weft: but they have no series of binding warp threads, as in true Alhambra fabrics. For this reason the degree of firmness of texture is entirely dependent upon the scheme of interweaving as predetermined by the design. Repp fabrics are further characterised by a freely floating figure, developed by warp threads only, and surrounded by a repp or transversely ribbed ground. The threads of both series of warp threads are arranged alternately with each other, and may be wound either upon the same, or upon separate warp beams. If wound upon the same beam, care should be taken, when preparing a design, to distribute the masses of figure and ground as evenly as possible, in order to ensure a uniform degree of contraction by both series of warp threads during weaving. Both series of threads may be displayed either on the face or back of cloth; but it is usual, and for structural reasons more economical, to display them separately, and not simultaneously, in the same parts of the fabric. By adopting this course, two fellow warp threads that are in the same dent of the reed will always interweave with weft in an exactly opposite manner, and therefore occupy reverse positions in cloth.

This circumstance is favourable to a more economical pro-

duction of these fabrics by using a "twin-hook" or "terry" Jacquard machine of the type illustrated in Fig. 422, in which two reversed hooks, controlled by one needle, govern two fellow warp threads (one of each series) contained in the same dent of the reed. Thus, if a needle is pushed backward, one hook

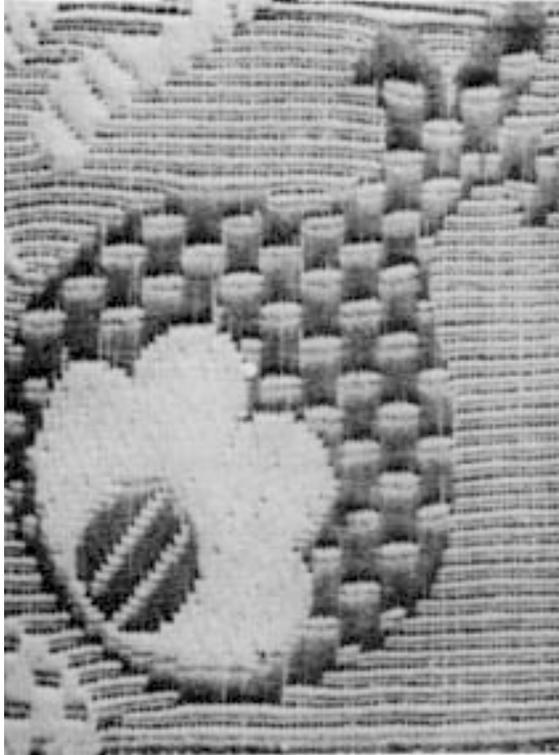


FIG. 575.—Compound figured repp fabric.

is pushed off, and the other over, its respective griffe blade, and, *per contra*, if a needle remains in its normal position, the first hook will remain over, and the second hook off, its griffe, and thereby cause their respective warp threads to be governed in a contrary manner to each other in the manner described. From this it will be manifest that repp fabrics of the type

under present notice display only warp threads on both sides of the fabric; whereas picks of weft are never exposed, but lie concealed between the two series of warp threads, thereby producing a perfectly reversible fabric in which the two different colours of figuring warp threads are exactly counter-changed.

In some fabrics of this class the repp ground filling surrounding the figure is developed by raising, in that part, warp threads of one series only for alternate picks of weft; and those of the other series only for intermediate picks of weft. In others, two consecutive picks are placed contiguously in alternate warp sheds, and a single pick in the intermediate sheds, to produce a coarse and fine rib alternately. A superior repp effect, however, is obtained by employing two different kinds of weft of considerable disparity in counts, and by inserting a fine and a coarse pick alternately with each other in reverse warp sheds, in the ground portion of the fabric. This course, however, would increase the cost of production, as it would require the use of a pick-and-pick loom to enable two shuttles to be propelled in succession from each end of the loom sley, besides incurring a higher rate of wages paid for weaving on such a loom.

The example of repp cloth represented in Fig. 575 contains 23 groups (69 threads) of warp threads of 20's coloured yarn; 23 warp threads of 3/16's bleached yarn; and 18 picks of 3's bleached soft weft per inch. Each series of warp threads is wound upon a separate beam. The fine coloured warp threads contract 10 per cent., and the folded white threads 15 per cent., of the warp length, during weaving.

## CHAPTER XV.

## PIQUÉS OR TOILET WELTS: ALSO MATELASSE FABRICS.

§ 198. Piqué and toilet welt are optional terms that are variously employed to signify a compound type of fabric of which there are several modifications. But they are all char-

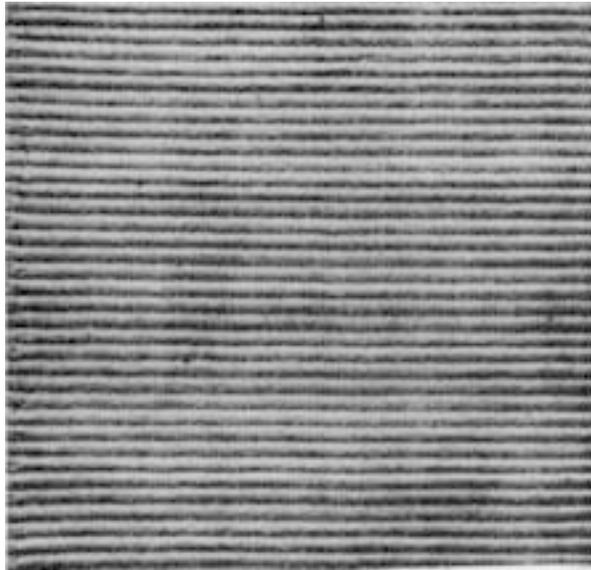


FIG 576.—Piqué or toilet welt (note selvedge on one side).

acterised by more or less pronounced ridges and furrows producing a series of ribs, welts or cords with a surface tissue of the plain calico weave, and extending in parallel lines trans-

versely across the *width* of the fabric, that is, in the direction of weft threads, as illustrated in Fig. 576, which is a full-scale photograph of an example of a plain piqué fabric containing twelve ribs or welts per inch. In their general outward appearance, piqué fabrics bear a very close resemblance to Bedford cord fabrics as described in Chapter V., and for which they are often mistaken by those who are unfamiliar with the structure of these respective types of fabrics, which differ very materially in their structural features, but which may be easily distinguished when their distinctive characteristics are known. But even without such knowledge they may be identified unmistakably, if any portion of the selvedge is present, by remembering that the ribs or cords in a piqué fabric extend *transversely* and therefore at *right* angles to the selvedges, whereas the ribs in a Bedford cord fabric extend *lengthwise*, in the direction of warp threads and, therefore, *parallel* with the selvedges.

§ 199. Piqué fabrics are chiefly manufactured entirely of cotton woven in the grey or natural state and afterwards bleached. They comprise a variety of modifications in their structural details, and are also produced in a variety of different textures, chiefly according to the purpose for which they are intended as, for example, ladies' light summer holiday and yachting costumes, men's fancy vests, neckties and many other articles of personal attire and also for domestic purposes. They may be either of a perfectly plain or simple character, that is, with the ribs or welts of uniform width, between the furrows or "cutting lines," throughout: or they may be produced with variegated ribs of two or more different widths in order to obtain variety of decorative effect.

In fact, piqué fabrics admit of decorative treatment by almost any of the usual means of embellishment that are possible in weaving, namely: (1) by substituting coloured threads of warp or weft, or of both series of threads, *in place* of the ordinary threads of either series; (2) by introducing coloured threads of either series as *extra* or "crammed" threads which may either be interwoven into the fabric, or else obscured, in those parts where they are not required to be displayed on

the surface for decorative effect. Or, again, the extra threads may be allowed to float quite freely, at the back of the cloth, when not required on the face, and afterwards to be cut away as waste material; (3) by the development of ordinary brocade or floating figures of warp or weft threads; (4) by the development of what is technically described as "toilet" figuring or "quilting," in which the calico surface tissue of the fabric is "quilted" and left somewhat free or bag-like, in the figured portions of the fabric, in order to develop a more or less raised or embossed figuring as exemplified in "toilet" quilting fabrics of the type described in the following chapter; and (5) by introducing gauze or "net-leno" stripes of cross-weaving; as well as by the combination of any two or more of the several methods just indicated.

The peculiar construction of piqué fabrics, however, imposes certain restrictions in the choice of suitable designs that may be successfully executed in fabrics of that type which permit of embellishment of a very simple character only. Such designs should, therefore, consist essentially of rectilinear figures only, as piqué fabrics are entirely unsuited for the successful development of curved lines, floral or other elaborate decoration.

§ 200. Piqué fabrics are composed essentially of two separate and distinct series of warp threads in combination with two and, in some examples, three series of weft threads, according to their special modification. The two series of warp threads are technically termed "face" and "back" threads respectively, according to their respective functions and the relative positions which they normally occupy in cloth. They are employed in the proportion of two "face" warp threads to one "back" warp thread, and are drawn through the eyes of the shedding harness and between the dents of the reed in the order of one "face," one "back" and one "face" warp thread, uniformly. Face warp threads are of finer counts of yarn and contract more, during weaving, than back warp threads, which latter require to be of greater strength than face threads since they are submitted to a higher degree of tension when in the loom. For this reason, therefore, and also because of the different rate of contraction between the face and back warp threads,

during weaving, each series of threads require to be wound upon a separate warp beam.

Piqué fabrics of lighter texture and inferior quality are usually woven with weft of the same counts of yarn throughout; but those of superior quality and stronger and heavier texture are produced from weft of two different kinds: one being of relatively fine counts, and another of coarse counts of yarn. The different series of weft threads are technically termed "face," "cutting," "wadding" and "back" picks, according to their relative disposition in the cloth. Face picks, of relatively fine counts of yarn, interweave with face warp threads on the plain or tabby principle, to produce the surface tissue of plain calico cloth. Cutting picks, of the same kind of weft as the face picks, produce the "cuttings" or furrows between the ridges of the ribs or welts. Wadding picks are sometimes inserted for the purpose of increasing the prominence of the ribs and also to produce a fabric of greater strength, bulk and warmth; whilst "back" picks are sometimes employed to increase the weight, strength and firmness of texture; but these picks are never employed excepting in conjunction with "wadding" picks also.

Face picks and "cutting" picks invariably consist of the same kind of weft inserted by the same shuttle. Wadding picks also are sometimes of the same kind of weft as the face and cutting picks, thereby requiring a single shuttle-box loom only to produce piqué fabrics of that variety. For piqué fabrics of superior quality, however, it is usual to insert wadding picks of coarser and softer spun yarn than that which is employed for the face and cutting picks, in order to impart more body and stability to the fabric. This procedure, however, necessitates the employment of a check loom having at least two shuttle boxes at one end of the sley, thereby increasing the relative cost of production, not only in respect of capital outlay, but also in the higher rate of wages paid for weaving on multiple shuttle-box looms. If backing picks also are inserted in these fabrics, they are usually of the same kind of weft (and inserted by the same shuttle) as the wadding picks, consisting of soft spun roving weft of coarser counts of yarn than that of the face and cutting picks.

Some piqué fabrics of very inferior quality and light texture have only one cutting pick inserted to form the furrows of the ribs, and are entirely devoid both of wadding and back picks. Most piqué fabrics, however, and especially those of superior structure and quality, are constructed with two cutting picks to form the furrows, and with one, two or more wadding picks inserted in each rib, whilst other varieties are constructed with backing picks also.

Plain Piqué Fabrics.

§ 201. Plain piqué fabrics may be woven in any ordinary type of loom furnished with a heald harness which may be controlled either by means of tappets or a dobby; but if their embellishment exceeds the practicable limitations of a heald harness, it will be necessary to employ a Jacquard harness to control the back warp threads only, for figuring purposes; whilst the face warp threads may be controlled by healds, as in the production of toilet quilting fabrics of the type described in Chapter XVI. Or else it may be necessary to govern both the face and also the back series of warp threads, by means of a Jacquard harness, according to the particular character of the designs. If a heald harness is employed, this usually consists of a set of six healds, namely, four healds at the front, coupled together to constitute two pairs, as in a plain calico loom, to control the face warp threads; and two healds at the back of those to control the back warp threads, with both series of warp threads drafted through the eyes of the healds and between the dents of the reed in the order of one face, one back and one face warp thread, and passed together through the same dent of the reed uniformly, in the manner indicated in the drafting chart, Fig. 577.

The structure of the most elementary example of a plain one-shuttle piqué fabric, devoid both of wadding and backing picks, is indicated in the design, Fig. 578, whilst a longitudinal section of the cloth reproduced from that design is represented in Fig. 579. The design for this example is complete on three warp threads only (*i.e.*, one face, one back and one face thread)

and four picks of weft, of which three constitute face picks to produce the crown of each rib or welt, and one, a cutting pick,

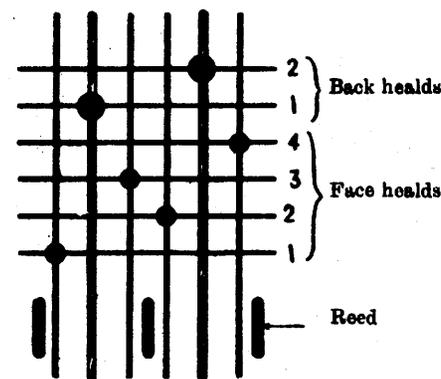


FIG. 577.—Draft for piqué fabrics.

to form the furrow between two ribs. It will be observed that only the face warp threads interweave with face picks of weft,

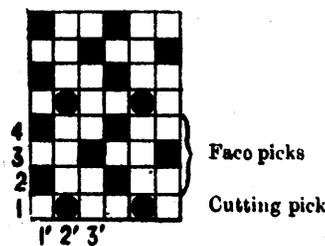


FIG. 578.



FIG. 579.

to produce a surface texture of the plain calico weave, whilst all back warp threads remain down, for those picks. But when a cutting pick is inserted, all face warp threads are depressed

and all back warp threads are raised, whereby the greater tension of the latter causes the cutting picks to be pulled down into a lower plane than the face picks, and thereby create the transverse furrows or channels in the fabric between the ridges forming the ribs. Another example of a piqué fabric of simple structure contains four face picks, to produce relatively wider ribs or welts, as indicated in the design, Fig. 580, and of which Fig. 581 represents a longitudinal section.

§ 202. The next further development in the structure of

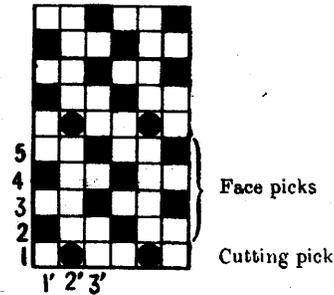


FIG. 580.

plain piqué fabrics is effected by inserting in each rib, one, two or more wadding picks of weft which never interweave with any of the warp threads, but simply lie quite straight and free between the surface tissue and the back warp threads, thereby increasing both the relative prominence of the ribs and also the weight and bulk of the fabric. Thus, any reasonable number of wadding picks may be inserted in each rib according to the prominence which it is desired to give to those ribs. A design for a piqué fabric containing only one wadding pick in each rib is given in Fig. 582, which repeats on six picks, namely, one cutting pick, four face picks and one wadding pick, as repre-



FIG. 581.

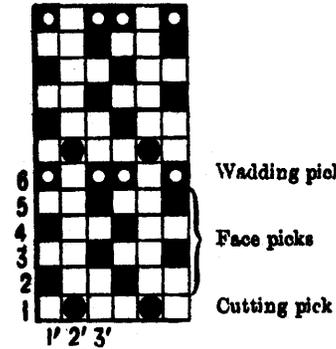


FIG. 582.

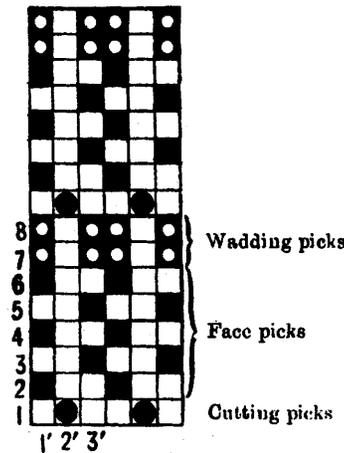


FIG. 584.



FIG. 583.



FIG. 585.

sented in the cloth section, Fig. 583. In all other respects this example is similar to the previous one, whilst a fourth example of a piqué fabric, of which the design and cloth section are given in Figs. 584 and 585, repeats on eight picks inserted as follows: one cutting pick, five face picks and two wadding picks, all inserted by the same shuttle.

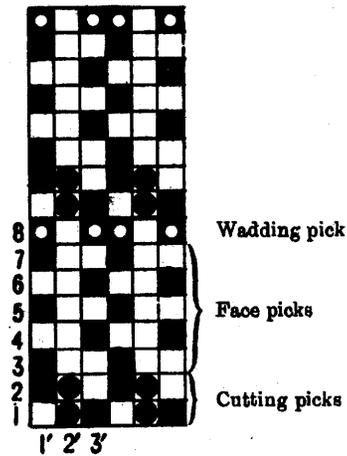


FIG. 586.



FIG. 587.

The four examples of piqué fabrics just described contain only one cutting pick each to form the furrows between the ribs, but the majority of piqué fabrics have two cutting picks inserted, in order to produce deeper and better defined furrows. Fig. 586 is a design for a piqué fabric containing eight picks to each rib, with two cutting picks, five face picks and one

wadding pick, as represented in the cloth section, Fig. 587, from which it will be seen that the continuity of the plain calico weave is broken by inserting the second cutting pick and first face pick of each rib in the same face warp shed. By adopting that procedure the repeat of the pattern is confined to eight picks only; but by continuing the plain weave through-

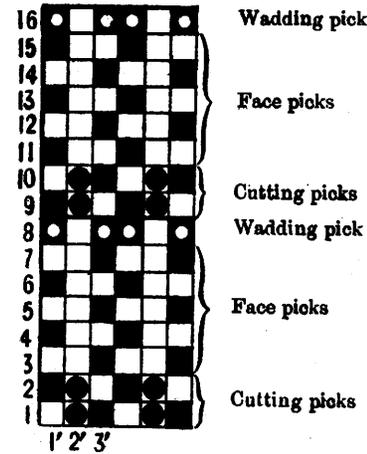


FIG. 588.

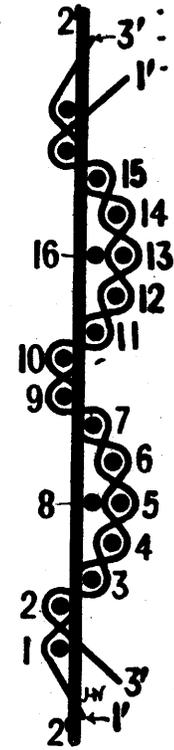


FIG. 589.

out, the complete repeat of the working design would comprise two ribs and, therefore, sixteen picks, as indicated in the design, Fig. 588, and also in the sectional diagram of the cloth, Fig. 589.

§ 203. An important feature in the construction of piqué fabrics is the particular manner in which the cuttings or

furrows, between the ribs or welts, are produced. Thus, if the furrows are produced by inserting two cutting picks, these may be interwoven according to two optional and distinct methods in order to develop what are described as "coarse"

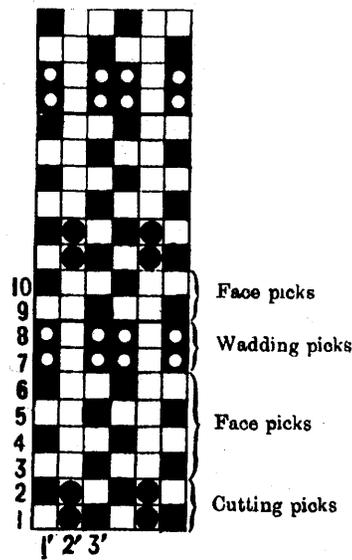


FIG. 590.

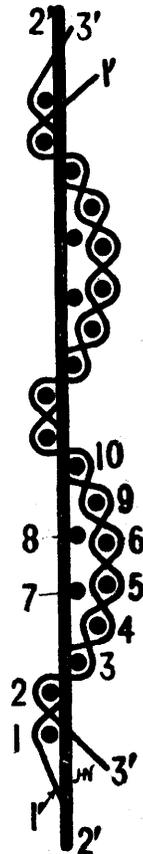


FIG. 591.

cuttings and "fine" cuttings respectively. If "coarse" cuttings are adopted, the furrows are relatively broad and shallow; whilst "fine" cuttings produce furrows of deeper and sharper delineation which, for reasons to be stated presently, imparts to the fabric a very superior effect.

A design for a piqué fabric with "coarse" cuttings is given in Fig. 590, whilst a longitudinal section of the cloth produced from it is represented in Fig. 591. In this example, each rib or welt contains ten picks of weft inserted in the following rotation, as indicated both in the design and sectional diagram,

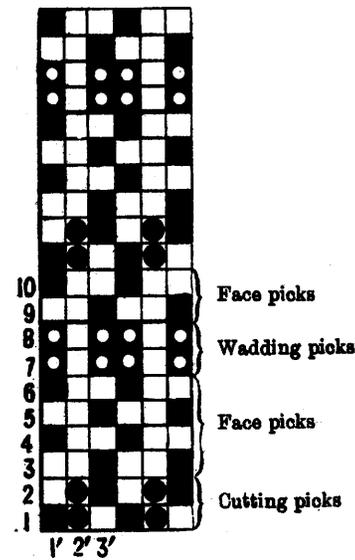


FIG. 592.

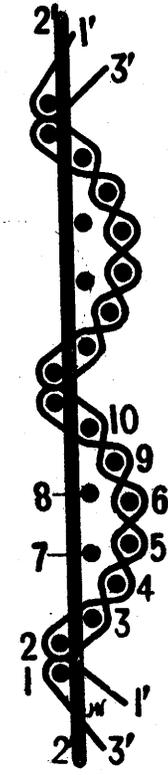


FIG. 593.

namely: two cutting picks, four face picks; two wadding picks and two face picks. (It should be observed at this stage, for the general guidance of students, that wadding picks should not be inserted until at least four face picks have followed the cutting picks of each rib. Otherwise, the wadding picks would prevent those face picks that follow them from approaching

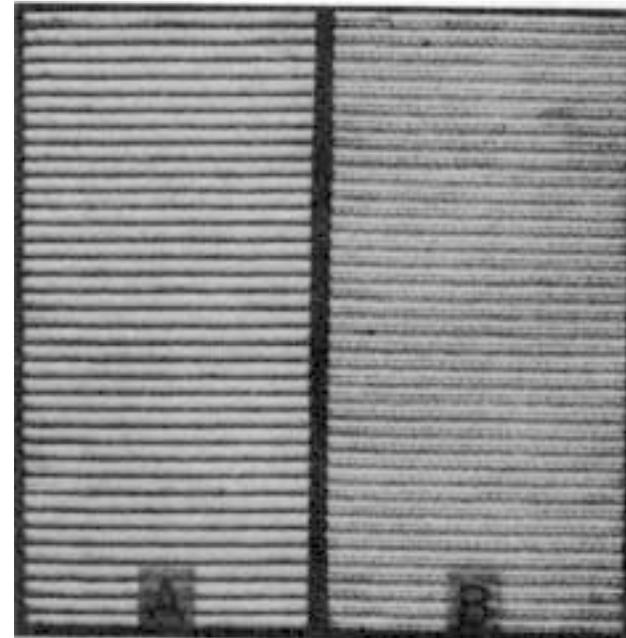
near enough to the preceding cutting picks, thereby involving the risk of producing "cracks" or "frets" immediately after each furrow or cutting.) On examining the sectional diagrams, Figs. 589 and 591, it will be observed that the cutting picks simply form a continuation of the plain calico weave which forms the entire surface tissue of the fabric. Hence, if the back warp threads were severed and withdrawn entirely away from the fabric, the surface tissue in both of these examples would still remain a perfect piece of plain calico fabric just as if it had been produced as such, independently, in a plain calico loom.

The construction of a piqué fabric produced with "fine" cuttings is indicated in the design, Fig. 592, whilst a section of the cloth produced from it is represented in the diagram, Fig. 593. The only difference between this and the previous example is in the relation of the cutting picks and the contiguous face picks on each side of them. Thus, instead of continuing the plain calico weave unbroken, throughout the entire surface tissue of the fabric, the two cutting picks in the present example are, respectively, inserted in the same face warp sheds as the contiguous face picks, albeit they are each inserted in reverse face warp sheds to each other, as indicated both in the design and diagram. By adopting this simple expedient, the ribs or welts are thereby more free to close together and thus produce narrower, deeper and finer cuttings or furrows between them.

#### Backed Piqués.

§ 204. The next stage in the development of plain piqués is to insert backing picks of weft which, as stated in § 200, are only employed in conjunction with wadding picks for the purpose of increasing the weight, strength and firmness or stability of the fabric. As these back picks are visible only on the back of the cloth, and bear no evidence whatever, on the face, of their presence, a backed piqué may only be distinguished from the simple "loose back" variety by its distinctly different appearance when viewed on the reverse side, as observed in Fig. 594, which shows the obverse and reverse sides of the

same fabric, at A and B respectively, after bleaching. This fabric contains 16 picks in each rib, with 10 face and 2 cutting picks of fine weft; 2 wadding and 2 back picks of coarser weft. During weaving, these are inserted in the following rotation: 2 cutting, 4 face, 1 wadding, 1 back, 6 face, 1 wadding and

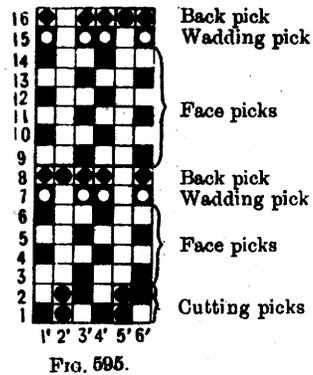


OBVERSE

REVERSE

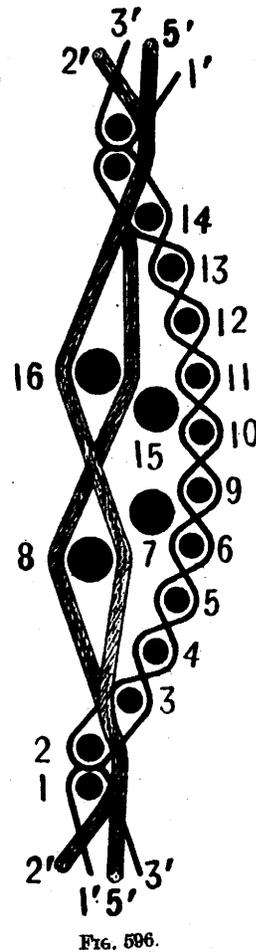
FIG. 594.—Fast back piqué fabric.

1 back pick, as indicated in the design, Fig. 595, and the section of cloth, Fig. 596, which demonstrate the construction of this variety of piqués. Instead, however, of inserting a wadding and a back pick in immediate succession, as indicated in the design and section of this fabric, both of the wadding picks and also both back picks may, respectively, be inserted in succession during weaving; but the method indicated effects a better distribution of those picks in the fabric.



**Decorative Effects in Piqué Fabrics.**

§ 205 The simplest departure from the plain-ribbed piqué, with the object of producing decorative effects, is exemplified in the development of variegated ribs of two or more different widths, as illustrated in Fig. 597. The variegation of the



ribs may be carried to any degree without departing from the general principles governing the construction of piqués, but simply by increasing or reducing the number of picks according to the relative width of ribs desired.

Other means of decoration, as briefly indicated in § 199, are illustrated in Figs. 598 to 609. These examples will serve to demonstrate the wide and almost unlimited scope which

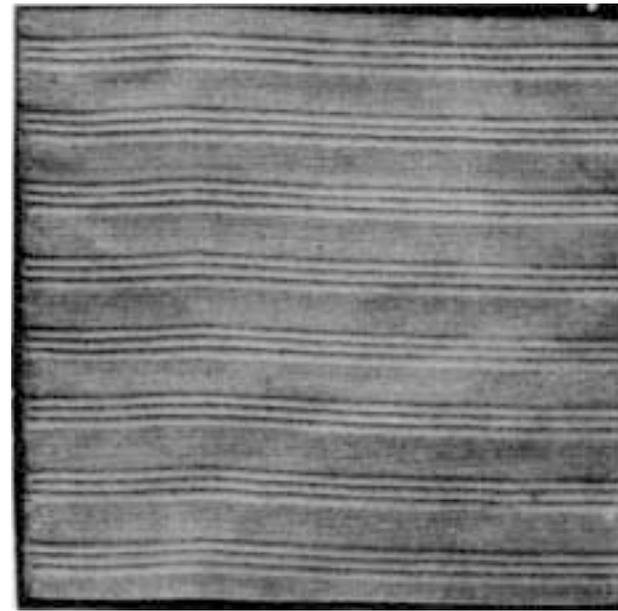


FIG. 597.—Piqué fabric with variegated welts or ribs.

the decoration of piqués affords to designers in the creation of very beautiful, though simple effects, with comparatively little cost or artistic effort. Thus, Fig. 598 is an example of a simple piqué decoration obtained by interweaving two fine picks, of blue and red weft, in the crown or ridge of six ribs in succession and then leaving an interval of six plain ribs. Thus, two picks of red weft are inserted in succession, but in the same face warp shed, in three alternate ribs; whilst

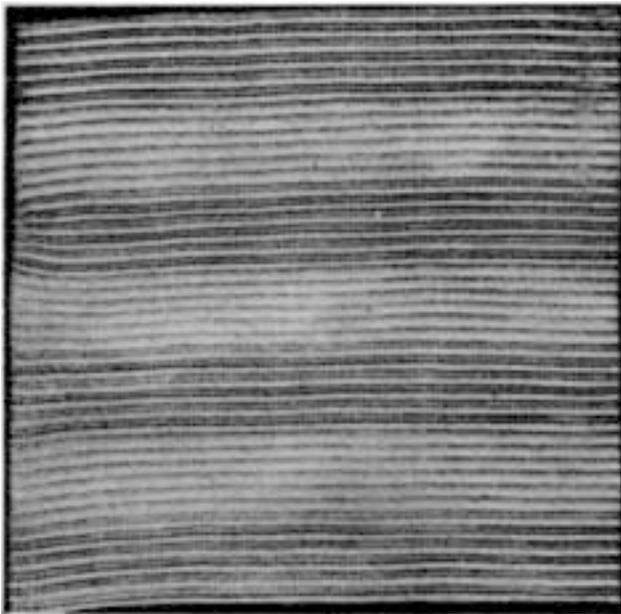


FIG. 598.—Piqué fabric embellished with coloured "face" picks of weft.

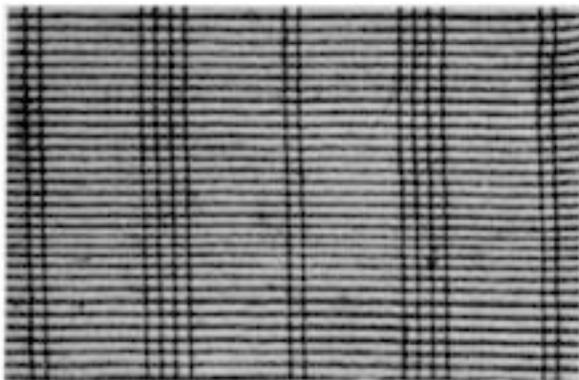


FIG. 599.—Piqué fabric embellished both with coloured face warp threads and "cutting" picks of weft.

two picks of blue weft are inserted, in the same manner, in the three intermediate ribs, thereby requiring a loom furnished with four shuttle boxes on one side, namely, one for the face and cutting picks; one for the wadding and back picks; and one each for the red and blue picks of weft.

Fig. 599 illustrates the development of a check pattern by



FIG. 600.—Piqué fabric embellished with extra picks of coloured weft.

substituting coloured threads both of warp and weft in place of the regular face warp threads and cutting picks. Where these occur, they are in pairs of the same colour, that is, two blue and two red threads of warp and weft, of which the latter are interwoven as cutting picks.

In Fig. 600 a simple wave effect is produced by introducing extra picks of navy blue weft to interweave in the crown of a wider rib. The coloured picks are disposed in eight pairs,

alternately with pairs of regular face picks, and float more or less freely, on the surface, to produce the effect desired.

Fig. 601 illustrates a neat figured effect obtained by means of extra coloured warp threads arranged in pairs that are raised on the surface to float over one rib only at the same time, and then depressed to pass underneath the cutting picks, in order to develop a series of square spots or figures that are disposed alternately.

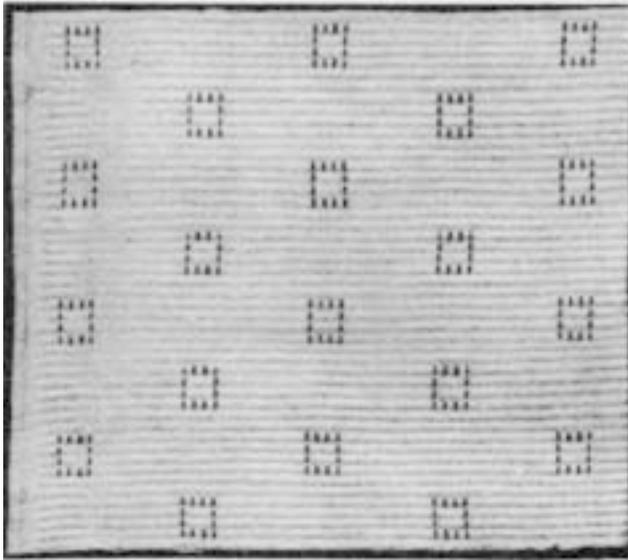


FIG 601.—Piqué fabric figured with extra coloured warp threads.

In Fig. 602 a check pattern is evolved by means of extra "crammed" warp and weft threads employed to develop coloured figured stripes in each direction at regular intervals of  $1\frac{1}{4}$  in. In this case the scheme of figuring would require the use of a Jacquard machine and harness to control both the face and the back warp threads, as the figured effect is beyond the practical range of a dobbie and heald harness.

Fig. 603 is a neat spot pattern developed by causing the

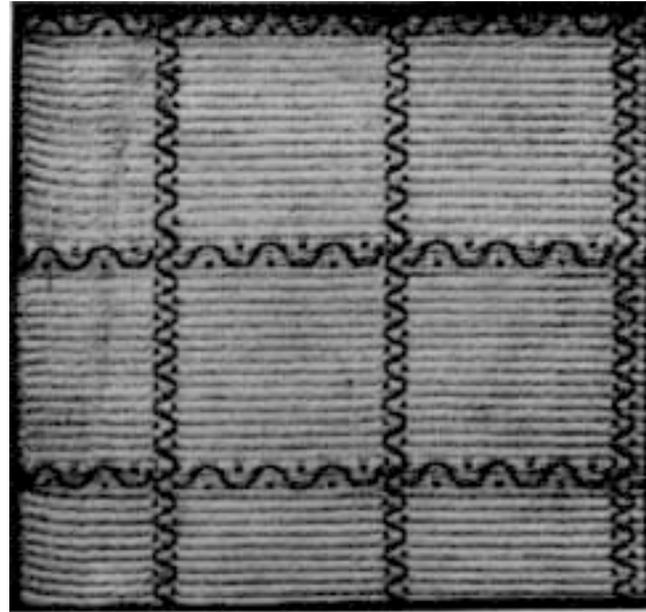


FIG. 602.—Piqué fabric figured both with extra coloured warp threads and picks of weft.

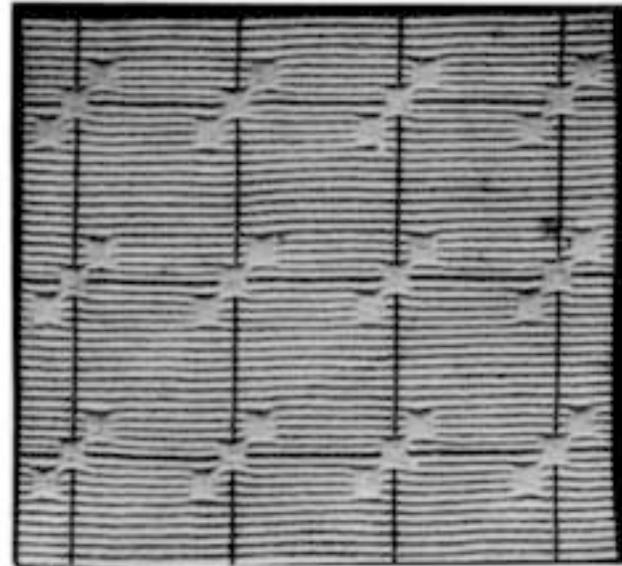


FIG. 603.—Piqué fabric figured by "floating" face warp threads; also by coloured warp and weft threads.

face warp threads to float freely on the surface over four ribs; whilst additional embellishment is obtained by means of coloured threads of warp and weft to produce a hair-line check.

In Fig. 604 the figuring is obtained by allowing the weft to float freely on the surface to develop a series of diamond-shaped forms enclosing a lozenge of plain "toilet quilting,"

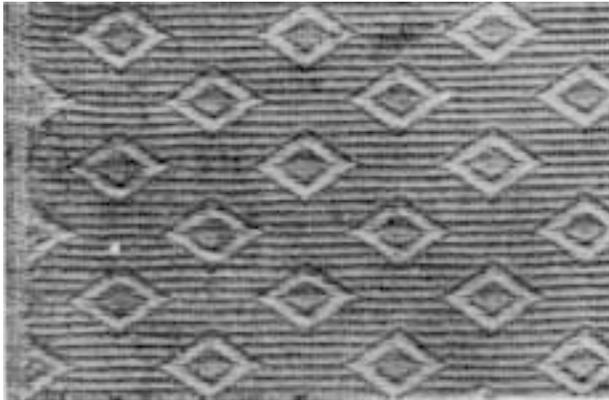


FIG. 604.—Piqué fabric figured by floating all picks of weft.

as described in Chapter XVI. This idea is still further developed in Figs. 605 and 606, in which the true principle of "toilet quilting" is observed. In Fig. 605 the figures are disposed alternately on a plain broad-ribbed piqué; whereas, in Fig. 606, a series of diamond figures are arranged horizontally on a fine-ribbed piqué groundwork also containing bands of broader ribs.

#### The "Float" Mounting.

§ 206. The type of Jacquard harness employed for these fabrics is a "sectional" or "divisional" harness constructed, or "tied-up," on the principle commonly termed a "float" harness which is divided, both in the Jacquard machine and the comber-board, into two separate and distinct sections, termed the "face" and "back" harness, to control the "face" and

2 F



FIG. 605.—Piqué fabric with "toilet" or "quilted" figuring.

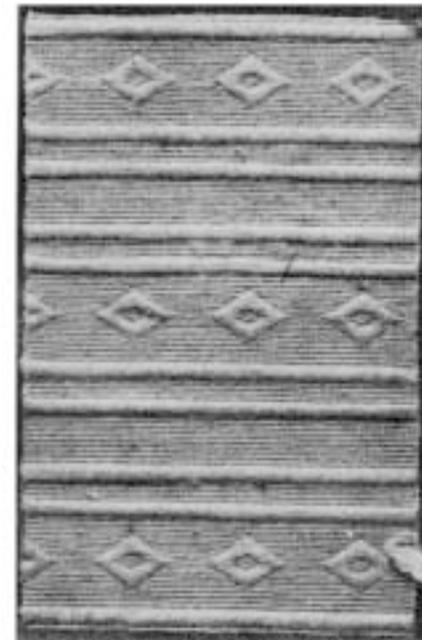


FIG. 606.—Piqué fabric with "toilet" or "quilted" figuring and variegated ribs or welts and of which Fig. 607. is the applied design.

"back" warp threads respectively, and of which the harness or mounting threads, and mail eyes, are in the ratio of two face warp threads to one back warp thread. For example, if a 400's Jacquard machine (408 hooks) with a "tie-up" of 240 hooks, "face," and 120 "back" = 360, is mounted on the loom with the cylinder on the left, when facing the loom, the mounting threads from the last 240 hooks—*i.e.*, over the front part of the loom and on the *right* or "26-side" of the machine, when facing the cylinder—will pass through the holes in the front part of the comber-board, to govern "face" warp threads: whilst the mounting threads from the 120 hooks immediately preceding the 240 face hooks and on the *left* or "25-side" of the machine—over the back of the loom—pass through holes in the rear part of the comber-board, to control "back" warp threads, thus leaving the first 48 hooks on the "25-side" idle, unless they may, if required, be employed as "spare" hooks to govern "extra" figuring warp threads for the development of simple effects, as exemplified in Figs. 601 and 602.

§ 207. The method of preparing an applied or working design for a "float" harness of this type is demonstrated in Fig. 607, which is a portion of the actual design for the fabric represented in Fig. 606. The "face" and "back" sections of the harness are indicated on the design paper separately, side by side, to correspond with the division of hooks in the Jacquard machine. The present pattern repeats on 48 "face," and 24 "back" warp threads; but the design is set out for a "tie-up" of 240 "face," and 120 "back" hooks, in a 400's machine. When cutting the design, therefore, the card-cutter will, in the present instance, first "read off" the "face" hooks five times over in succession, and then proceed to "read off" the "back" hooks for a corresponding number of times. The fine ribs in this fabric each contain 5 picks of the same counts of weft, namely, 1 cutting pick, 3 face picks, and one wadding pick, inserted in the order named. The wider ribs contain 14 face and 13 wadding picks inserted alternately, and in order to prevent the wadding picks from crowding too closely together, in the fabric, they are very loosely interwoven

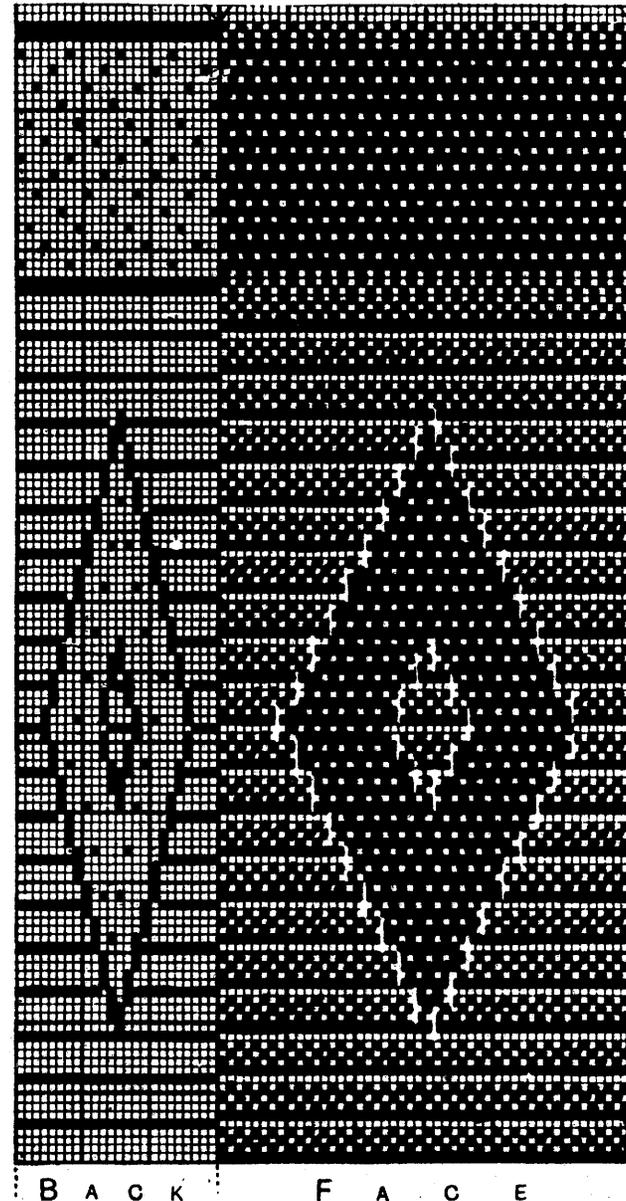


FIG. 607. —Applied design for figured piqué fabric, Fig. 606.

with the back warp threads in the manner indicated in the design. The diamond-shaped "toilet" figures are also developed in a similar manner; with a marginal "stitching" by raising single "back" warp threads over four consecutive picks of weft, to "stitch" or bind down the surface tissue of plain cloth. The points at which the "back" warp threads appear on the face of the cloth are indicated by means of short

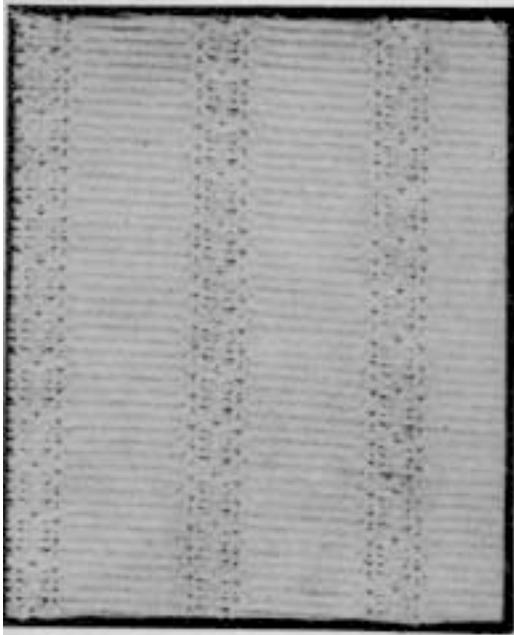


FIG. 608.—Piqué fabric with net leno stripes.

white lines in the "face" section of the design, but this procedure is not necessary in actual practice.

§ 208. Two examples illustrating the embellishment of piqué fabrics by means of "net leno" figuring are represented in Figs. 608 and 609. The first of these is an example of a "two-doup" open leno stripe effect with the stripes disposed at regular intervals apart on a plain piqué ground with the

ribs of uniform width; whereas the second of these examples illustrates a "one-doup" "net leno" cord effect forming a single wave line separating piqué stripes containing ribs of two different widths respectively. Also, in the hollow of each wave is a single spot of coloured yarn, displaying two "taped" extra warp threads passing over four picks of weft at intervals corresponding to the width of the wider ribs, or two



FIG. 609.—Piqué fabric with net leno stripes.

of the narrower ribs, as indicated. Many other examples could be produced in illustration of the various methods of embellishing piqué fabrics, but those given will serve to indicate the general procedure adopted, and the numerous modifications of which these are capable.

§ 209. Piqué fabrics, both plain and figured, are produced in many different qualities, ranging from a very low to a very high

grade. The data obtained from five different examples are given in the following table :—

DATA RELATING TO PIQUE FABRICS.

Dents per In. in Reed.	Ribs per In.	Number of Picks per Rib.	Counts of Warp.		Counts of Weft.	
			Face.	Back.	Fine.	Coarse.
30	16	1C. ; 5F. ; 1W. = 7	30's T.	20's T.	30's	—
32	12	2C. ; 8F. ; 2W. ; 2B. = 14	40's T.	30's T.	40's	—
40	14	2C. ; 10F. ; 2W. ; 2B. = 16	40's T.	30's T.	50's	20's
50	30	2C. ; 8F. ; 6W. = 16	100's T.	2/30's	110's	30's
60	44	2C. ; 4F. ; 4W. = 10	100's T.	2/30's	110's	40's

**Matelasse Fabrics.**

§ 210. "Matelasse" is a term which designates an interesting variety of fabrics that are largely manufactured in worsted material for ladies' mantle cloths ; also in worsted and cotton materials, respectively, for men's fancy vestings, and of which two typical examples are illustrated in Figs. 610 and 611, which represent a cotton vesting and a worsted mantle cloth, respectively. These fabrics are essentially compound textures of a complex structure evolved by interweaving two distinct series each of warp and weft threads, termed "face" and "back" warp threads and picks respectively, according to the respective positions which those threads occupy in the fabric. Each series of warp threads requires to be wound on to a separate weaver's beam to allow of their different rates of contraction during weaving. Face warp threads are generally of finer counts of yarn than back warp threads and are in the ratio of two to one respectively. When drawing-in the warp threads these are passed through the shedding harness and reed in the order of one face, one back and one-face thread, uniformly, with all three warp threads together in the same dent of the reed. In some very superior qualities of cotton matelasse vesting fabrics, however, both face and back warp threads are passed with an alternate or "end-and-end"

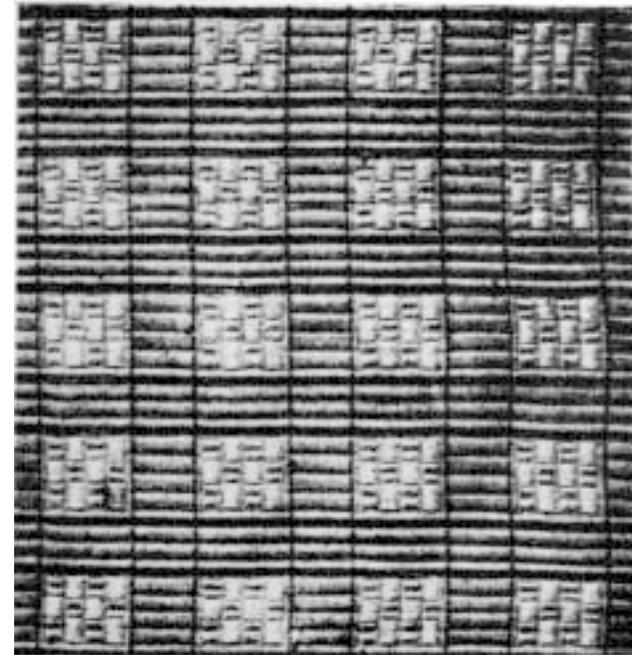


FIG. 610.—Matelasse fabric.

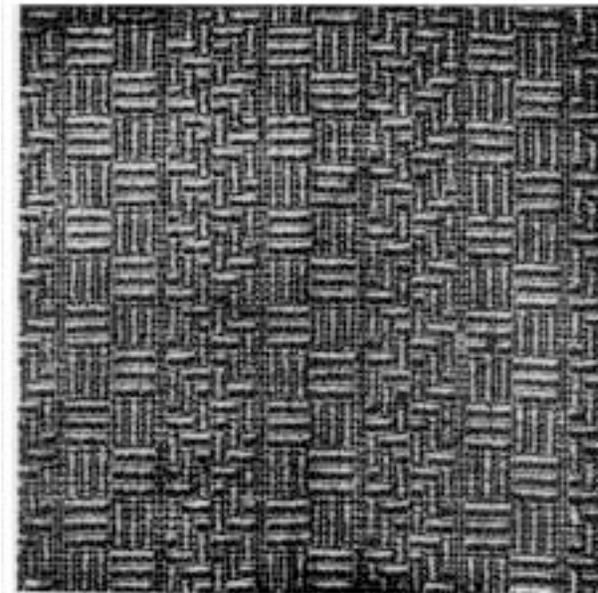


FIG. 611.—Matelasse fabric.

disposition through the shedding harness, and with four warp threads in each dent of the reed. It is usual, however, to employ only one counts of weft, both for face and back picks, in these fabrics, and to insert them according to the disposition of the warp threads, *i.e.*, either two face and one back pick, or else alternately.

Matelasse fabrics are characterised by well-divided and sharply-defined geometrical figures of a chequered or diaper

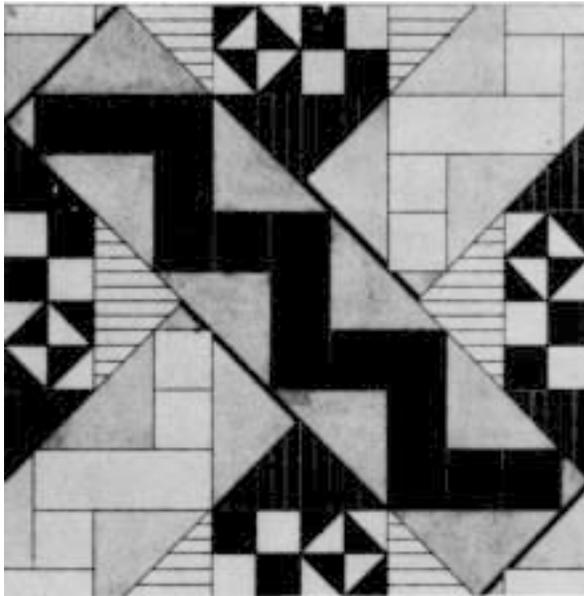


FIG. 612.—Sketch design for matelasse fabric.

character developed by floating both face warp and weft threads either more or less freely on the surface, or by interweaving them in some elementary order, as in a simple brocade fabric, to constitute the surface tissue of the fabric; whilst the back of the fabric consists of a texture of the plain calico weave produced by interweaving back warp and weft threads on that principle. These fabrics are woven from yarn in the "grey" or natural colour, and afterwards bleached, when they present a very rich and pleasing effect.

Two typical sketch designs suitable for this type of fabric are given in Figs. 612. and 613. These are counter-change patterns evolved by straight lines only, as the peculiar structure of matelasse fabrics is not favourable to the development of curvilinear patterns. Black, in the sketches, represents the face warp threads floating freely on the surface: white indicates the face picks of weft: and grey indicates any neutral

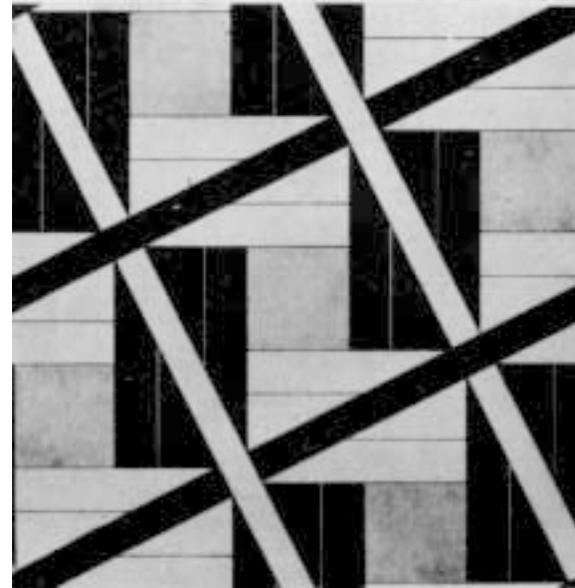


FIG. 613.—Sketch design for matelasse fabric.

simple weave as the "tabby" or plain calico weave; a "two-and-two" dice; a matt weave, or other similar effect.

§ 211. The development of applied designs, on point paper, for matelasse fabrics requires expert technical knowledge of fabric structure, inasmuch as the effects produced are not simply mechanical, but depend entirely on the creative ability of the designer. The type of shedding harness employed for matelasse fabrics is the "float" harness, as employed for figured piqué fabrics, and described in § 206. The method of

preparing a matelasse design, for the card-cutter, is demonstrated in the applied design, Fig. 615: but before this can be accomplished, it is necessary to prepare a block pattern, as represented in Fig. 614, and afterwards set this out on design paper in two separate divisions corresponding with the "face" and "back" series of hooks in the Jacquard machine, as ex-

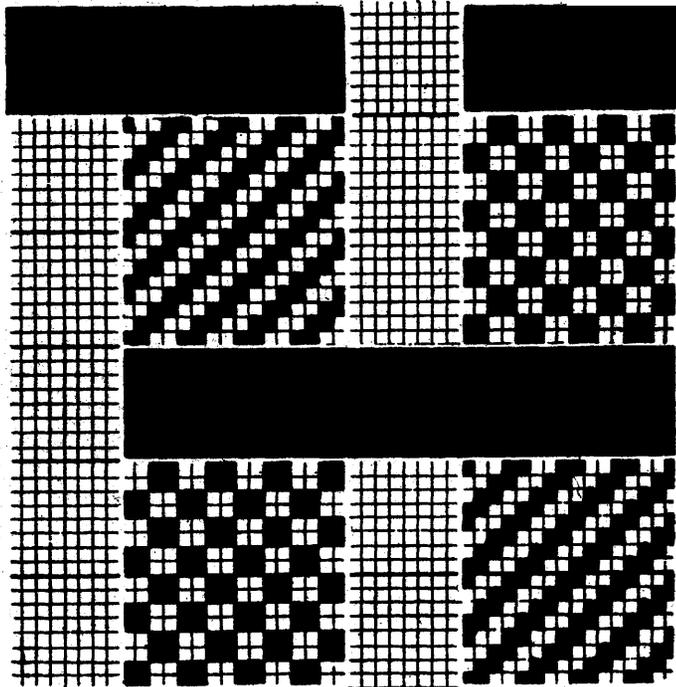
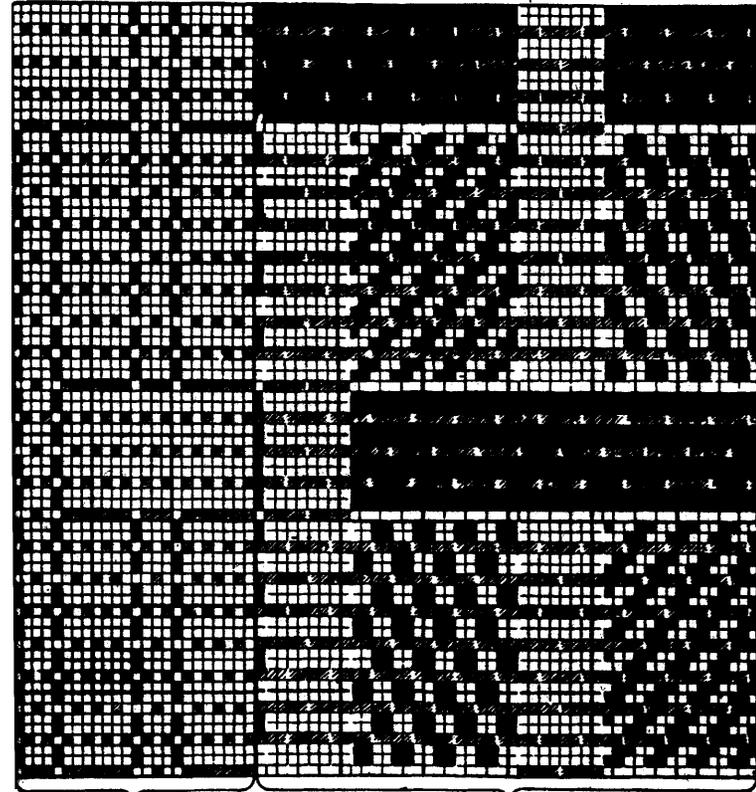


FIG. 614.—Block design for matelasse fabric, of which Fig. 615. is the applied design.

plained in § 206. The pattern selected is a simple counter-change effect repeating on forty-eight face warp threads and picks with a disposition of two face and one back thread in each series. Before proceeding to transfer this to design paper, for the card-cutter, however, it is better to distinguish the back picks from the face picks by faint lead pencil lines drawn across both the face and back sections of the design. The features of

the pattern may then be set out, in lead pencil, in the "face" section of the applied design, after which the "cutting" lines marking the well-defined edges or other distinctive lines of the figures are indicated, in pencil, in the "back" section of



Back hooks

Face hooks

FIG. 615.—Applied design for matelasse fabric with pattern as in block design, Fig. 614.

the design. Thus, the delineation of pattern in an upward direction, or warp-way, is obtained by causing a back warp thread to pass *over* the face picks and *underneath* the back picks, as far as may be necessary, and as indicated by longi-

itudinal white lines in the block pattern, Fig. 614. The delineation of pattern transversely, or weft-way, is obtained by causing a back pick of weft to pass *over* face warp threads, and *underneath* back warp threads, as indicated by transverse white lines, in the block pattern. The face section of the design may then be painted up in order to develop the features in accordance with the block pattern. In this section, care should be taken to raise *all* face warp threads over the back picks excepting where it is necessary to produce a transverse cutting, when face warp threads are left down, and back warp threads raised in those parts. Finally, the plain tissue, at the back of the cloth, is developed by interweaving the back warp and weft threads with the plain calico or tabby weave, excepting when those threads are raised to the surface for the delineation of pattern in the manner just described.

Additional embellishment may be imparted to these fabrics by introducing coloured threads either of warp, weft or both series, and which may either supplant or else supplement, as extra threads, the regular warp and weft threads, according to the particular effect desired. Also, matelasse figuring may also be produced in combination with a plain piqué ground, as exemplified in Fig. 610, which also displays a simple coloured check pattern.

A good quality of cotton matelasse is produced from 80 face warp threads of 2/70's, and 40 back threads per inch, of 2/50's yarn: and 80 face and 40 back picks per inch, of 2/60's weft.

## CHAPTER XVI.

## TOILET QUILTING FABRICS.

§ 212. Although the term "toilet" fabric is the general description of all kinds of cotton fabrics that are used for toilet purposes, such as, for example, counterpanes or bed-covers, dressing table covers, and mats, quite irrespective of the particular class or type of fabric to which they belong, that term, "toilet," is also employed as a technical term descriptive of a particular well-known type of cotton fabric known as "toilet quilting," which is essentially a compound texture comprising several modifications, all of which are characterised by an embossed or raised figure portion of the plain calico weave surrounded by a comparatively rough ground portion also consisting of plain cloth, but which is quite flat and depressed. All these different modifications of "toilet quilting," however, bear a close resemblance in their general appearance when viewed obversely, but they differ essentially in the minor details of construction, and more especially in the manner in which the reverse side of the fabric is constructed as explained hereafter, at the end of § 214.

Toilet quilting fabrics of the type under present notice, however, are produced from "grey" warp and weft, and afterwards bleached, are strictly one-sided and not reversible fabrics, when in use, and are described, technically, as "*two*," "*three*," "*four*," "*five*" and "*six-pick*" toilet quilting, according to the number of picks of weft inserted during the interval between the formation of successive "figuring" warp sheds: or, in other words— if a Jacquard machine is employed for figuring purposes— according to the number of picks that are inserted during the operation of each pattern card of that machine. They contain at least two series of warp threads and either one or else two

series of picks of weft, according to the particular variety of fabric required, and are constructed with what are termed "loose backs," "half-fast" or "stocking backs," and "fast backs." The warp threads consist of what are termed (a) "face" threads, and (b) "back" threads, which latter are also variously described as "figuring," "stitching" and "binding" warp threads.

§ 213. "Face" warp threads are invariably of finer counts of yarn than "back" or "stitching" warp threads which are held at much greater tension than the former series of threads, during weaving, and therefore require to be considerably stronger. Also, since the rate of contraction, during weaving, is much greater with "face" warp threads than with "back" warp threads, it is, therefore, necessary to wind each series of threads on separate warp beams.

Face warp threads are always controlled by a heald harness governed by means of tappets to produce the plain "tabby" or calico weave for the face or obverse side of the fabric; whereas the back or figuring warp threads may be controlled either by means of healds governed by a dobbie, or else by means of a Jacquard figuring harness for more elaborate schemes of figuring. Face and back warp threads are invariably employed in the proportion of two face threads to one back thread, and are drawn through the shedding harness and reed in the order of one face, one back and one face thread between each successive dent of the reed uniformly always with a *back* warp thread between the two face threads in the same dent, and a reed wire always separating two contiguous face threads, as indicated in the drafting chart, Fig. 618, which is the method of drawing in the warp threads through a heald harness consisting of eight healds, namely, four coupled healds to govern face warp threads, and four healds to govern back warp threads that are drawn in with a "V" or pointed draft, although any other number of healds and scheme of drafting the figuring warp threads may be adopted according to the character of the design to be produced.

Some toilet quilting fabrics are constructed with only one series of picks of weft termed "face" picks, which interweave with "face" warp threads only to produce a plain calico texture

of cloth to constitute the entire "face" or surface tissue of the fabric. Other varieties contain two series of weft consisting of "face" picks and "wadding" or "filling" ("padding") picks sometimes of the same kind and counts of weft, but usually with wadding picks of coarser and softer spun "roving" weft which lies midway between the surface tissue and the back of the fabric to impart additional bulk, weight and warmth to the fabric. Superior qualities of toilet quilting, however, contain three series of weft, namely, "face" picks, "wadding" picks and also "back" picks; either with the same or different counts of weft both for "face" and "wadding" picks, but with the same kind and counts of weft for both the "face" and the "back" picks, of which the latter lie entirely at the back of the cloth and interweave only with "back" or figuring warp threads, when these are not required for "stitching" over the "face" tissue of the fabric, and in a manner to be explained subsequently in §§ 219 and 222.

§ 214. Before describing minutely the details of the construction of the several modifications of toilet quilting fabrics, it is advisable, at this stage, to define clearly what constitutes the cardinal and essential characteristics of this important type of fabric, as illustrated by an obverse and reverse view, in Figs. 616 and 617 respectively, of a specimen of "five-pick" "fast-back" toilet quilting of medium quality, containing 52 "face" warp threads of 24's T.; 26 "back" warp threads of 18's T.; 52 "face" picks and 26 "back" picks, both of 18's weft; and "wadding" picks of 8's soft weft per inch, when out of the loom and in the "grey" or unbleached state. As stated in the previous paragraph, the entire surface tissue of these fabrics consists of a perfect sheet of the plain calico weave produced by interweaving "face" warp threads and "face" picks of weft only on the "tabby" or plain weave principle of weaving, and over which surface tissue of plain cloth the "back" or "stitching" warp threads are raised singly (that is, never with two or more consecutive threads together) over *two* consecutive "face" picks only, at the same time, along the margin of the figure portion for figuring purposes and also in the ground portion of the fabric; but the "stitching" threads remain at the

back of the fabric immediately behind the figured portions, thereby leaving the surface calico tissue in these parts quite free and loose from the back of the fabric and therefore causing the figure portions to appear somewhat baggy and to stand out more or less prominently in bold relief from the subdued or depressed ground portion of the fabric. The embossed figuring is emphasised by the insertion of "wadding" picks of coarser and softer weft which lie quite loosely between the "face" texture and the back of the fabric, in the figure portions only; but these picks interweave with the "back" warp threads at the back of the fabric in the ground portion, in a manner to be described subsequently.

In "loose-back" toilet quilting fabrics, "back" warp threads do not interweave with any picks of weft, behind the figure portions, but they float quite freely and loosely in those parts, thereby constituting a very objectionable feature of this particular variety, as the stragging threads are liable to be caught and pulled, accidentally, and thus impair both the appearance and stability of those fabrics. This objection, however, is partly averted in the "half-fast" or "stocking-" back variety of toilet quilting fabrics, and prevented entirely in the "fast-" back variety, as seen in Fig. 617. Thus, in a "half-fast" or "stocking-" back toilet quilting, a "back" pick is inserted either at regular intervals of *three* pattern cards, uniformly, or else a "back" pick is inserted for each of two consecutive pattern cards out of every four cards, uniformly. In both cases the object is to interlace the "back" picks with "back" warp threads, and thus prevent these from floating entirely and quite freely at the back of the cloth, behind the figure portions, as described. The most perfect examples of toilet quilting fabrics, however, are the "five-pick" and the "six-pick" varieties, in which a "back" pick is inserted for each pattern card, thereby constituting a perfect open and light muslin tissue of plain calico at the back of the fabric, as seen in Fig. 617, and produced by combining the "back" picks of weft and the "back" or figuring warp threads on the "tabby" or plain calico principle of weaving, as stated in § 213, and in a manner described in §§ 219 and 222.

§ 215. Another characteristic feature of true toilet quilting fabrics is observed in the figuring or "stitching" warp threads of, say, the *odd* series only being raised during the operation of, say, odd-numbered pattern cards, and *even* figuring threads only are raised for even-numbered cards. Under these circumstances, therefore, consecutive figuring warp threads are never raised simultaneously for the same pattern card, although any *odd* number of consecutive figuring threads may be left down simultaneously. In like manner, figuring warp threads of the



FIG. 616.—Toilet quilting fabric—obverse.

same series, whether odd or even, are never raised for consecutive pattern cards, although they may be left down for any *odd* number of those cards in succession. Warp threads that are raised in this manner are said to be on the "tab" or "shed"—the term "tab" being an abbreviation of "tabby," a term which is commonly employed by textile designers to indicate the plain calico weave. This disposition of figuring warp threads causes a somewhat rough and broken outline at the margin of the figure and ground portions of the fabric, but that defect is inherent to this disposition of threads in fabrics of

any description and is, therefore, unavoidable. If, in the production of toilet quilting fabrics, the figuring threads were allowed to float freely above the surface tissue during the operation of more than one pattern card in immediate succession, they would lose their binding or stitching power over the face of the cloth in the ground portion instead of holding it down firmly in those parts. Also, if contiguous figuring threads were raised above the face of the fabric, the wadding and back picks of weft, wherever those threads were so raised,



FIG. 617.—Toilet quilting fabric—reverse.

would float quite freely at the back, and thereby weaken the structure of the fabric, especially in those parts where such floats occurred. For these reasons, therefore, it is expedient, in the construction of toilet quilting fabrics, to raise or dispose the figuring warp threads on the "tab" or "shed" in the manner described, and as indicated in Fig. 639, which illustrates the method of preparing an applied design for toilet quilting, although in certain varieties of fabrics of this type, described as "toilettings," and which are usually embellished with small figured designs of a simple character, the general practice of

raising the figuring threads on the "tab" is not always strictly observed, but may be departed from in some instances, according to the discretion of the designer and the particular effects which he wishes to produce in cloth.

§ 216. From the foregoing general description of the chief characteristics of toilet quilting fabrics, the following detailed description of the various modifications of this type of fabric, and of the accompanying charts indicating the drafts and shedding plans for their production, will be more easily comprehended by those who are unfamiliar with their manufacture. A modification of this type of fabric embodying certain characteristic features of the true "toilet" principle of fabric structure is that formerly described as "dandy toileting," of fine texture and employed chiefly for making fancy white summer vests and neckties for men's wear. This variety of toilet fabric is constructed with two series each of both warp and weft threads, namely, face threads of fine counts and "back" threads of coarser counts of yarn, but without any "wadding" picks. Warp threads are drawn through the shedding harness and reed in the order of one "face" F, one "back" B and one "face" thread between each successive dent of the reed and as indicated in the drafting chart, Fig. 618; whilst the weft series of threads are inserted in the order of two "face" and two "back" picks, in alternate succession and as indicated in the "shedding plan," Fig. 619, which draft and shedding plan are adapted to produce a simple figured effect consisting of the simple six-end diamond weave represented in Fig. 199. Face warp threads are drawn through a set of four plain healds that are coupled together virtually to constitute only two healds with the usual calico or plain drafting in the order technically indicated as "1, 3, 2, 4," which signifies that consecutive "face" warp threads are passed through the eyes of the 1st, 3rd, 2nd and 4th heald in regular succession and as indicated in Fig. 618; whereas "back" warp threads are drawn through four healds, placed in the rear of the "face" healds, and with a "V" or pointed draft repeating on six warp threads, as indicated. Therefore, by raising the respective healds in the manner indicated in the shedding plan, Fig. 619, the back warp threads



on design or point paper the manner in which both the "face" and "back" warp threads are raised and depressed for consecutive picks of weft, the structure of the respective varieties of toilettings just described will be the better comprehended.

### Varieties of Toilet Fabrics.

§ 218. For convenience of reference, toilet fabrics may be classified under six chief divisions, each comprising the following varieties, namely:—

1. A: "*Dandy*"—Two-PICK, two-shuttle, fast-back toileting, containing "face" and "back" picks only, but no "wadding" picks—Fig. 619.

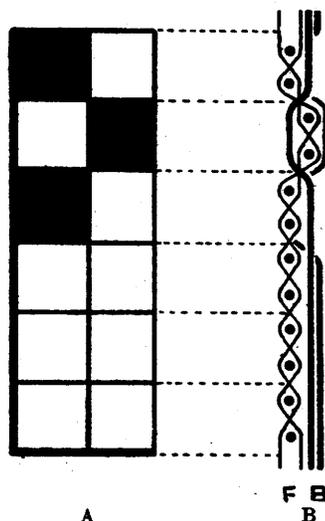


FIG. 621.

- B: "*Run-up*"—Two-PICK, one-shuttle, loose-back toileting, containing "face" picks only—Fig. 620.
2. Two-PICK, one-shuttle, loose-back toilet quilting, containing "face" pick only, as represented by a longitudinal section of cloth, in Fig. 621 B.
3. A: THREE-PICK, one-shuttle, loose-back toilet quilting, containing "face" and "wadding" picks only.

- B: THREE-PICK, one-shuttle, "half-fast" or "stocking-" back toilet quilting, containing "face," "wadding" and "back" picks, with a "back" pick inserted for every *third* pattern card.
- C: " " " " two-shuttle, loose-back toilet quilting, containing "face" and "wadding" picks only, as represented in Fig. 622 B.

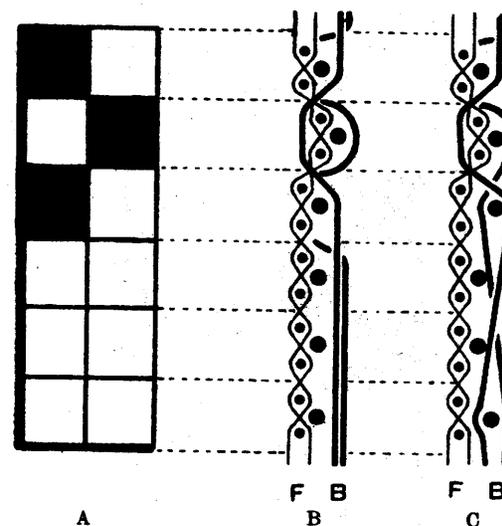


FIG. 622.

- D: THREE-PICK, two-shuttle, "half-fast" back toilet quilting, containing "face," "wadding" and "back" picks, with a "back" pick inserted for every *third* pattern card, as represented in Fig. 622 C.
4. A: FOUR-PICK, one-shuttle, loose-back toilet quilting, containing "face" and "wadding" picks only.
- B: " " " " one-shuttle, "half-fast" back toilet quilting, containing "face," "wadding" and "back" picks, with a "back" pick inserted for each of *two consecutive* pattern cards, out of every *four* cards.

- C: FOUR-PICK, as 4 B, but with a "back" pick inserted for every *third* pattern card.
- D: " " one-shuttle, fast-back toilet quilting, containing "face," "wadding" and "back" picks, with a "back" pick inserted for *every* pattern card.
- E: " " two-shuttle—otherwise as 4 A, and as represented in Fig. 623 B.

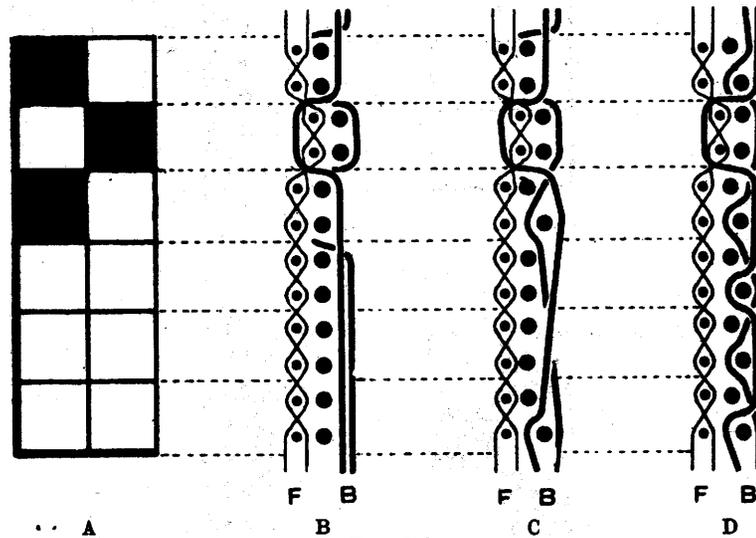


FIG. 623.

- F: FOUR-PICK, two-shuttle—otherwise as 4 B.
  - G: " " " " —otherwise as 4 C, and as represented in Fig. 623 C.
  - H: " " " " —otherwise as 4 D, and as represented in Fig. 623 D.
5. FIVE-PICK, two-shuttle, fast-back toilet quilting, as represented in Fig. 624 B.
6. SIX-PICK, two-shuttle, fast-back toilet quilting, as represented in Fig. 625 B.

The structure of toilet quilting fabrics is better demonstrated

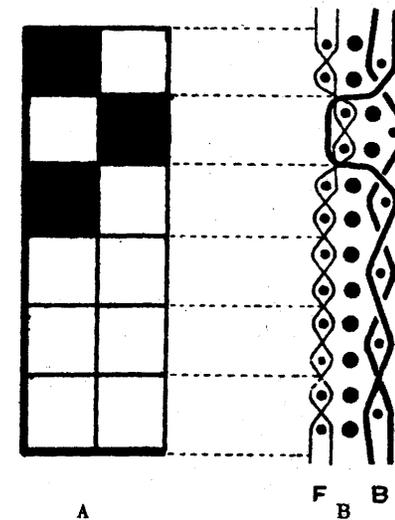


FIG. 624.

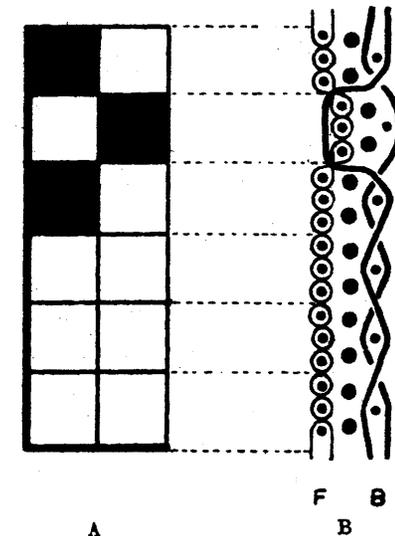


FIG. 625.

by the aid of the following graphic diagrams, Figs. 621 to 625, representing longitudinal sections of several varieties of those fabrics. These sectional diagrams are placed by the side of the corresponding portion of an applied toilet design of which only two vertical and eight horizontal spaces on design paper—corresponding to two hooks of the Jacquard machine and eight pattern cards respectively—are shown. The sectional diagrams are also accompanied by the respective shedding plans indicating the manner in which the Jacquard harness, comber-boards and healds are raised during the operation of each pattern card, according to the particular variety of fabric produced.

§ 219. A toilet quilting harness consists of a Jacquard figuring harness to govern the “back” or “stitching” warp threads, and operates in conjunction with a set of four coupled healds, placed in front of the figuring harness, to control the “face” warp threads. For “loose-back” toilet quilting the harness threads pass through the holes of a single fixed comber-board; but for “half-fast” and “fast-back” toilet quilting, harness threads are passed through *two* separate comber-boards to receive odd-numbered and even-numbered harness threads respectively. In this case, a large knot is formed on each mounting or harness thread immediately above their respective comber-boards, which are raised in alternate succession in order to raise first the alternate and then the intermediate “back” warp threads, alternately, across the entire width of the fabric for the insertion of “back” picks only, as indicated in the shedding plans for those varieties. Excepting for this difference between one fixed comber-board and two operative comber-boards controlling odd and even mounting threads, respectively, the drafting chart for all varieties of toilet quilting fabrics is the same, as indicated in Fig. 626. The Jacquard machine is governed by means of a lifting cam which makes one complete revolution during the operation of each pattern card, corresponding to such number of picks as are inserted for each card; whilst the comber-boards and healds are governed by means of positive box-plate-side tappets, as represented in Fig. 631. The production of one-shuttle toilet quilting requires the use of an ordinary

single-box loom only; but the two-shuttle varieties require the use of a loom with two shuttle boxes at one end of the sley, and with a “checking” or box motion to operate those boxes for the two kinds of weft employed. Also, an ordinary alter-

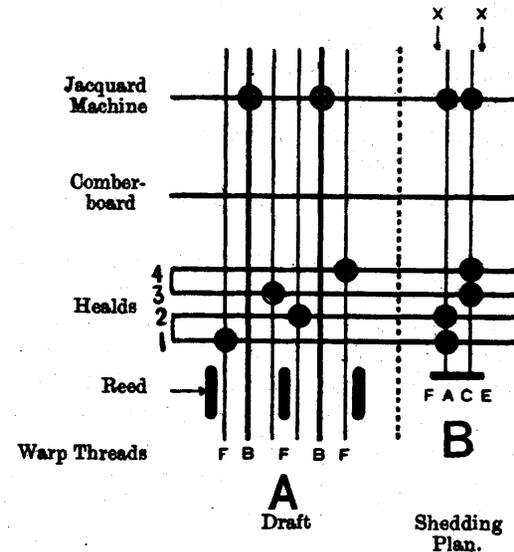


FIG. 626.

nate picking motion only is necessary for these looms; but this requires both the fine and coarse picks of weft to be inserted in two or a multiple of two picks of each kind of weft in succession, and as indicated in the shedding plans of those varieties.

### Two-pick, One-shuttle Toilet Quilting.

§ 220. The structure of two-pick, one-shuttle toilet quilting is represented by a longitudinal section of cloth, in Fig. 621 B, whilst the drafting chart and shedding plan for that variety are indicated in Fig. 626 A and B respectively. This variety contains only two picks of weft, both of which are “face” picks F, for each pattern card, during the operation of which the Jacquard machine is raised and remains up for both picks in succession, and then changes very quickly to form the next

figuring warp-shed, as indicated by small arrows X, in the shedding plan, Fig. 626 B. At the same time the healds governing "face" warp threads rise and fall in alternate succession for consecutive picks of weft and in exactly the same manner as in an ordinary plain calico loom, to produce the surface tissue of plain cloth as represented in the sectional diagram, Fig. 621 B, and also in the shedding plan, Fig. 626 B. Therefore, all figuring warp threads that are raised "stitch" over two "face" picks of weft in succession, whilst those threads that remain down float quite freely at the back of the cloth for any odd number of pattern cards in succession, thereby producing a "loose-back" toilet quilting devoid both of "wadding" and "back" picks, and one which is, therefore, the simplest and relatively the lightest texture of this type of fabric.

Three-pick Toilet Quilting.

§ 221. In a three-pick toilet quilting, three picks are inserted for each pattern card, namely, two "face" picks and

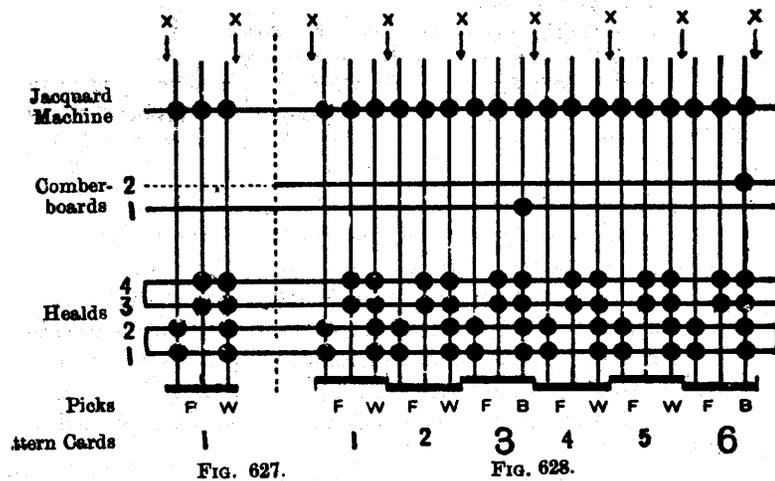


FIG. 627.

FIG. 628.

one "wadding" pick W, either of the same or different counts of weft. Also, they are usually constructed with a "loose back" and sometimes with a "half-fast" or "stocking-

back," as represented by sectional diagrams, Figs. 622 B and C respectively, and of which the shedding plans for four different varieties of three-pick toilet quilting are indicated in Figs. 627, to 630 inclusive. Thus, if the "loose-back" variety is produced from the same kind of weft both for face and wadding picks, it may be woven in a single-box loom with the weft inserted in the order of two face picks and one wadding pick for each pattern card, uniformly, as indicated in the shedding plan, Fig. 627 for that variety. If, however, wadding picks are of coarser counts of weft than the face picks, the picks of weft

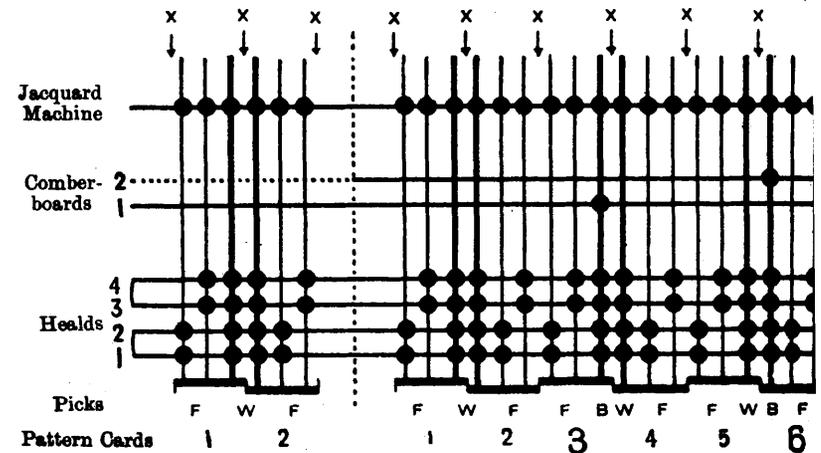


FIG. 629.

FIG. 630.

are inserted in the order of two face picks and one wadding pick for alternate pattern cards, and one wadding pick and two face picks for intermediate cards as indicated in the shedding plan, Fig. 629, and in order to conform to the restriction imposed by a loom sley constructed with a double shuttle-box at one end, and a single shuttle-box at the other end, and also a loom equipped with an alternate picking motion, as explained in § 219.

In weaving this and all other varieties of "loose-back" and "half-fast" back-toilet quilting the Jacquard machine remains up for all the picks that are inserted for each pattern card, and must, therefore, change quickly between the last pick of one

card and the first pick of the next card, as indicated by the arrows X.

§ 222. If a toilet quilting fabric is to be produced either with a "half-fast" or a "fast back," the odd and even series of mounting or harness threads will require to be passed respectively through two separate comber-boards, and with the harness threads knotted immediately above those boards that will be raised in alternate succession for the "back" picks only, in order to raise first the odd series and then the even series of figuring or stitching warp threads for consecutive "back" picks respectively, and as indicated in the several shedding plans for those varieties of toilet quilting. The comber-boards are governed by means of box-plate side tappets and "jack-levers." Each of these boards may be controlled by a separate tappet constructed according to the particular order of shedding required, and by connecting-rods secured to the ends of the tappet treadles and their respective "jack-levers." By an alternative method which is indicated in Fig. 631, both comber-boards F may be controlled by the same tappet A. This is effected by attaching to the tappet treadle B two long hooked rods C that are connected respectively, by means of cords G, to two separate spare or extra hooks H of the Jacquard machine, as represented in the diagram. Therefore, whenever the tappet treadle B is depressed, both of the hooked lifting-rods C will also descend together. When these rods are in their normal position, they are held, by means of spiral springs D, quite clear away from the ends of the "jack-levers," E, until they are pulled over the ends of those levers by the ascent of the corresponding Jacquard hooks H. Thus, by constructing the tappet A in such a manner that it will depress the treadle-lever B always for the *last pick* of each pattern card in succession, uniformly, and also by cutting holes in those cards according both to a pre-arranged plan as determined by the particular variety of toilet quilting to be woven, and to the order in which the "back" picks are inserted, the hooked lifting-rods C will be pulled over the ends of their respective "jack-levers" E in alternate succession, to raise the corresponding comber-boards F for consecutive

"back" picks, and quite irrespective of whether these are to constitute "half-fast" or "stocking-back," or a "fast-back"

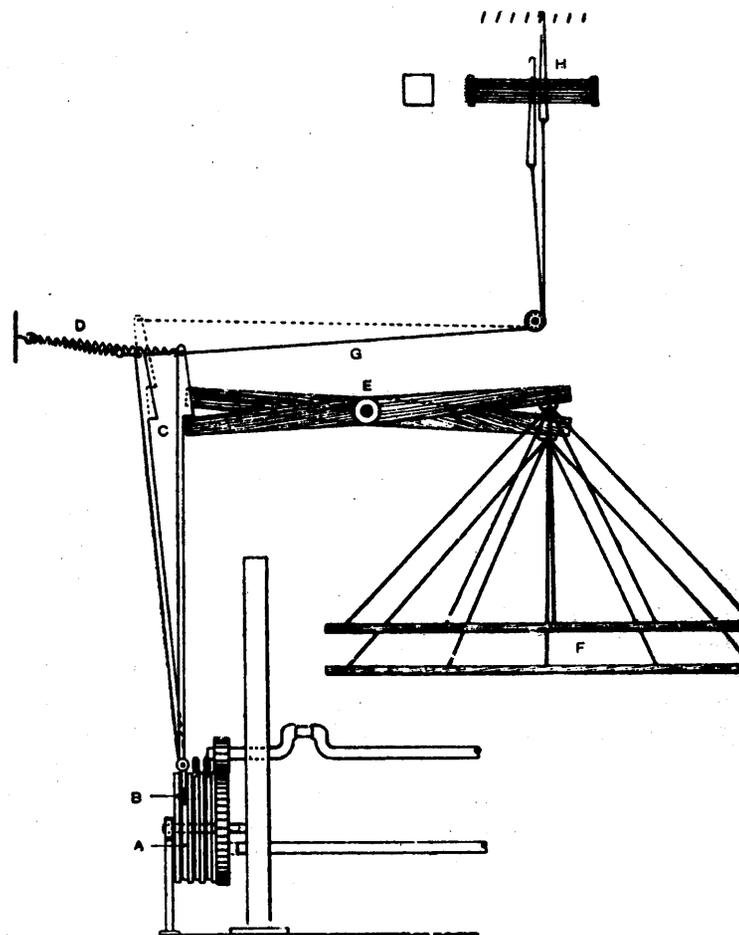


FIG. 631. —A method of operating comber-boards in a toilet quilting loom.

toilet quilting fabrics. It should be observed, however, that this method of governing the action of the comber-boards, that is, by means of spare Jacquard hooks that are controlled by

the pattern cards, is not applicable to the two-shuttle "half-fast" or "stocking-back" variety of three-pick toilet quilting, of which the shedding plan is indicated in Fig. 629, for the simple reason that, in this example, two consecutive "back" picks are inserted as the *last pick* of one pattern card and the *first pick* of the next card respectively, and not as the last pick of those pattern cards, uniformly.

Four-pick Toilet Quilting.

§ 623, The structure of the three principal varieties of four-pick toilet quilting is illustrated by sectional diagrams, Figs. 223. B, C and D, which represent the "loose-back," the "half-fast" or "stocking-back" and the "fast-back" varieties, for which the shedding plans are indicated in Figs. 632 to 635

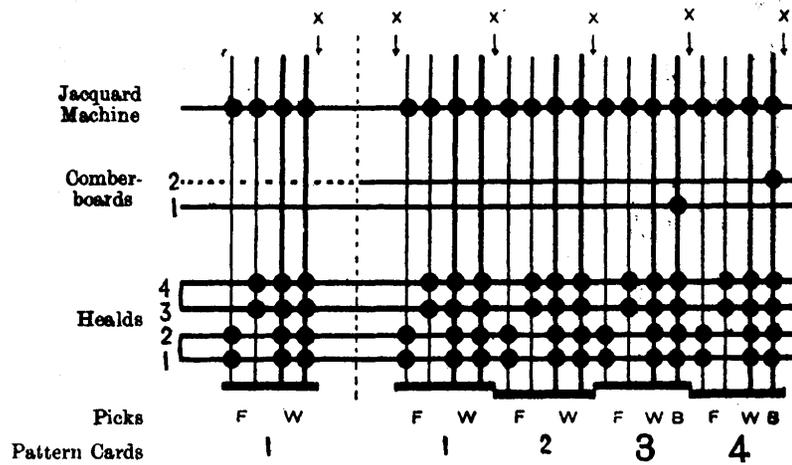


FIG. 632.

FIG. 634.

respectively. The sectional diagram, Fig. 623 C, and the shedding plan, Fig. 633, relate to the "stocking-back" variety produced by inserting a "back" pick for every *third* pattern card, uniformly; whereas the shedding plan, Fig. 634, is for the alternative method of which a "back" pick is inserted for two consecutive pattern cards in every *four* cards, as indicated. The shedding plan for the four-pick "fast-back"

toilet is indicated in Fig. 636, which, in this and also in the shedding plans for the "five-pick" and "six-pick" toilet quiltings,

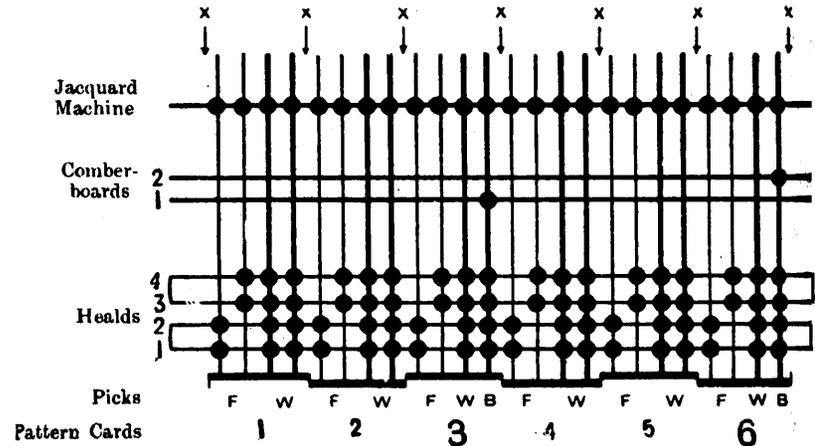


FIG. 633.

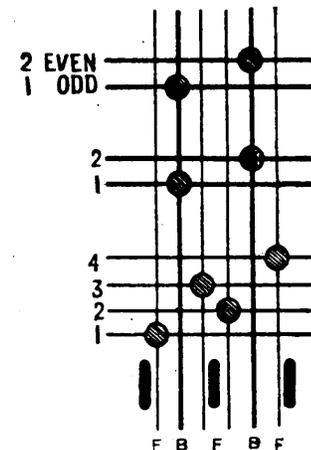


FIG. 635.

as indicated in Figs 637 and 638 respectively, is arranged for what is known in the trade as a "split-shed" "tie-up"

of the Jacquard figuring harness, in which the odd and the even series of mounting threads, respectively, are each controlled independently by two separate Jacquard machines, as indicated in those shedding plans, and also as represented in the drafting chart, Fig. 635. This course is only possible by reason of raising figuring warp threads first of the odd and then of the even series only, during the operation of alternate and intermediate pattern cards respectively, as explained previously in § 215. With a "split-shed" harness, each Jacquard machine controls *all* figuring warp threads of *one series*

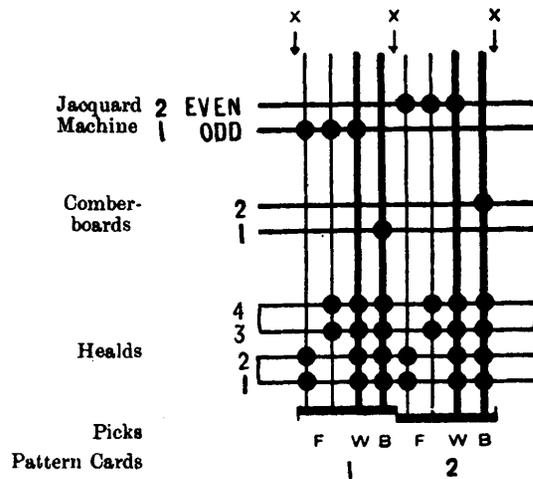


FIG. 636.

*only*, respectively, across the entire width of the fabric, and only *one* of the two machines operates for each pattern card employed, thereby requiring only one-half the usual number of those cards and therefore only one-half the amount of card-cutting that would otherwise be required if the Jacquard machines each controlled all figuring warp threads in half the full width of the "back" warp respectively, in which case both machines would operate simultaneously for every pattern card employed, instead of rising in alternate succession in the manner described and indicated in the shedding plans.

Another practical detail concerning the construction of "fast-back" toilet quilting fabrics relates to the manner of operating the Jacquard machines. It was observed in § 221 that, in the production of "loose-back" and "half-fast back" toilets, the Jacquard machine requires to change quickly between the last pick of one pattern card and the first pick of the succeeding card, in order to keep the figuring warp

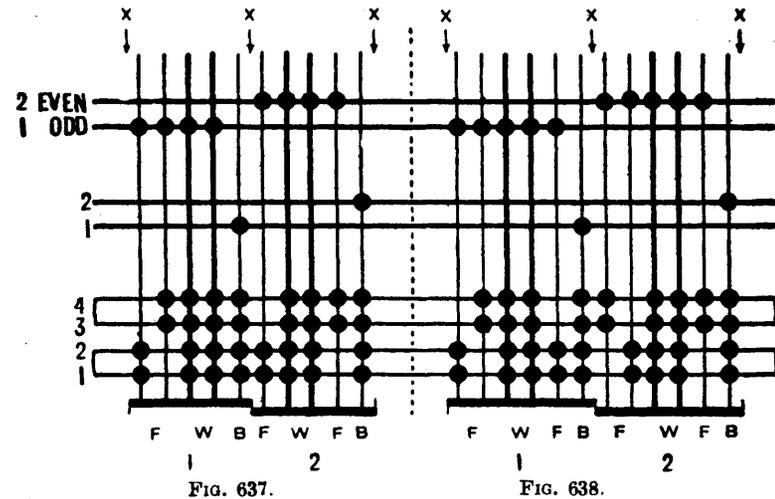


FIG. 637.

FIG. 638.

shed open during all the picks of weft inserted for each pattern card. If, however, the last pick of each successive pattern card is a "back" pick uniformly, as in all "fast-back" toilets, the Jacquard machine may, under these circumstances, descend immediately after the previous pick of weft is inserted, and remain down entirely for the "back" picks, as indicated in the shedding plans, Figs. 636, 637 and 638.

**Five-pick Toilet Quilting.**

§ 224. The five-pick variety of toilet quilting fabrics is invariably produced from weft of two different counts and with a "fast back," as represented in the sectional diagram, Fig. 624 B, of that variety of which the shedding plan is indicated in Fig. 637. The "face" and "back" picks are both of the same

counts of fine weft, inserted by the same shuttle, whilst the "wadding" picks are of coarser counts of soft spun or roving weft. In order to conform to the conditions imposed by a loom equipped with an alternate picking motion, and with a loom sley constructed with a double shuttle-box at one end only, and a single box at the other end, the order in which the picks are inserted in a five-pick toilet fabric is not the same for each of any two consecutive pattern cards, by reason of "five" being an *odd* number, whereas only an even number of picks of the same kind of weft may be inserted under the conditions just specified, for reasons stated in § 219. For these reasons, therefore, the picks of weft are inserted in the order of two "face" (F), two "wadding" (W) and one "back" (B) pick, for, say, the odd-numbered pattern cards only; and in the order of one "face," two "wadding," one "face" and one "back" pick for even cards only, as indicated in the shedding plan, Fig. 637, thereby requiring the tappets governing the healds and also the pattern chain governing the action of the shuttle-boxes to be constructed ten picks to the revolution.

#### Six-pick Toilet Quilting.

§ 225. The six-pick toilet quilting is a very uncommon variety which differs in construction from the five-pick toilet only in the detail of having *three* instead of two "face" picks inserted for each pattern card uniformly, as represented by the sectional diagram, Fig. 625 B, of that variety, and also as indicated in the shedding plan, Fig. 638.

In addition to the foregoing examples of toilet quilting fabrics, there are several other varieties of a kindred type, but which do not conform strictly to the essential conditions governing the construction of the more typical examples of this class of fabrics. For example, in one of these varieties which is of the "loose-back" structure, a coloured "back" or figuring warp is employed, of which any number of consecutive warp threads are displayed for any number of consecutive pattern cards, quite freely above the plain surface tissue of the fabric in a manner exactly similar to that observed in respect of the figuring warp threads in Alhambra fabrics,

as described in Chapter XII. Excepting for the coloured figuring warp threads which require to be dyed with "fast" dyes, these fabrics, like other "toilet" fabrics, are woven in the "grey" state and afterwards bleached.

§ 226. Another variety of this class of fabrics is produced as a typical five-pick "fast-back" toilet quilting with the additional embellishment afforded by the employment of an extra coloured figuring warp, of which the threads are displayed in any desired manner and quite freely over the plain surface tissue, but which float loosely at the back of the fabric whence they are subsequently cut away as waste material previous to bleaching.

#### Preparation of Applied Designs for Toilet Quilting Fabrics.

§ 227. Unlike applied designs for textile fabrics of simple structure produced from only one series each of warp and weft threads, and which indicate the actual manner in which those threads are interlaced in the woven fabric, an applied toilet quilting design merely serves to indicate the manner in which the "back" or "figuring" warp threads or hooks of the Jacquard machine are raised for the respective pattern cards. Hence, the vertical spaces on the squared design paper represent figuring warp threads, or Jacquard hooks, and the horizontal spaces represent Jacquard cards. Therefore, the proper counts of design paper to employ for a toilet quilting design is determined according to the ratio of figuring warp threads and pattern cards employed in a given unit of space, say one inch, in the finished fabric. Thus, if a design to be prepared for any variety of toilet quilting fabric containing 32 back warp threads, and requiring 40 pattern cards per inch, is to be woven in a loom mounted with a 400's Jacquard machine (8 hooks deep), the required counts of design paper will be ruled 8 × 10 squares to a bar; but if a 600's machine (12 hooks deep) is employed, the design paper should be ruled with 12 × 15 squares to a bar.

The development of an applied toilet quilting design is indicated in Fig. 639, which represents a small portion of such a design, prepared on paper ruled with 8 × 8 squares to a bar.

showing how the figuring warp threads are raised singly on the "tabby" principle of weaving, as explained in § 215. After painting in the margin of the ground and figure in the manner indicated, it is usual, in order to economise time and labour, to fill in the ground portion with a thin wash either of green or yellow paint, as indicated by shaded squares, and which

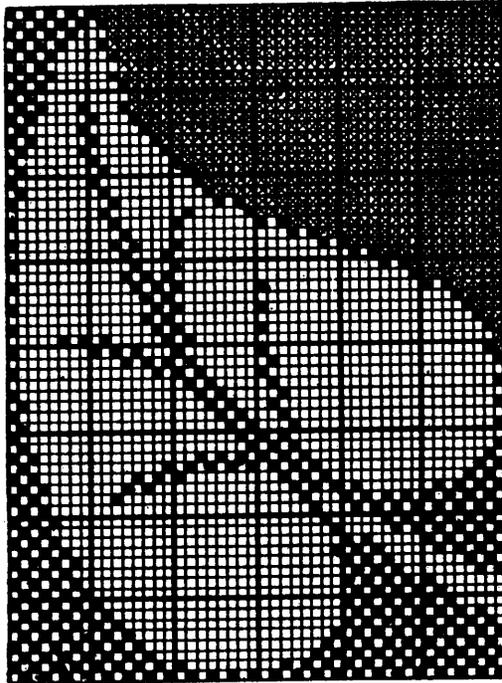


FIG. 639.—Method of developing applied designs for toilet quilting fabrics.

is understood by the card-cutter to signify that this colour must be "read off" and cut as "tabby"

§ 228. It may, at this juncture, be observed that applied toilet quilting designs for all the different varieties both as regards the number of picks inserted for each pattern card and also the character of the reverse side of the fabric, are all developed in exactly the same manner, so that the same design is equally applicable to any one of those varieties of which the

particular character is determined entirely by the mechanical equipment of the loom.

It should further be observed that if pattern cards for a toilet quilting design are being cut for a "split-shed" "tie-up" of the figuring harness, of which the odd and the even series of mounting threads are each controlled independently by separate Jacquard machines, as described in § 223, the card-cutter will, in these circumstances, "read" two bars of the design paper as representing only one short row, either of 8 or else 12 hooks, according to the index of those machines. In this case, therefore, alternate dots, representing the "tabby" weave, on design paper, will be cut as if they were placed consecutively. Thus, the vertical spaces corresponding to 1, 3, 5 and 7 in each of the *first two* and succeeding pairs of bars on design paper, ruled with eight vertical spaces in each bar, represent hooks 1, 2, 3, 4, 5, 6, 7 and 8 respectively, in each short row, of the "odd" Jacquard machine, and, in like manner, the vertical spaces, 2, 4, 6 and 8 in the same pairs of bars represent hooks 1 to 8 in each short row, of the "even" machine, albeit consecutive hooks in those machines govern only the odd and the even series of figuring warp threads, respectively, as described.

§ 229. Toilet quilting fabrics are produced in a variety of different grades of texture and quality of which the following table gives the particulars of ten actual examples of these fabrics in the "grey" or unbleached state, namely:—

DATA RELATING TO TOILET QUILTING FABRICS.

Example.	Variety of Fabric.	Dents per Inch in Reed.	Pattern Cards per Inch.	Counts of Warp.		Counts of Weft.	
				Face.	Back.	Face.	Wedding.
No. 1	Four-pick : one-shuttle : half-fast back	22	20	18's T.	18's T.	7's	7's
" 2	Five-pick : two-shuttle : fast back	26	26	24's T.	18's T.	18's	18's
" 3	Three-pick : one-shuttle : loose back	26	30	20's T.	20's T.	11's	11's
" 4	Four-pick : one-shuttle : half-fast back	28	28	18's T.	18's T.	9's	9's
" 5	Four-pick : two-shuttle : fast back	30	28	2/80's	2/40's	20's	7's
" 6	Four-pick : two-shuttle : loose back	32	34	46's T.	18's T.	28's	9's
" 7	Five-pick : two-shuttle : fast back	39	40	2/80's	2/50's	40's	24's
" 8	Three-pick : two-shuttle : loose back	41	50	42's T.	2/40's	50's	11's
" 9	Five-pick : two-shuttle : fast back	42	42	2/80's	2/60's	40's	12's
" 10	Five-pick : two-shuttle : fast back	42	64	2/100's	2/60's	80's	20's

## CHAPTER XVII.

## PATENT SATIN OR MITCHELINE FABRICS.

§ 230. "Mitcheline" and "patent satin" are the trade names of the first two varieties of a distinctive type of cotton fabric of which there are several modifications that differ from each other in minor details only. They are employed chiefly as counterpanes or bed-quilts, toilet covers and mats, antimacassars and similar articles, and are usually woven in the grey state and afterwards bleached. Some are woven with a white or coloured figuring on a coloured ground, and they may be embellished with coloured threads to produce stripes or checks, by embroidery, printing and painting.

The prototype of this class of fabrics was patented in 1868 by D. Mitchell—hence the term "Mitcheline"—and, in 1881, an improved structure of this fabric was patented by T. Taylor and J. Warburton, and registered as "patent satin," by which trade description it is known universally, and of which an example is illustrated in Fig. 640. The term "satin," however, is used in this connection merely as a fanciful description, as there is nothing of the satin or "sateen" weave in the construction of a "patent satin" fabric. This is essentially a compound structure produced by an ingenious combination of two series each of warp and weft threads to develop two distinctly different tissues of the plain "tabby" or calico weave, but which are so united, by interweaving, that the two tissues virtually constitute a single fabric in which the scheme of figuring is evolved simply by interchanging their relative positions.

The two series of warp threads consist of figuring threads of relatively coarse yarn and binding threads of finer yarn, and are in the ratio of two to one respectively: whilst the picks of weft

consist of coarse figuring weft and fine ground weft in equal proportions. The respective series of warp threads are wound upon separate weavers' beams in order to allow of the different rate at which each series of threads contract, during weaving. The coarse figuring warp threads and the fine ground picks of weft are interwoven on the principle of the plain calico weave in order to produce a relatively fine texture, to constitute the ground portion of the design; whilst the finer binding warp threads and the coarse figuring weft produce a relatively coarse texture,

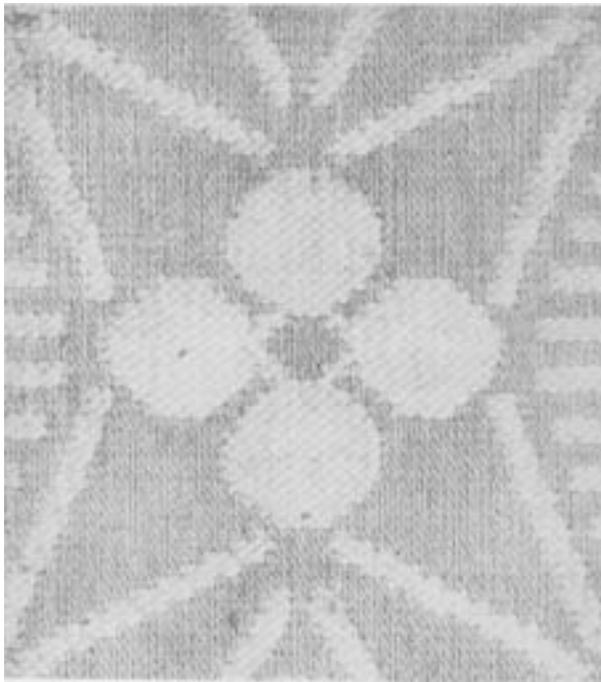


FIG. 640.

also of the plain calico weave, for the development of the figured portion of the design. At the same time, the fine binding or stitching warp threads also interweave with the fine ground picks of weft in such a manner that the two otherwise independent textures, of figure and ground, respectively, are so firmly and compactly interwoven and stitched together that they unite perfectly and become integral parts constituting one firm and compact fabric.

§ 231 The figuring warp threads are governed by a Jacquard harness and two comber-boards, operating in conjunction with a pair of healds to control the binding warp threads, and of the same type as that of a "toilet quilting" harness, described in § 219, Chapter XVI. The harness threads are also divided into two equal sections, each passing through a separate comber-board, to constitute an "odd" and an "even" series respectively, and with the mounting threads "knotted" immediately above the comber-boards. Each hook of the Jacquard machine controls two harness threads and two consecutive figuring warp threads, with each of the two complementary harness threads, that are attached to the same hook, passing through a separate comber-board. Thus, the first hook commands the first and second figuring warp threads by means of two separate mounting threads that pass through the first and second comber-board respectively; the second hook commands the third and fourth warp threads in a similar manner, and so on, as indicated in the drafting plan A, Fig. 641, which also indicates the shedding plan at B.

When "drawing-in" the warp threads, these are passed through the harness eyes and reed in the order of one figuring thread through the first mail eye of the Jacquard harness of the first comber-board; one binding thread through the first eye of the first heald; and one figuring thread through the first mail eye of the second comber-board. These three warp threads are passed together through the same dent of the reed, and the operation is repeated, with consecutive warp threads, harness eyes and dents of the reed following in their proper rotation, as indicated in the "draft," in which it will be observed that a fine binding warp thread always intercepts two complementary

figuring warp threads that are controlled by the same hook of the Jacquard machine, and which are also passed together through the same dent of the reed. With this arrangement of shedding harness and method of drafting, the figuring warp threads are raised and left down *en masse* by the Jacquard machine for the development of the design, whilst they may be raised in "odd" and "even" series, respectively, by raising the comber-boards in alternate succession to produce the fine calico ground tissue of the fabric, and at the same time operating the healds alternately to produce the figuring tissue, and also to bind both tissues firmly together in a manner to be described presently, and as indicated in the shedding plan B, Fig. 641.

In the production of these fabrics, four picks of weft, namely, two coarse and two fine picks are inserted during the operation of each pattern card, and one complete action of the Jacquard machine which is operated by a lifting cam that makes one revolution in four picks, and is constructed to raise the griffes for the two coarse figuring picks and to depress them for the two fine ground picks. At the same time one heald is raised and the other depressed whilst the first figuring pick is inserted. Hence, that pick extends entirely above depressed figuring warp threads and below raised warp threads, in accordance with the design; but it lies between the odd and even series of binding warp threads. Whilst the griffes are still raised, the healds reverse their relative positions for the insertion of the second coarse pick. The griffes then descend, the first comber-board is raised, and the healds remain in their present position, when the first fine ground pick is inserted. For the second fine ground pick the griffes remain down, whilst the first comber-board descends as the second one rises, and the healds also change their relative positions (as indicated in the shedding plan), after which this cycle of operations is again repeated for each successive pattern card, uniformly. The healds and comber-boards are operated by means of box-plate positive side tappets that raise and depress the healds for two consecutive picks in alternate succession, but in a contrary manner, thus,  $\frac{2}{2}$ , whilst the two comber-boards rise for the third and fourth (fine) picks respectively, thus  $\frac{1}{2}$ . The healds change their relative positions between the two coarse figuring picks, and again between

the two fine ground picks of weft. Hence, a coarse and a fine pick are inserted side by side in each binding warp shed, as indicated in the sectional diagram B, Fig. 642, which represents at A the method of preparing an applied design for the card cutter for a "patent satin" fabric, and also a longitudinal and a transverse section of the cloth at B and C respectively.

§ 232. A modification of the normal structure of "patent satin" fabrics, as just described, is effected by controlling the figuring warp threads separately by the Jacquard machine instead of in pairs, and also by inserting only two picks of weft for each pattern card, namely, one coarse and one fine pick as

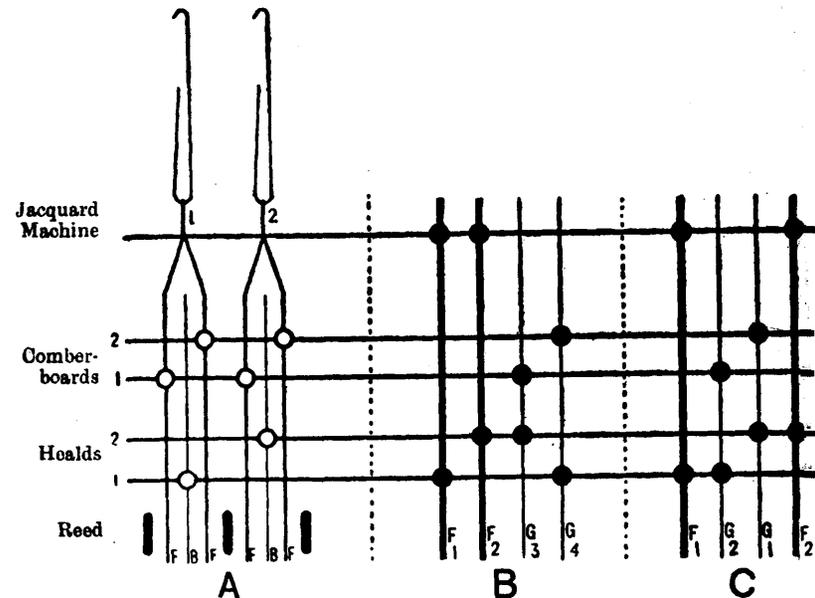


FIG. 641.—Draft and shedding plans for patent satin fabrics.

indicated in the shedding plan C, Fig. 641. But, in order to effect this object without the necessity of employing a loom adapted with two shuttle boxes at each end of the sley, and a "pick-and pick" picking motion, the picks of weft, in this modified structure, are inserted in pairs of coarse and fine picks respectively, but in the following rotation, thus: for alternate

pattern cards, first a coarse and then a fine pick is inserted; and for intermediate cards the picks are inserted in the reverse order of a fine and a coarse pick respectively, as indicated in the shedding plan C, Fig. 641. By adopting this course of inserting the picks in pairs of the same counts of weft, a loom with two shuttle boxes at one end and an alternate picking motion may be employed.

The special advantage of this modification of structure is that it produces a relatively finer margin or edging of the figures, and

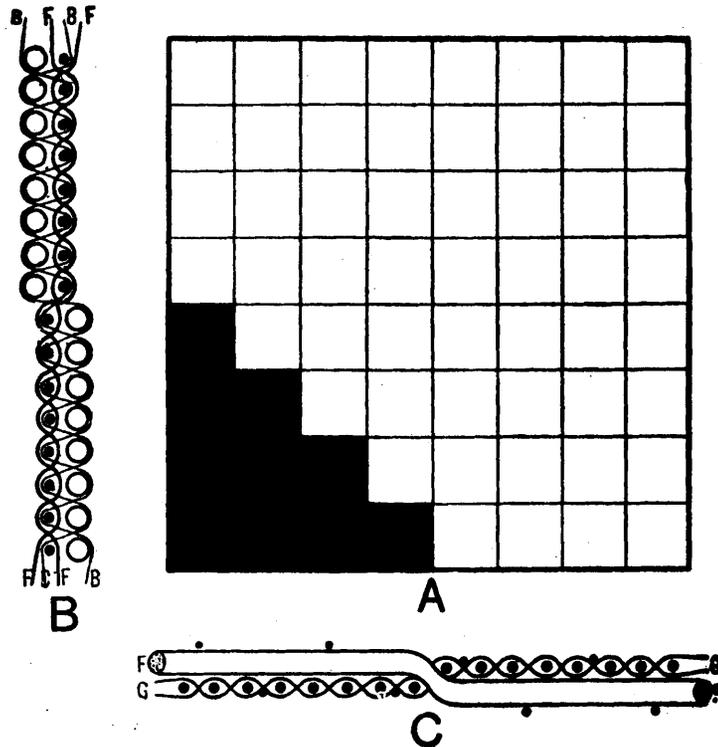


FIG. 642. -Part of applied design (A) with corresponding cloth sections (B, C) of patent satin fabric, Fig. 640.

thus imparts to the fabric a smarter and superior appearance by stepping the margin of the figure in single threads, instead of in steps of two threads of warp and weft for each figuring hook

and pattern card. This superior effect, however, is obtained only at much greater cost in requiring twice as many figuring hooks, and, therefore, four times as many pattern cards, for fabrics of similar texture, and designs of equal dimensions.

§ 233. An applied design for a "patent satin" fabric is prepared *en bloc* in the manner indicated at A, Fig. 642. Each vertical division on design paper represents one hook of the Jacquard machine, and each horizontal division corresponds to one pattern card, irrespective of the number of figuring warp threads controlled by each hook, and of the number of picks inserted for each card. The correct counts or ruling of the design paper is determined by the ratio of hooks and pattern cards representing a given unit of measurement in each direction. When painting up a design, it is usual to paint the figure and leave the ground bare, in which case the card-cutter punches holes in the pattern cards for blank squares, and leaves them blank for filled squares of design paper.

§ 234. Patent satin fabrics are produced in a wide range of qualities, of which the actual data relating to ten different examples is specified in the following table:—

DATA RELATING TO PATENT SATIN FABRICS.

Example.	Dents per In. in Reed.	Cards per In.	Counts of Warp.		Counts of Weft.	
			Figuring.	Binding.	Figuring.	Ground.
1	18	11	12's T.	26's T.	2½'s	20's
2	19	12	12's T.	28's T.	3½'s	20's
3	19	13	12's T.	28's T.	3½'s	20's
4	21½	17	14's T.	28's T.	3½'s	30's
5	21½	17	14's T.	28's T.	3½'s	40's
6	21½	18	16's T.	36's T.	4½'s	30's
7	21½	24	2/30's	2/50's	6's	14's
8	30	32	20's T.	36's T.	8's	60's
9 <sup>1</sup>	33	40	30's T.	45's T.	18's	110's
10 <sup>1</sup>	38	40	35's T.	45's T.	18's	120's

<sup>1</sup> Examples 9 and 10 are of a very superior quality of the modified structure of "patent satin" fabrics in which the figuring warp threads are each controlled by separate hooks, and also with only two picks inserted for each pattern card, as described in § 232.

## CHAPTER XVIII.

TAPESTRY FABRICS: ALSO KIDDERMINSTER OR SCOTCH  
CARPET FABRICS.

§ 235. Tapestry fabrics that are produced by power-loom weaving comprise numerous distinctive types and modifications that differ essentially, both in their structural features and in the character of texture, chiefly according to the particular use for which they are specially adapted—as, for example, window curtains or hangings, door-hangings, furniture upholsterings, wall-coverings, table-covers, and counterpanes. Many of these fabrics display considerable artistic merit both in design and colour combination, but the mechanical restrictions and commercial considerations imposed in their manufacture are obstacles both to the free development of designs and to the employment of such a considerable variety and free distribution of colours that are possible of achievement in the true specimens of tapestries that are produced by hand-loom weaving, and as exemplified in Gobelin, Beauvais, and several other famous tapestry creations that have been evolved entirely by the handicraft and artistic skill of the weaver, and in the production of which there are virtually no mechanical or artistic limitations or restrictions, but only such restraint as may be imposed by human possibilities.

It is not, however, the purpose of this treatise to describe the construction either of the true hand-loom varieties of tapestry productions, nor those of the numerous varieties of, so-called modern power-loom tapestries, of which there are many admirable examples possessing considerable technical and artistic merit. It is proposed, therefore, only to describe briefly the construction and manufacture of a certain type of power-loom tapestry fabrics, of which Figs. 643 and 644 are photographic reproductions of two typical examples.

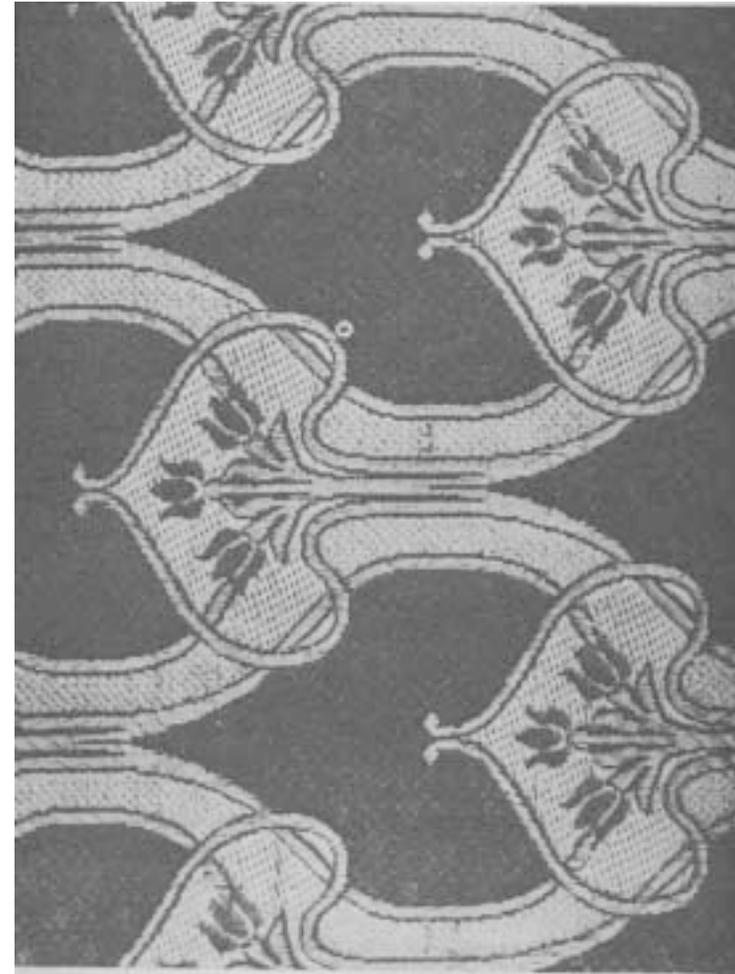


Fig. 643. Two series each of warp and weft threads.



FIG. 644.—Tapestry fabric containing two series each of warp and weft threads.

In this type of tapestry fabric there are several modifications that differ chiefly in the number of distinct series of warp and weft threads employed, and in all of which modifications the entire series of warp and weft threads interweave quite freely in any desired combination. There are no extra "binding" or "stitching" threads either in the warp or the weft, and the warp or weft threads of each series may be displayed either on the face or the back of the fabric as desired.

§ 236. The various modifications of this type of tapestries are constructed with one or more distinct series of warp threads in combination with one or more distinct series of weft threads of different colour. Or, instead of any one of the warp or weft series of threads being of the same colour, uniformly, some of the threads of either or of both series may be supplanted by threads of other colours to produce a greater variety of colour effect without in any way affecting the structure of the fabric, since the threads which supplant the others (and which are usually said to be "planted") are not introduced as "extra" or additional threads, but are substituted only in the place of others.

The special object of "planting" with different colours of threads is to display those colours locally, either to accentuate certain features of the design or else to endow it with additional embellishment, without increasing the price of the fabric or cost of production, as would be incurred if the additional colours were obtained by the employment of supplementary threads. The several colours are "disposed" in accordance with a pre-arranged scheme which, when once adopted, remains fixed, so far as "planted" warp threads are concerned, until the warp prepared according to that scheme of "planting," is finished. If, however, this method of "planting" is adopted in respect of the weft series of threads, the scheme of "colouring" may very easily be varied, simply by controlling the shuttle boxes of the loom according to the particular colours of weft required.

Tapestry fabrics of this type are usually manufactured entirely from cotton yarn for both warp and weft, as exemplified in Fig. 643 which represents a comparatively heavy texture, composed entirely of cotton yarn and intended for table-covers or counterpanes. Sometimes, however, worsted yarn is employed in the

heavier textures for one or more series of weft threads. Also, in some tapestries of lighter texture that are more suitable for window curtains or door-hangings, silk is sometimes employed for one of the series of weft threads as an additional embellishment, and also to impart to the fabric a brighter and richer appearance, as exemplified in Fig. 644.

§ 237. It is proposed, however, to describe the construction of the three following varieties of tapestry fabrics, only:—

1. With one warp and two series of weft threads, with weft only displayed on both sides.
2. With two warps and one series of weft threads, with warp only displayed on both sides.
3. With two series each of warp and weft threads.

#### 1. Tapestry Fabrics with One Warp and Two Series of Weft, with All-weft Surfaces.

In this variety of tapestry fabrics, two different colours of weft are employed. These are inserted in alternate succession or "pick-and-pick," thereby requiring a loom equipped with a special picking motion and with two shuttle boxes at each end of the sley. Only the picks of weft are displayed on both the

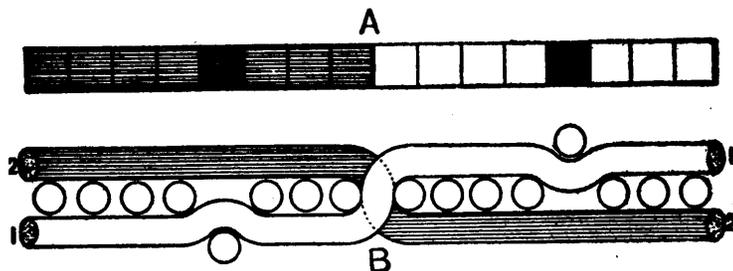


FIG. 645. —Transverse section of tapestry fabric containing one series of warp threads and two series of picks of weft.

obverse and reverse sides of the fabric which is, therefore, reversible, with the figure and ground portions developed by reversing the relative positions of the two kinds of weft, whilst the warp threads simply lie between, excepting when they are employed for binding or stitching over and under the picks of weft to prevent too long floats, as indicated in the diagram B,

Fig. 645, which represents a transverse section of the fabric as it would appear if woven according to the strip of the design as represented at A, which represents sixteen warp threads and two picks of weft, *i.e.*, one pick of each colour.

An applied design for this fabric would require to be prepared with three colours of paint, whilst the design paper would serve for a fourth colour, namely, one each to represent the respective colours of weft; and two for the binding or stitching points. Therefore, assuming red and white (paper) for the two colours of weft, and yellow and black for the face and back binding points respectively, the instructions to the card-cutter would be as follows:—

1. Red pick—cut white (paper) and yellow.
2. White pick—cut red and yellow.

Yellow dots are always *cut*, and black dots always *missed*. Thus, where a yellow dot occurs, the warp thread is raised at those points for *both* picks, to bind the weft which is, for the time being, floating on the *face* of the fabric; whereas a black dot indicates that the warp thread must be left down for *both* picks, to bind the weft at the *back* of the fabric, when in the loom. When binding the design, care should be taken to dispose the binding points for the back, as nearly as possible midway between those of the face.

#### 2. Tapestry Fabrics with Two Warps and One Series of Weft, with All-warp Surfaces.

§ 238. The structure of this variety of tapestry is virtually similar to that described in the previous section, excepting that the warp and weft of the former variety are transformed, as it were, into the threads of the other series, that is, warp threads become as weft threads, and *vice versa*. The two series of warp threads may be wound either upon the same weaver's beam, or on two separate beams. They may also be controlled either by two equal divisions of the same Jacquard machine, to govern two sections of the harness threads—one for each series of warp threads—or each section of the harness may be governed by a separate machine, according to their capacity and other con-

ditions. The two series of warp threads, if equal in number, are disposed through the harness eyes and reed with an "end-and-end" or alternate disposition. Also, as there is only one kind of weft, an ordinary single shuttle-box loom only is required.

In preparing an applied design for this variety of tapestry fabric, as for the previous variety, three colours of paint are required in addition to the design paper, which represents a fourth colour, namely, one each to represent the respective colours of warp threads; and one each for the face and back binding or stitching points respectively, as observed in the strip of design, Fig. 646 A, which represents thirty-two warp threads,

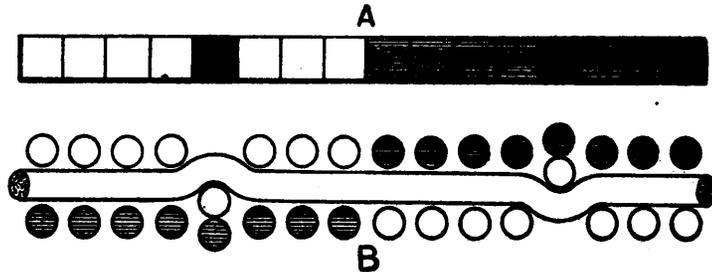


FIG. 646. —Transverse section of tapestry fabric containing two series of warp threads and one series of picks of weft.

i.e., sixteen of each colour, and one pick of weft, of which a transverse section is indicated at B. Thus, assuming the warps are indicated by red and white, with yellow and black dots for the face and back binding points respectively, the card-cutting instructions would be as follows:—

1. Red warp harness—cut red and yellow.
2. White warp harness—cut white (paper) and yellow.

Yellow dots are always *cut*, in order to raise at those points a warp thread of each colour to bind the face; whereas black dots are always *missed*, in order to leave-down a warp thread of each colour, to bind the back of the fabric when in the loom, and as indicated in the sectional diagram B.

### 3. Tapestry Fabrics with Two Series Each of Warp and Weft Threads.

§ 239. Tapestry fabrics produced from two series of warp threads and two series of weft threads are much more interesting than the varieties described previously, inasmuch as the additional series of threads introduces a fourth colour which increases very considerably the scope of a designer both in the choice of a subject for a design and also in the wider range which the additional colour affords in the development of different schemes of colouring, as exemplified in the specimens of this variety of tapestry fabrics illustrated in Figs. 643 and 644.

Both of these examples of tapestry fabrics are composed of two series, each of warp and weft threads of different colour, and they each embody precisely the same principles in their construction, although they are quite dissimilar both in texture and in weight, according to the different purposes for which they are constructed. Fig. 643 illustrates an ordinary two-warp, two-weft tapestry; whilst Fig. 644, which is of a similar structure, also exemplifies the method of "planting" threads of different colour, in one series of warp threads only, as described in § 236.

The warp threads may be arranged in the fabric, and therefore through both the shedding harness and reed of the loom, either with an end-and-end or alternate disposition—that is, with a thread from one series and then one from the other series of warp threads drawn in alternate succession through separate mail eyes of the harness, whence they pass both together through the same dent of the reed, as observed in the construction of Fig. 644. Or else, the threads from the respective warps may be taped in pairs, uniformly with a two-and-two thread disposition—that is, with two contiguous threads from one warp, and then two from the other warp, drawn in alternate pairs through separate mail eyes, whence both pairs of threads from the respective warps are passed, all four together, through the same dent of the reed, as observed in the construction of Fig. 643, of heavier texture, in which the colours of the two

series of warp threads are green and orange respectively. By thus employing twice the number of warp threads of finer counts of yarn, and passing them in pairs through the harness eyes, and with four threads through each dent of the reed, it thereby ensures a much better distribution of the warp threads, which therefore cover up the weft more effectively, and also conduces to the development of a relatively much finer texture of superior quality than if only one-half that number of warp threads of coarser counts of yarn were passed separately through the harness eyes, and with only two threads through each dent of a reed of corresponding counts.

Both series of warp threads may optionally be wound together, either with an end-and-end or a two-and-two disposition, on the same weavers' beam; or else they may each be wound upon separate beams. But both for technical and practical considerations, however, the former course is preferable, inasmuch as both the degree of tension and the rate of contraction during weaving should be exactly the same for both series of warp threads. Also, the weaver will have the weighting of only one beam to regulate, thereby avoiding the risk of obtaining unequal tension upon the two series of warp threads, as would be liable to occur if they were each wound upon separate warp beams. On the other hand, however, if two separate warp beams are employed, each carrying only one-half the aggregate number of threads, the length of the respective warps may then be doubled, thereby reducing by one-half the amount of time and labour spent in gaiting and looming, and also incurring less waste of material which those operations involve.

§ 240. The warp threads of both series are controlled entirely by a Jacquard harness, which may be governed, optionally, either by means of single-acting or else double-acting Jacquard machines of ordinary construction, without any special mechanism. Also the Jacquard harness is constructed preferably in two separate and distinct sections—one for each of the two series of warp threads. The two sections of the harness pass through the front and rear portions of the same comber-board respectively, and are governed either by separate sections of one machine only, or else by two separate machines, according to

the planning of the harness tie-up and the capacity of the Jacquard machines. If only one machine is employed, this is divided equally into two similar sections, virtually to constitute two smaller machines placed side by side, and mounted preferably with the card cylinder (or cylinders) on one side (or both sides) of the loom, with the object of keeping both sections of the harness quite separated for their entire length. If, however, a separate single-acting machine is employed for each section of the harness, both sections may be kept quite separate by mounting the two machines *back to back*, and operating them simultaneously, as if they constituted two equal sections of one Jacquard machine only.

As stated previously, these two examples of tapestries each contain two series of weft threads of different colour. These are inserted in the fabrics with a pick-and-pick or alternate disposition, thereby requiring each end of the loom sley to be constructed with two shuttle boxes controlled by a shuttle box or checking motion, and also a loom provided with a pick-at-will picking motion adapted for picking twice in succession from each side of the loom; but in all other respects the loom employed may be of the usual type of construction. Also, for practical considerations only, it is expedient to govern the operation of both the shuttle box and picking motions by means of spare hooks in the Jacquard machine to ensure the operation of those motions, and also of those with the pattern cards, in unison with each other. Otherwise, if these several parts are each controlled independently, they are liable to get out of harmony with each other, and thus create difficulties.

§ 241. *Method of Preparing Tapestry Designs.*—When preparing an applied design upon squared or point paper, to be read off by the card-cutter, for tapestry fabrics of the type under present consideration, it is necessary to indicate the respective colours of warp and weft threads by means of a corresponding number of distinctive colours of paint, which may be either of the same colour as the respective series of threads which they represent, or of different colour. In actual practice, however, the design paper itself usually represents one series of weft threads, and thus saves the time and trouble of painting it on the design.

The counts or ruling of design or point paper required must be in accordance with the index of the Jacquard machine employed, and also with the relative number of warp threads and picks of weft per inch in respect of only *one* series each of those threads, and not in respect of the aggregate number of threads contained in one inch.

An applied design for each of the examples of tapestry fabrics represented in Figs. 643 and 644, is planned on such number of vertical and horizontal divisions of the design paper as corresponds with the nominal number of warp and weft threads—but in respect of only *one* of each series of those threads—constituting one complete repeat of the design, which must repeat either on the full tie-up or any measure of that. The design may be developed in any suitable colours of paint to represent the respective colours of warp and weft threads which may be interlaced and combined in any conceivable practical manner to produce the desired effects in cloth. Binding weaves of any description may be employed to prevent too long floats of threads, but for technical reasons it is not advisable to insert single binding points of one series of warp threads on a warp surface composed of warp threads of the other series, nor those of one series of weft threads on a weft surface composed of the other series; for, although such a course may be practicable, it would impart to those threads an abnormal degree of tensile strain, and also develop structural defects in the woven fabric. For these reasons, therefore, it is more expedient to bind any one series of threads with those of either of the transverse series of threads. Also, some designers prefer to separate the figure and ground with an outline consisting of one or two threads of the darkest colour, to impart to the margin of the figure a sharper and clearer definition.

§ 242. *Instructions for Card Cutting.*—From the foregoing description it will be manifest that each vertical division on the design paper represents two separate and distinct warp threads, that is, one thread of each series; and also, in like manner, that each horizontal division represents two picks of weft—one of each series, as observed in the diagram B, Fig. 647, which represents a transverse section of cloth as it would appear if

woven according to the strip of the design shown at A. Hence it is necessary for the card-cutter to read off and cut the design four times over—once for each pick of each colour of weft for each section of the Jacquard harness, whether these are controlled by one machine only, or by two separate machines.

Therefore, assuming a design is developed with colours of paint corresponding with those of the respective colours of warp and weft threads composing the specimen of coarse tapestry, Fig. 643, the instructions for card cutting will be as follows:—

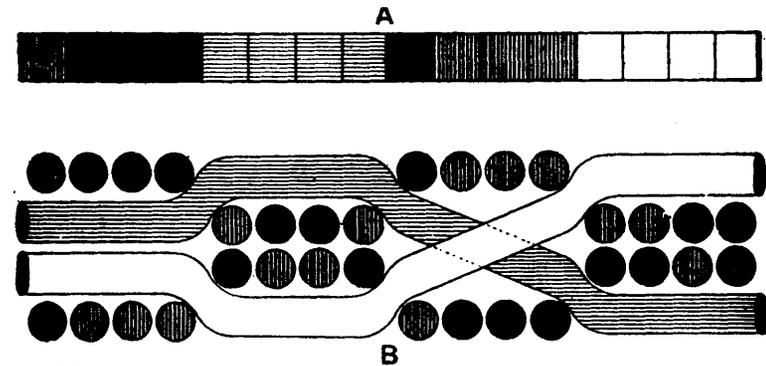


Fig. 647. —Sectional diagram showing construction of a tapestry fabric containing two series each of warp and weft threads as Figs. 643 and 644.

1. *For Section of Harness Controlling Green Warp Threads.*
  - (A) Black weft . . . . . Cut green and pale blue.
  - (B) Pale blue weft . . . . . " " " black.
2. *For Section of Harness Controlling Orange Warp Threads.*
  - (A) Black weft . . . . . Cut orange and pale blue.
  - (B) Pale blue weft . . . . . " " " black.

It will be observed that when cutting for a specified section of harness and colour of weft, *the colour of warp threads* controlled by that particular section, and also *the other colour of weft*, only, are cut, whereby the respective series of warp and weft threads are disposed in the fabric in the manner indicated in the sectional diagram B, Fig. 647. A longitudinal section of

the fabric would also reveal an exactly similar structure, which is essentially of a compound character of texture in which the respective series of warp and weft threads are disposed each in such a manner that whichever of the two series either of warp or weft threads is displayed on one side of the fabric, the complementary threads of the same series are displayed on the reverse side in the corresponding part of the fabric; or else both groups of the same series of threads are disposed midway between the two outer series of threads simultaneously, thereby producing a reversible fabric, but one in which the scheme of colour distribution is different on each side, as indicated in the diagram B, Fig. 647.

§ 243. The counts of design paper required for the applied designs of the accompanying specimens of tapestries, and other data relating to their construction, are specified as follows:—

Fig. 643: *Tapestry Fabric of Coarse Texture*; composed of 3/48's green and orange mercerised cotton warp threads taped in pairs uniformly, and containing 64 actual (or 32 nominal) threads of each colour per inch in the cloth, with 30 dents per inch in the reed, and 4 separate warp threads (two of each colour) in each dent; also of 6's black and pale blue soft-spun cotton weft, with 32 picks of each colour of weft per inch.

The shedding harness, shuttle boxes, and picking mechanism are all controlled by a 400's double-acting one-cylinder Jacquard machine with a straight tie-up repeating on 160 hooks for each section of the harness, which are governed respectively by separate sections of the machine. Therefore, since the nominal number of threads per inch is the same for both warp and weft, the correct counts of design paper to employ for this example is that ruled with 8 × 8 divisions in each bar, because a 400's Jacquard machine contains eight rows of hooks and lances or needles.

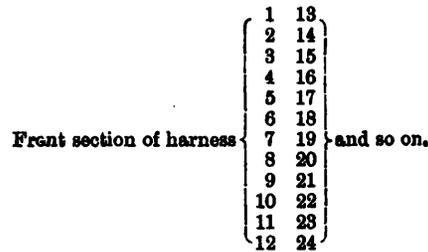
Fig. 644: *Tapestry Fabric of Fine Texture*; composed of 2/60's cotton yarn for both series of warp threads, one of which is dyed blue uniformly, whilst the other is composed of both maroon and light brown threads planted in stripes of different width, and containing 72 threads of each warp per inch in the cloth, with 68 dents per inch in the reed, and two separate

warp threads (one from each warp) in each dent; also of five-dram light gold floss silk weft (equivalent to a little finer than 60's cotton weft), and 16's black soft-spun cotton weft, with 60 picks of each kind of weft per inch.

The shedding harness is tied-up with a straight tie-up repeating on 300 hooks, and may therefore be controlled either by one 600's Jacquard machine, or else two 300's machines. In either case the counts of design paper required for this example is in the proportion of 72 : 60, so that with 12 hooks in a row the correct counts would be 12 × 10 vertical and horizontal divisions respectively.

If, instead of employing one 600's Jacquard machine, there are two 300's machines mounted back to back, it is important to observe that when cutting the pattern cards for the *rear machine* the design will require to be inverted, and read off upside down, because the hooks on the 26 side (on the *right* when facing the card cylinder) of that machine control the harness threads in the rear section, corresponding to those in the front section that are controlled by the hooks on the 25 side (on the *left* of the cylinder) of the front machine. Also, it will be necessary, when drawing in the warp threads through the harness mail eyes, to *reverse* the direction of those governed by the *rear section*, because the two complementary warp threads of different colour that pass through the same dent of the reed are governed respectively by two hooks that are situated in corresponding rows of both Jacquard machines. This will be understood by reference to the following plan, which indicates the order in which the harness threads pass through the holes in the front and of the rear sections comber-board, thus:—

	12	24	
	11	23	
	10	22	
	9	21	
	8	20	
	7	19	
Rear section of harness	6	18	} and so on.
	5	17	
	4	16	
	3	15	
	2	14	
	1	13	



**Kidderminster or Scotch Carpet Fabrics.**

§ 244. "Kidderminster" and "Scotch carpet" are optional terms that are variously employed to designate a distinctive

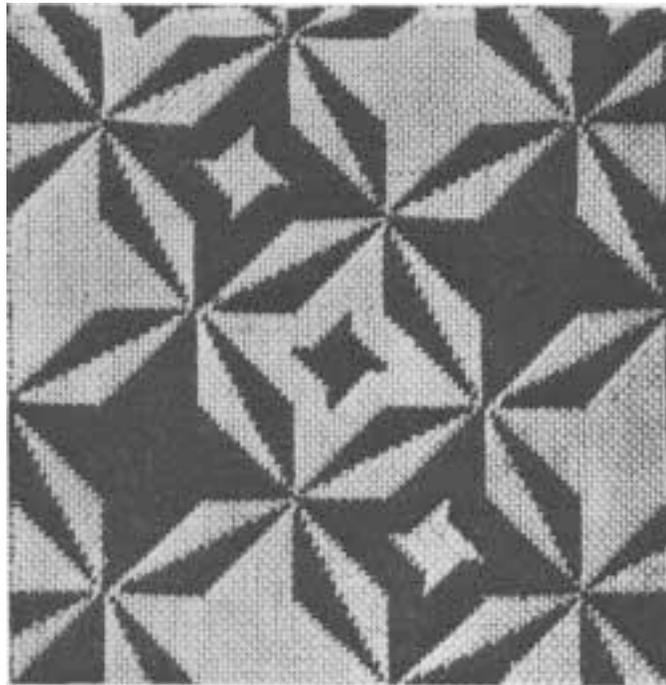


FIG. 648. —Scotch or Kidderminster carpet fabric.

type of compound fabric structure embodied in a wide range of textures varying from heavy and coarse, to light and fine grades,

chiefly according to the character of the textile material from which they are produced and also the purpose which they are intended to serve, as, for example, carpets, rugs, curtains, hangings, coverlets and mats, counterpanes and such-like articles for domestic use. An example of this type of fabric, which is essentially a compound structure evolved from two series each of both warp and weft threads, is illustrated in Fig. 648, and contains 64 warp threads (taped in pairs) of each series of threads, i.e.,  $64 \times 2 = 128$  warp threads and 32 picks of weft of each series, i.e.,  $32 \times 2 = 64$  picks per inch of  $3/48$ 's cotton yarn for both warp and weft, which produces a very substantial fabric of medium texture and one, therefore, suitable for use as hangings and antimacassars.

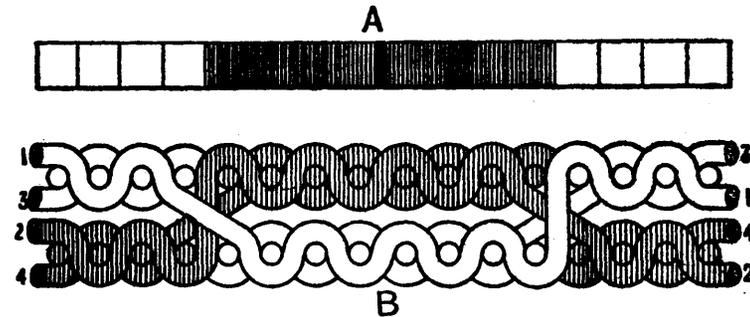


FIG. 649. —Sectional diagram showing construction of Kidderminster or Scotch carpet, Fig. 648..

Fabrics of this type embody the true double cloth or two-ply principle of construction, as they comprise two separate and distinct tissues of different colour and of similar or dissimilar texture, usually of the plain calico or other simple weave. In the scheme of decoration, however, the two tissues interchange their relative positions and thus become united only at the margin of the figure and ground, where they penetrate each other and thus constitute a true reversible fabric as illustrated in Fig. 649 B, which represents a sectional diagram of this fabric, whether viewed transversely or lengthwise, as it would be presented if woven according to the design A, each square of which represents two warp threads, i.e., one of each colour, and two picks of weft, i.e., one of each colour also.

The two series of threads of the same colour are interwoven so as to develop the figure and ground in monotones of the respective colours employed.

§ 245. Both series of warp threads are, preferably, wound together on the same weaver's beam, to ensure a uniform degree of tension on each series, and they are passed through the harness eyes and dents of the reed with an "end-and-end" or

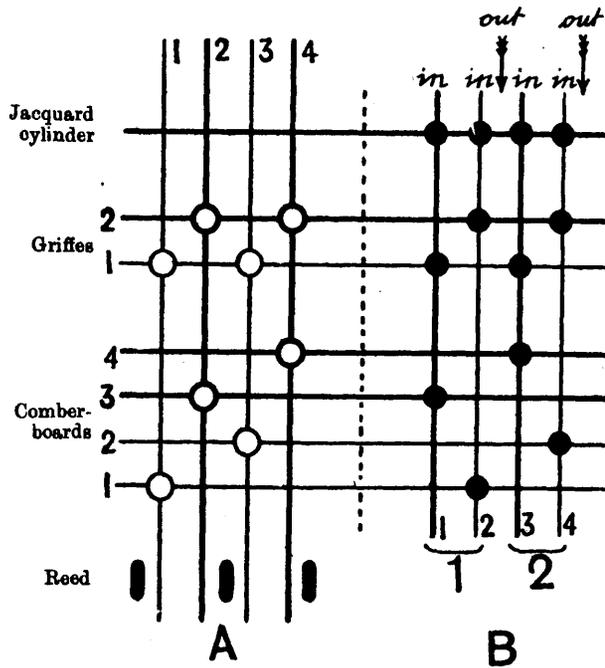


FIG. 650.—Draft (A) and shedding plan (B) for Scotch or Kidderminster carpet.

alternate disposition, as indicated in the drafting chart A, Fig. 650, which also indicates the shedding plan at B, as these would be adapted to the special type of Jacquard machine and shedding harness which are employed in the manufacture of these fabrics. This type of machine and harness, as represented in Fig. 651, is designed to control the two series of warp threads from two independent sources, namely, by the Jacquard machine H, which controls the warp threads *en masse* according to the

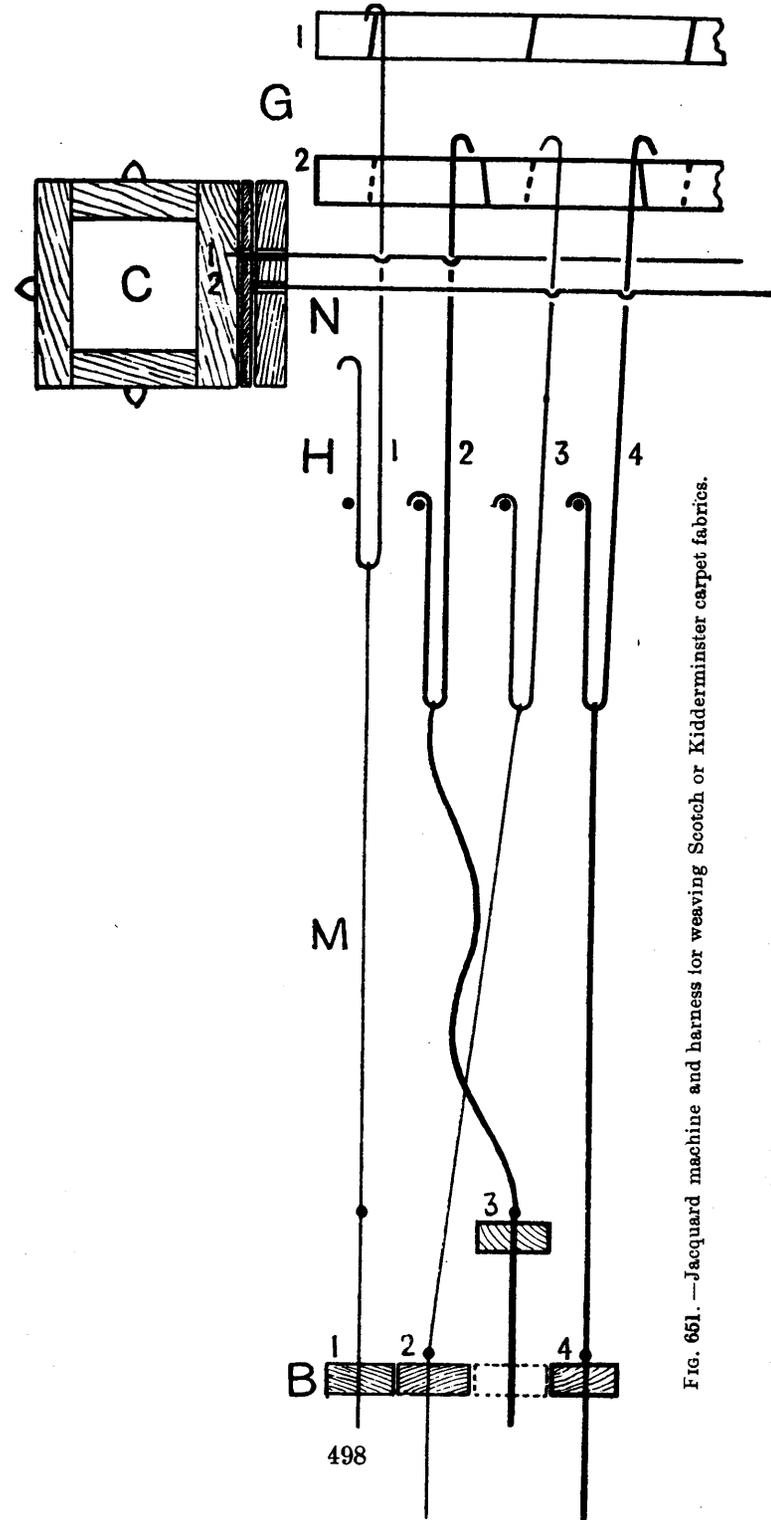


FIG. 651.—Jacquard machine and harness for weaving Scotch or Kidderminster carpet fabrics.

design ; and also by means of comber-boards B, by which the warp threads are raised in a prescribed order according to the method of interweaving the warp and weft for the creation of texture, as distinct from the scheme of decoration.

The special advantages of this type of machine and harness are that they simplify the preparation of designs which are developed *en bloc*, i.e., in solid masses of figure and ground ; they also facilitate the operation of card-cutting and effect considerable economy in pattern cards, each of which serves for two consecutive picks, one of each colour of weft.

§ 246. The Jacquard machine indicated is constructed with two distinct sets of hooks, H 1-4, of which only the first four rows from the card cylinder are represented in the diagram. The alternate rows of hooks, 1, 3, 5, etc., constitute one set which faces the cylinder C, with their beaks or nebs normally *over* their respective griffe blades G 1, of which there are also two sets : whilst the hooks in the intermediate rows, 2, 4, 6, etc., constitute the second set, with their nebs pointing *away* from the cylinder, and also normally *away* from their respective griffe blades G 2, as indicated by the hook H 2. Both sets of hooks, however, are controlled by only one set of needles N, each of which commands two hooks in opposite rows that stand back to back, i.e., with their nebs pointing away from each other, as for example, H 1-2, and H 3-4 respectively.

Each set of hooks controls a separate section of the harness threads M, one for each series of warp threads ; whilst each section of harness threads is again subdivided into an "odd" and an "even" series that pass through two separate comber-boards B, immediately above which the mounting threads M are knotted, whereby the corresponding division of warp threads of either series may be raised collectively to form a warp shed with that series, for the insertion of a pick of weft of the corresponding colour of yarn. Thus the mounting threads governed by hooks contained in rows H 1, 3, 5, etc., which *face* the cylinder, constitute the front section of the harness, of which the odd and even series of threads pass through comber-boards B 1-2 respectively ; whilst the odd and even series of harness threads, which constitute the rear section and is governed by hooks contained in rows H 2, 4, 6, etc.

pass through comber-boards B 3-4 respectively, as indicated in the diagram, Fig. 651, and also in the drafting chart A, Fig. 650.

§ 247. The card cylinder C, griffe frames G 1-2, and comber-boards B 1-4 are each operated independently and as indicated in the shedding plan B, Fig. 650. Thus, the cylinder is governed by a cam that makes one revolution for two picks and is designed to hold the cylinder against the needles for both picks. The cylinder then changes the card quickly and returns before the warp shed is formed for the first pick of the next following pattern card, as indicated by the small arrows in the shedding plan. The griffe frames containing the two sets of griffes G 1-2 are operated by a double crank fixed on one end of the picking tappet-shaft of the loom, whereby the respective griffe frames are raised in alternate succession for the two consecutive picks of weft inserted for each pattern card : whilst the four comber-boards B 1-4 are operated by side tappets and are each raised in a prescribed order, as indicated in the shedding plan, once during the operation of two pattern cards, corresponding to four picks of weft, which represent one complete cycle of movements by the card cylinder C, griffes G 1-2, and the comber-boards B 1-4 namely :—

Card No. 1	{ 1st pick—(RED) <sup>1</sup> { 2nd pick—(GREEN) <sup>1</sup>	{ Card cylinder IN : also { Griffe G 1 (GREEN) and { Comber-board B 3 (RED) RAISED. { Cylinder moves outward as { Griffe G 2 (RED) and { Comber-board B 1 (GREEN) are { RAISED.

<sup>1</sup>The two colours red and green are represented in Figs. 650 and 651 by thick and thin lines respectively.

It should be observed that each pair of hooks that are controlled by the same needle command two contiguous warp threads, one of each colour, that are contained in the same dent of the reed, and that only one of each pair of hooks and, therefore, warp threads of one series and colour only may be raised, *by the griffes*, at the same time and for the same pick of weft. Thus, for the first pick of each card, which is a red pick, only green warp threads are raised or left down *en masse* by the Jacquard hooks for the development of the pattern, whilst at the same time the odd and even series of red warp threads are raised for the odd and even pattern cards respectively, by the comber-boards B 3, 4, for the creation of the red tissue of cloth. Likewise, for the second pick of each card, which is a green pick, only red warp threads are raised or left down *en masse* for the pattern, and, at the same time, odd and even-numbered green warp threads are raised by the comber-board B 1, 2 for the odd and even pattern cards respectively, and as indicated in the shedding plan B, Fig. 650, for the creation of the green tissue of the fabric.

## CHAPTER XIX.

## THE DECORATIVE VALUE OF ARTIFICIAL SILK IN TEXTILE FABRICS.

§ 248. The conception of artificial silk and its production on a commercial scale—combined with its rapid development and progress (especially during the past decade) as a valuable fibre of great utility in the textile industry—surely rank amongst the greatest romances of discovery in the field of chemistry and, at the same time, constitute one of the finest achievements of industrial enterprise in the great textile industry in which artificial silk is destined to play an increasingly important and conspicuous part.

Nevertheless, though artificial silk is now accepted as one of the principal and important of the recognized textile fibres of commerce, it is doubtful whether it could stand alone and entirely on its own intrinsic merits as a fibre of commercial utility, excepting on such a very small scale that it would be negligible so far as the textile industry is concerned. This is due chiefly to the chemical composition, physical properties, and mechanical structure of artificial silk; and paradoxical as the statement may appear, yet it is by virtue of these inherent properties and characteristics that it has established itself in favour with every section of that industry. These characteristics comprise a high degree of lustre, richness, and purity of colour, as well as a superior delicacy and refinement of filament, in all of which respects artificial silk, more than any other textile material, resembles natural silk.

Excepting in the production of knitted and lace goods, as well as a small variety of woven luxury fabrics of the most delicate texture, artificial silk is of such a character that it may be employed successfully only when in combination either with a natural staple fibre, as cotton, wool or silk, or else with threads produced from such textile fibres, in order to constitute a foundation texture of sufficient stability, according to

the specific use for which the fabrics are intended. It should be realized, therefore, that the special function of artificial silk, so far as the weaving industry is concerned, is that of embellishing and enriching woven fabrics of any description to which it may be applicable, and in which decorative treatment may be employed effectively. In this direction, more than any other, lie the great value and infinite possibilities afforded by the use of artificial silk, which, in its present form, at least, can never reasonably hope to supersede, still less supplant, the stronger and more substantial textile fibres of nature.

§ 249. The attributes of artificial silk, however, are not shared by any other textile material, excepting natural silk; and these attributes are of such a character as to give it predominance over all others in the decoration of every variety of fabric, whether knitted or woven, in which elegance, refinement, and artistic embellishment are desirable features. Thus, artificial silk constitutes not a substitute, nor even a rival, but a powerful and useful ally, to its kindred of natural growth; not to supplant but supplement these, by providing new avenues of commercial and industrial enterprise, as well as affording much greater scope both for the artistic and inventive abilities of textile designers, in the conception of new ideas and schemes in the decorative treatment of textile fabrics of almost every type and variety, produced from any of the recognized staple fibres of commerce, whether cotton, wool, silk or any combination of these. For these reasons, no manufacturer engaged in the production of any class of fabric that requires decorative treatment can afford to neglect the immense possibilities which the use of that wonderful material provides, in the direction indicated.

Of the four great staple industries of cotton, woollen and worsted, linen, and silk, the cotton section of the trade affords much greater scope than the other sections for the most effective display of artificial silk. Not only does cotton represent the largest section as regards the volume of trade, but cotton fabrics are produced in a much greater variety of textures in which artificial silk may be introduced as a decorative feature, with the most pleasing artistic effect.

With the exception of the lower grades of cotton fabrics, and others included under the generic term of the "plain trade," comprising calicoes, twills, sateens, and similar classes of fabrics that are chiefly employed for domestic purposes, there are comparatively few varieties of cotton textures that do not display some element of decoration, the artistic effect of which would not be considerably enhanced by the aid of artificial silk. This applies equally to garment fabrics for men's underwear, as exemplified in shirting fabrics, pyjama suitings, and dressing-gowns, which are frequently embellished with a gorgeous scheme of rich, vivid, and brilliant colouring developed by the use of artificial silk.

§ 250. Excepting in the manufacture of some luxury fabrics and other varieties in which durability is sacrificed for artistic effect, artificial silk, as already stated, may be employed with success, in the weaving trade, only when in combination or reinforced with one or more of the more substantial natural fibres as, for example, an all-cotton warp picked with weft of all-artificial silk, or *vice versa*; a warp of artificial silk picked with worsted weft; by combining warp threads of artificial silk with those of any other textile threads either alternately, two and two, or in any other sequence or proportion, either in the warp series only, to produce warp stripes; in the weft series only, to produce "cross-over" or weft stripes; or in both series of threads, to produce "checks" of various kinds. Again, artificial silk threads either of the same colour or of any number of different colours may be introduced as substitutes in the place of the ordinary warp or weft or warp and weft threads, or as extra threads either of warp or weft or warp and weft, in order to produce either simple or variegated stripes in the direction of the warp only, or of the weft only, or in both directions in the same fabric to produce check patterns. Also, the warp and weft may be interwoven in order to develop any desired textural or woven effect, from the simplest and most elementary weaves, such as may be produced by tappets, to those of a more complex character. The fabrics may also be produced either as simple brocades or as compound structures and decorated with simple figuring

by the aid either of tappets or dobbies, or with the most elaborate jacquard designs.

Further, in the more elaborate and complex types of fabrics as, for example, tapestries, upholsterings and such like, both variety of texture and colouring afford unlimited possibilities and opportunity to a resourceful textile designer, in æsthetic imagination, art and ingenuity, and the conception of original ideas. And although tapestry fabrics are sometimes made entirely of artificial silk, yet more pleasing artistic effects and more durable fabrics are evolved by a suitable admixture of artificial silk either with cotton, wool, or both of these materials, in which case, the more lustrous artificial fibre is thereby displayed to greater effect and advantage by its juxtaposition and contrast with the duller and more sombre threads of cotton and worsted, and thus reveals the features of the design and colouring with much more pronounced effect. In fact, these and other combinations innumerable, of artificial silk with the natural fibres, will suggest themselves to a competent designer, with most satisfactory results; but it should be remembered that the true function of artificial silk, so far as woven fabrics are concerned and in most cases, is to furnish material that will give additional embellishment and so enhance the general decorative effect, whilst the other qualities of the fabrics, such as softness, suppleness, weight, warmth and strength must be provided by the more substantial and durable textile fibres of nature.

§ 251. As a general rule, the decorative features of a woven fabric may be developed with greater success with the warp system than with the weft system of threads, for the practical reason that, during the operation of weaving, the warp threads are under more complete control and tension than are the threads of weft. Consequently, the warp series of threads lie much straighter and firmer in the fabric and thus produce a more perfectly flat and even surface of the figure than can be obtained by employing the weft for figuring purposes. Moreover, not only does the tension of the warp threads tend to effect a better distribution of the fine filaments composing those threads, and thus ensure a more complete "covering"

of the weft, but, by keeping those threads straight, it also increases their power of reflection, which enhances their lustre. Still, great care should be taken not to subject the warp threads of artificial silk to a degree of tension, in the loom, greater than is absolutely necessary to ensure good weaving; as any tension in excess of that requirement will only create frictional chafing and abrasion of the fine and delicate filaments of those threads, resulting in frequent breakages of warp threads, and so causing imperfections in the cloth produced, besides showing "bright" threads. Further, the employment of warp, instead of weft (whenever the choice of these alternatives is quite optional and solely for decorative effect, and as distinct from technical and practical considerations), is a more economical policy from the manufacturers' point of view, besides involving a smaller percentage of waste material.

#### Illustrations of Fifteen Typical Examples of Fabrics.

§ 252. With a view to indicating in what directions artificial silk may be introduced, in combination with other materials, as a decorative element in the construction of woven fabrics of various types and textures, the following fifteen illustrations, reproduced from actual examples of fabrics, are selected as representative of their particular class, to serve merely as general suggestions. Only the briefest descriptions are given of the salient features of each example, with a few brief particulars relating to their construction and manufacture, the details of which will, in many cases, suggest themselves to readers, although it is, of course, quite impossible to convey, through the medium of black and white prints, an adequate impression either of the textural features and characteristics, or the colour scheme of a fabric. The first of these examples, as illustrated in Fig. 652, is a blouse and dress material, or a shirting, with a very neat warp stripe that demonstrates one of the simplest and most effective applications of artificial silk to a woven fabric consisting of an all-cotton warp of pink and white (bleached) threads, picked with an all-artificial silk, white weft. The striped effect is obtained simply by disposing two pink threads and two white threads alternately and

“taped” in pairs of each colour, respectively, that is, either passed both together in pairs through the same harness eye, to work as a double warp thread, or, preferably with each warp thread, passed singly through separate harness eyes, to

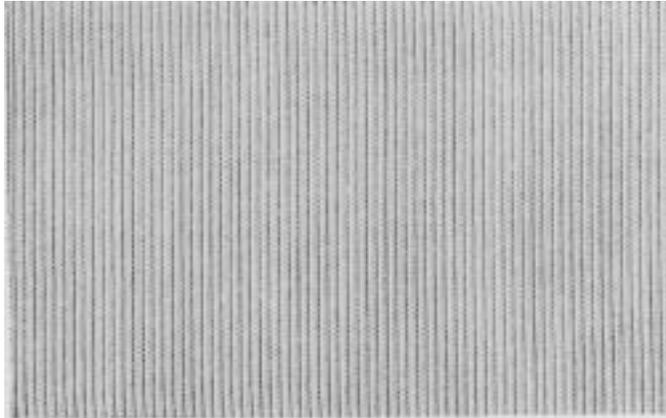


FIG. 652.

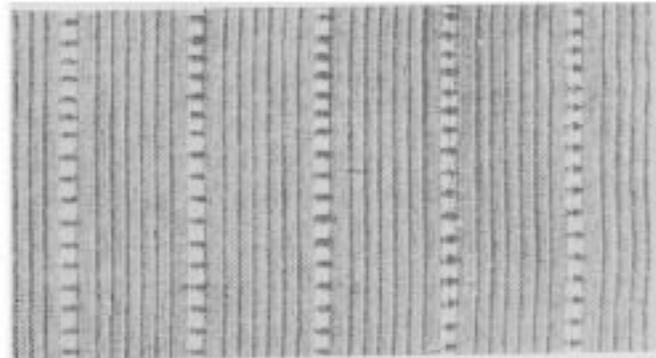


FIG. 653

prevent any tendency of the two “taped” threads twisting or turning, instead of running together side by side, quite

parallel and perfectly flat or “spread.” The structure of this fabric is the simple plain weave, with double (“taped”) warp threads and with all the pink threads and then all the white threads raised in alternate succession, for consecutive picks of weft.

§ 253. An example of a cotton blouse and dress material of light cotton texture, of the plain calico weave, and in which there are developed neat and effective ribbed warp-stripes of artificial silk, is illustrated in Fig. 653. In this example, the artificial silk is introduced as extra figuring warp threads, as exemplified in “Alhambra,” “dhooty” and similar types of fabrics. Thus, the stripes are developed by disposing six white threads of artificial silk alternately with those of the ground warp, to produce stripes at the required intervals apart, and by floating the artificial silk threads over seven picks of weft and then underneath one pick, which latter picks serve as “cutting” picks to form the furrows between successive ribs of floating artificial silk. At the same time, whilst the six threads of artificial silk are depressed, for the “cutting” picks, the seven ground warp threads, in each stripe, are raised together, over those “cutting” picks, although they interweave in the plain calico order with the remaining picks that are covered by the artificial silk threads.

The six narrow stripes, between the wider ribbed stripes of artificial silk, are developed by “taping” six pairs of bleached cotton warp threads and weaving each pair together as a double thread, and in the plain calico order, with an all-cotton bleached weft. The ribbed silk stripes require only three healds, in addition to the four for the plain calico ground texture.

§ 254. The example illustrated in Fig. 654 is a bleached cotton blouse and dress fabric of light voile texture, woven with an all-cotton weft, and figured with a neat design of small square spots developed by floating extra figuring warp threads of bleached artificial silk yarn, on repp stripes that alternate with voile stripes of corresponding width. As in the previous example, illustrated in Fig. 653, the extra warp threads of artificial silk are arranged alternately with the cotton ground warp threads, on the dhooty principle of figuring. In the

present example, there are eight figuring threads in each stripe, and the spots are formed by floating the eight threads bodily over eleven picks of weft which, at the same time, interweave in the plain calico order with the ground warp threads in the same stripes. The repp effect, between the figure-spots, is

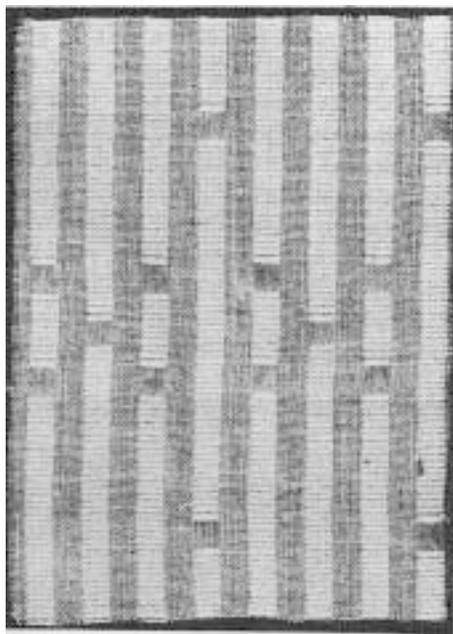


FIG. 654.

developed by raising the eight figuring threads bodily, over alternate picks, and leaving them down for the intermediate picks of weft, with the intervening ground weaving in exactly the reverse order, *i.e.*, they are raised bodily when the figuring threads are down, and *vice-versâ*. The design therefore, requires ten staves of healds, *viz.*: seven for the plain calico and repp weaves (because four alternate ground warp threads, in each of the three different figured stripes, must be drafted through three different shafts of healds—one heald for each of those stripes) and three healds to govern the figuring

threads of artificial silk, and seven for the plain calico and repp weaves. Three of these seven healds are necessary to govern four alternate ground threads in the figured stripes, in order to develop the repp weave in the manner described.

§ 255. An example of very neat and simple dobby stripe figuring developed with extra warp threads of artificial silk, in combination with a calico foundation texture of cotton warp and weft, is illustrated in Fig. 655. In this example, each stripe contains sixteen figuring threads of bleached artificial silk arranged alternately with bleached cotton ground warp threads to develop the figured stripes on the dhooty principle, whilst the intermediate narrow stripes, forming a neat chain effect, are developed by alternating four helio, with four white, cotton warp threads, and weaving them over two and under two picks, alternately, and in counter-change. Fourteen healds are required to weave this cloth, *viz.*: four plain healds, two for the chain stripes, and eight for the figured stripes.

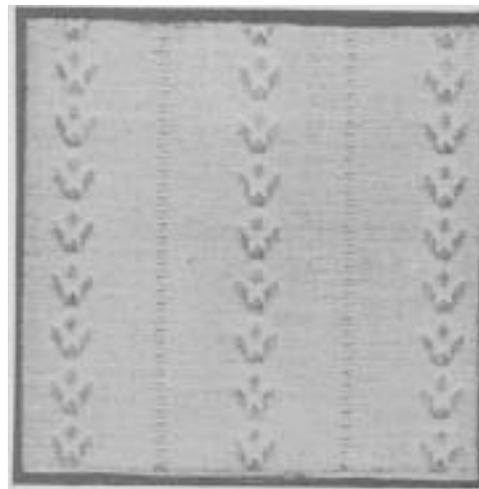


FIG. 655.

§ 256. The example shown in Fig. 656 illustrates a figured check pattern developed by substituting threads of artificial silk, both as warp stripes and weft stripes, in combination with warp and weft threads of two-fold cotton yarn. In this

example, the artificial silk provides the figuring or decorative feature of the fabric, in which the cotton warp and weft are interwoven so as to develop a "mock leno," openwork or canvas-weave effect. The figured warp stripes each contain twenty threads of bleached artificial silk, taped in ten pairs and, therefore, equivalent to ten double warp threads, in order to effect a better distribution, or spreading, of those threads than would be obtained by employing only ten single threads of coarser counts (or deniers) of artificial silk. For the same reason, the twill weft stripes are produced by inserting twenty-two picks of bleached artificial silk weft, with two single picks placed together, in each warp shed, thereby requiring a "catch-cord" at one side of the loom.

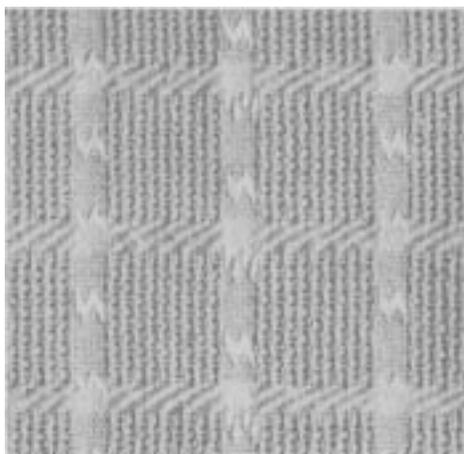


FIG. 656.

§ 257. A more elaborate warp stripe figured effect is illustrated in Fig. 657, which shows an example of Jacquard brocade figuring, on a broken repp ground, and developed with extra warp threads of artificial silk in combination with a foundation texture of light cotton muslin, or voile.

§ 258. Fig. 658 illustrates an example of Jacquard brocade

figuring on a light texture of voile or muslin, and embellished with an "all-over" design, developed with float figuring of all-artificial silk weft in combination with an all-cotton warp of fine counts of yarn, on a ground texture of the plain calico weave, broken with a neat diamond pattern.



FIG. 657.

In the development of brocade or float figuring with artificial silk, care should be taken, when preparing an applied design for the card-cutter, to ensure a thorough degree of interlacement of the threads, and also to avoid floats of inordinate length, both individually and collectively. This precaution is especially necessary for fabrics that are subject to wear or friction, as, owing to the multi-filament structure of artificial silk threads, the fine filaments are easily caught and broken.

§ 259. A style of fabric unlike any of the previous examples described in this chapter is illustrated in Fig. 659, and is an example of a neat warp ondulé effect in conjunction with a "net leno" effect developed on a light texture, of the plain

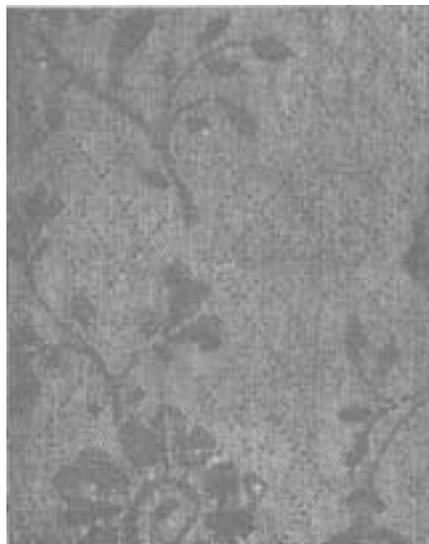


FIG. 658.

calico weave, produced from an all-cotton warp in combination with an all-artificial silk weft. It is of interest to note that this example was woven in the loom illustrated in Fig. 534, and is one of the usual type of ordinary plain Lancashire calico looms, furnished with Fielden's ondulé motion, as described in §§ 167 and 168, Chapter XI.

When artificial silk is employed as "doup" threads, either in simple "marquisette" gauze or leno fabrics, or in the development of any style of "net" or "chain" leno stripes or figuring, they should not be sized, for the obvious reason that sizing would deprive them of the suppleness and flexibility which is so essential to permit of their crossing and re-crossing with their respective "standard" warp threads, without incurring

the risk of frequent breakages both of "doup" and "standard" warp threads, during weaving. For net leno "figuring" with "doup" threads of artificial silk, a superior effect is obtained by employing two or more doup threads together, and of folded, *i.e.* doubled, threads, produced by folding and twisting together

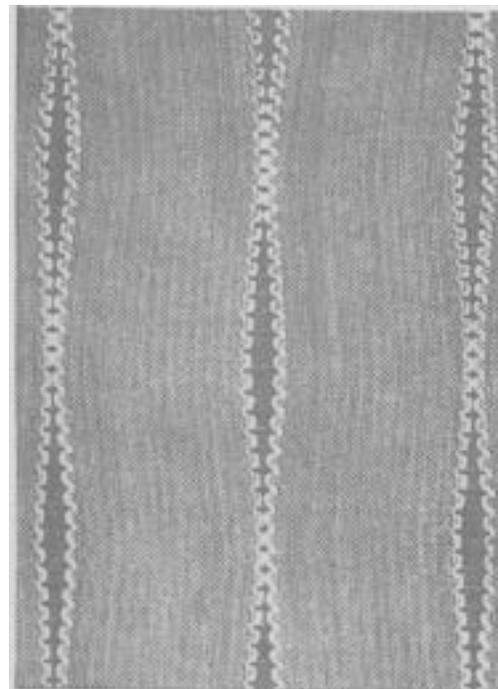


FIG. 659.

two or more threads of artificial silk, with a doubling twist of, say, three or four turns per inch and in the same direction as that in which the fine filaments of artificial silk are twisted together as these filaments emerge in groups from the finely-perforated glass or platinum metal nozzles of the "spinning" machine. Also, provided the gauze or leno effects are of such a character as to permit of the use of a *bottom doup* harness, in that case, an advantage would be afforded, over worsted doups, by the use either of tempered steel-wire, or else flat steel, doups

of the types described and illustrated in §§ 131-138, Chapter IX, and in which latter section are stated the limitations imposed by the use of a steel doup harness.

§ 260. An interesting example of a neat light-texture dress fabric of a type in which artificial silk may be employed in a



FIG. 660

most effective manner, as illustrated in Fig. 660, is constructed on the well-known principle of fabric structure described technically as the "double plain" weave, as exemplified in the structure of "Scotch" or "Kidderminster" carpet fabrics, and described in the previous Chapter (XVIII). In the present example, a cotton warp of bleached and mercerised yarn interweaves on the plain calico principle with bleached weft of artificial silk, to constitute the ground texture of the fabric; whilst both the warp and weft of the figuring texture consist of two-fold cotton yarn, of a light orange colour and, like the ground texture, also interweave on the calico principle.

The two textures (figure and ground) are of unequal density, as both the warp and weft threads are in the ratio of one to two, respectively, with the warp threads drawn through the reed with three ends in each dent; whilst the picks are inserted in the order of four figuring and two ground picks, alternately, thereby requiring a double shuttle-box at one end only, of the loom sley. Although this fabric is of light texture, with comparatively few warp ends and picks per inch, the principle of construction affords ample opportunity for the effective display of artificial silk in each of the two textures of the figure and

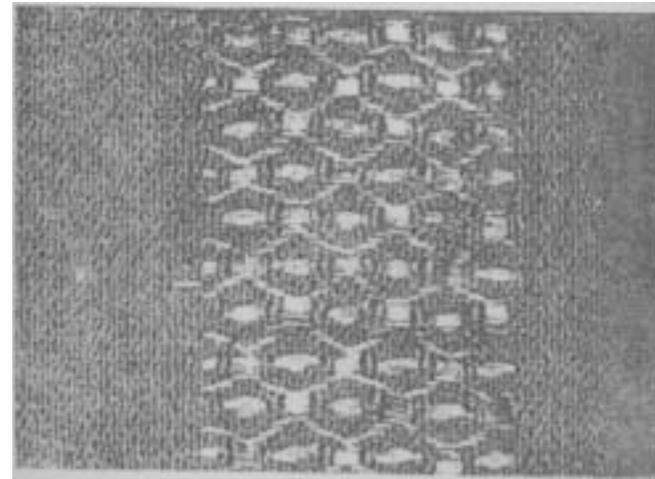


FIG. 661.

ground portions, without any long floats of warp or weft, or looseness of texture; besides affording ample scope in colour blending and in the production of "shot" and other mingled colour effects, simply by interchanging the two colours of weft with the two colours of warp threads, and as exemplified in the fabric illustrated in Fig. 669, and described in § 266.

§ 261. An example of a light, dobby-figured, striped and piece-dyed dress fabric of an attractive appearance, and constructed with an all-cotton warp of "fancy-twisted" yarn, picked with an all-artificial silk weft, is illustrated in Fig. 661.

In this fabric, the figured effect is developed by floating the weft on the face, as brocade figuring, according to the pattern; whilst the ground texture of the fabric, including that of the plain stripes, is of the plain calico weave. The warp threads consist of "fancy" yarn produced by spinning a coarse two-

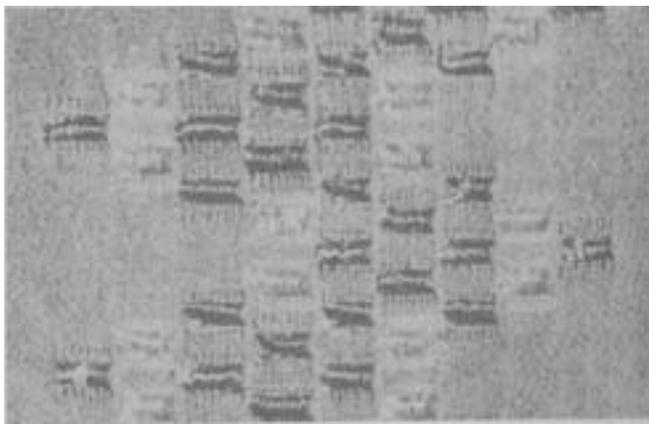


FIG. 662.

fold hosiery thread around a single hard-twisted thread. During the fancy-doubling operation, the two-fold yarn is delivered at a slightly quicker rate than that of the single thread, in order to produce a "fancy" thread with a slight "gimp" or "corkscrew" effect which imparts to the fabric a "crêpe" or "oatmeal" character. The warp threads are passed with one end only through each dent of a 56's Stockport reed; and the cloth contains 68 picks per inch.

§ 262. Fig. 662 illustrates an example of a cotton crêpe-voile dress fabric of very light texture of the plain calico weave and embellished with artificial silk introduced as extra figuring warp threads, as in dhooty figuring. The ground warp threads consist of bleached, single, hard-spun cotton yarn of fine counts, picked with cotton weft of fine counts and normal twist. The crêpe effect results from alternating warp threads spun with a high degree of twist spun "twist-way," with threads spun in

the reverse direction, or "weft-way"; whilst the figuring warp threads of artificial silk are floated bodily on the face, according to the pattern, and then float loosely at the back, from which they are "sheared" off, after weaving.

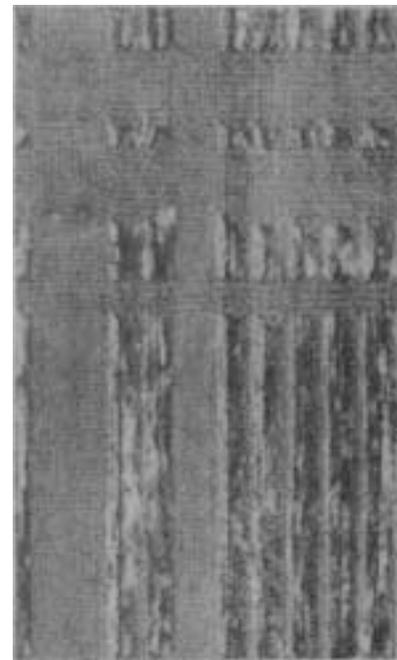


FIG. 663.

In the present example, the figuring is produced by three waves lying side by side and extending lengthwise of the fabric, *i.e.*, in the direction of the warp. Each of these waves consists of rectangular figured spots produced either with green or else white threads of artificial silk, of which there are virtually nine distinct vertical stripes or groups of threads. Some of these stripes contain sixteen green figuring threads only; some sixteen white threads only; whilst others contain sixteen figuring threads of each colour, or thirty-two of both combined. Where there is a group of only one colour of figuring threads,

the warp threads are disposed with two figuring and two ground threads, alternately; but where there are two colours of figuring threads in the same stripe the disposition is two figuring threads of each colour, and two ground threads, alter-



FIG. 664.

nately, although figuring threads of each colour are never displayed simultaneously, on the face of the fabric, and in the same rectangular figures. Hence the alternating disposition of the white rectangular spots, in pairs, and in the intermediate stripes, give to this simple, yet very effective scheme of embellishment, additional charm and interest.

§ 263. An interesting example of a new style of dress fabric of very smart appearance and having a rich and distinctive character is that illustrated in Fig. 663 and popularly described as "chenile voile," which is invariably embellished with designs

of the "block check" character, that are usually developed by means of narrow ribs or stripes of velvet or plush weft pile produced from bleached artificial silk weft introduced in com-

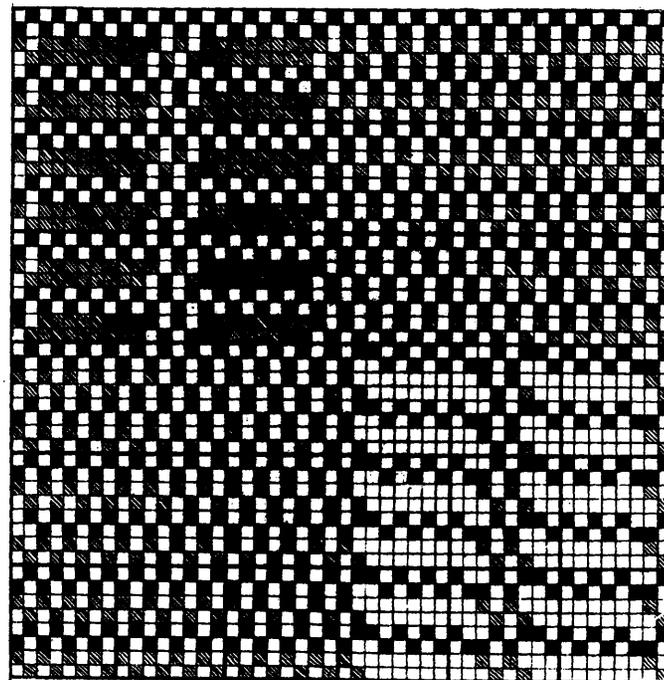


FIG. 665.

bination with a coloured foundation texture of very light voile consisting of an all-cotton warp and weft, of the same colour, that interweave uniformly, and throughout the entire fabric, on the plain calico principle, with the white artificial silk weft introduced as extra figuring material, and the picks of weft inserted in the order of two ground picks of cotton, and two figuring pile picks of artificial silk, alternately and uniformly, and is woven in a loom furnished with a double shuttle-box at one end only, of the loom sley.

In addition to the plush pile figuring, the present example also illustrates an additional feature of embellishment which is not always introduced in the designs for fabrics of this type. This innovation is effected by displaying, on the face and in accordance with the design, small portions of the voile foundation texture only (as seen in Fig. 663) by causing the artificial silk weft to float bodily at the back of the cloth, in those parts, and as seen in Fig. 664, which illustrates the reverse or back of the piece shown in Fig. 663.

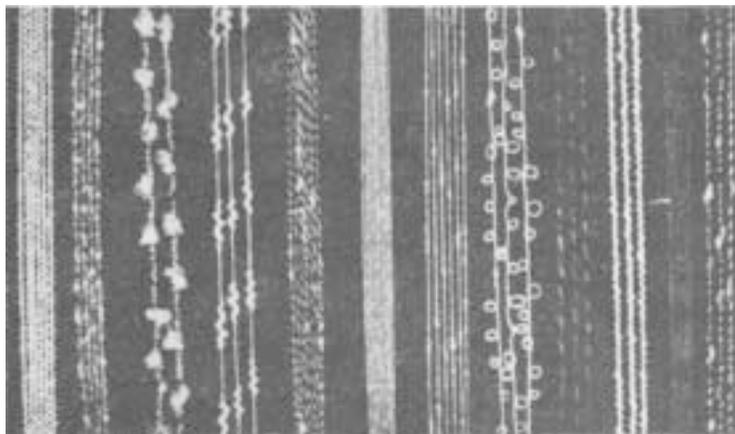


FIG. 666.

With the object of demonstrating the construction of this interesting fabric structure, a small portion of the design is given in Fig. 665, in which it will be seen that the ribs of velvet pile are developed by floating the picks of artificial silk bodily over nine warp threads and then interweaving them, in the plain order, with four or more warp threads, according to the closeness of those ribs. It follows, therefore, that wherever the ribs of pile occur on the face, the cotton voile foundation texture only will be exposed solidly at the back, in the corresponding parts of the fabric, as will be observed in Fig. 664, which also shows the picks of artificial silk weft floating bodily, at the back, in those parts where the foundation texture

only is exposed solidly on the face of the fabric. In all other parts of the fabric, constituting the ground-work, the artificial silk weft interweaves, in the plain order, with the foundation texture, along with the ground picks, but on the opposite

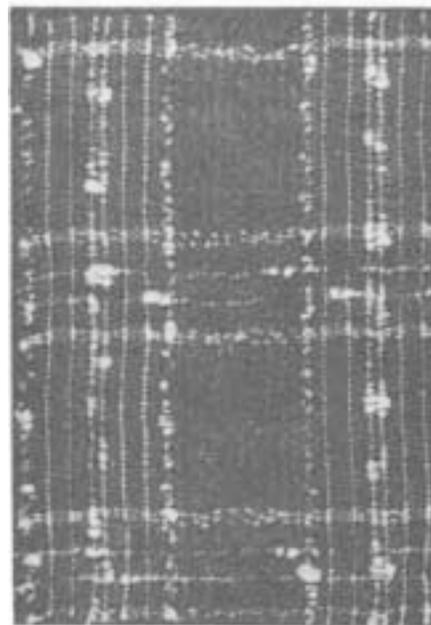


FIG. 667.

“tab” or “shed”—(for a definition of which technical terms, see the *note*, forming the last paragraph of § 193, Chapter XIV). After the cloth is woven and taken out of the loom, the ribs of floating artificial silk weft are “cut” up the centre in order to sever the floats of weft which immediately assume a more or less vertical position and thus constitute the tufts of cut velvet or plush pile, after the manner of forming the ribs of pile in corduroy and velvet cord fabrics, as described in §§ 75-77, Chapter VII.

The foundation texture of the example illustrated is woven from cotton warp and weft dyed a delicate tone of sky blue,

though this style of fabric is produced in a large variety of delicate tones of various hues of colour, as well as with many different designs and in several qualities of material. The design of the present example repeats on  $4\frac{1}{2}$  inch in width, and  $3\frac{1}{2}$  inch in length; and the cloth contains 64 warp threads and  $(56 \times 2 =)$  112 picks per inch, and may be woven with only six healds, with two skeleton healds for the selvages.



FIG. 668.

§ 264. Another method of employing artificial silk with very pleasing effect, in many varieties of fabrics, is by introducing "fancy twisted" threads produced by doubling and twisting together one, two, or more strands of artificial silk yarn with those of any other material in order to obtain "fancy" threads of which there is a considerable variety of very novel, cunning and ingenious styles comprising what are known as "gimp," "spiral," "knop," "flake," "slub," "curl," "knicker," "crimp," "grandrelle" and other "fancy" yarn effects, and of which a few different styles are represented in Fig. 666. These "fancy" threads may be of one colour only, or of two or more different colours in combination so as to develop variegated and mingled colour effects in the fabric, in which they may be introduced either as warp or weft threads only, in order to produce either

an "all-over" effect, uniformly and throughout the entire fabric, or else to produce stripes in either direction; or again, they may be introduced both as warp and weft, in the same fabric, in order to develop a mingled or indefinite "check"



FIG. 669.

effect in variegated colours, and of which a typical example is illustrated in Fig. 667, which is a light and flimsy dress fabric of loose and open texture of the plain calico weave, and produced from an all-cotton warp picked with weft of all-artificial silk, with the "fancy twisted" threads of various styles and variegated colours introduced both in the warp and the weft series of threads in such a manner as to produce a "broken" check pattern, as seen in the illustration.

§ 265. Another type of fabric structure, which is unlike any of the previous examples, and one that is suited most admirably for the display of artificial silk with considerable artistic effect, is illustrated in Fig. 668, and is a typical example of a French tapestry fabric of light texture, in three colours, suitable for furniture upholstery, decorative curtains, hangings and similar use, and virtually consists of a two-shuttle tapestry or compound brocade fabric structure produced with one system of cotton warp threads, dyed green, and two systems of artificial silk weft, dyed bronze and light blue, respectively. The weft is inserted with one pick of each colour in alternate succession, thereby requiring to be woven in a loom with a double shuttle-box at each end of the sley, and furnished with a "pick-and-pick" motion. The design is developed with floating, weft-brocade figuring, of the bronze weft, edged with the blue weft, on a green ground of 3-end ( $2-1$ ) warp twill weave, and has a very rich appearance.

§ 266. Another example of an effective furniture upholstery and curtain fabric, of medium-weight texture, illustrated in Fig. 669, is constructed (like the dress fabric illustrated in Fig. 660) on the "double-plain" cloth principle of the Scotch or Kidderminster carpet fabric structure, and of which a sectional diagram is shown in Fig. 649. In the present example, however, the two fabrics are of corresponding texture, each having an equal number of warp threads, of red and light brown (or fawn) cotton yarn, respectively, arranged "end-and-end" (*i.e.*, alternately); and an equal number of picks, of green cotton and gold artificial silk weft, respectively, inserted alternately or "pick-and-pick." The scheme of decoration is evolved by combining either of the two colours of warp threads with either of the two colours of weft, in the manner suggested in the last paragraph of § 260, whereby four distinct colour effects are obtained. Thus, the design is developed by combining fawn warp threads with gold weft; red warp threads with gold weft; fawn warp with green weft; and red warp with gold weft; thereby producing a very pleasing and effective scheme of colour blending.

### Chief Types and Varieties of Artificial Silk and Their Reaction with Dyes.

§ 267. Artificial silk comprises several varieties that are classified under two main groups, viz.:

1. The hydrated or regenerated cellulose group.
2. The acetyl-cellulose (cellulose acetate) group.

Each of these two main groups or divisions also comprises several chief types of which there are numerous varieties or brands that are indicated by distinctive trade-names, according to their chemical origin and personal or local association. Thus:

#### Group 1, Hydrated or Regenerated Cellulose.

<i>Chief Types.</i>	<i>Principal Varieties.</i>
1. Nitro-cellulose	{ A, Chardonnet B, Tubize
2. Cuprammonium . . . . .	{ A, Bemberg B, Despeissis C, Glanzstoff D, Pauly E, Siruss
3. Viscose . . . . .	{ A, British B, American C, Continental
4. Zinc Chloride . . . . .	{ A, Glanzstoff B, Lustre

#### Group 2, Cellulose Acetate (Acetyl-Cellulose).

<i>Chief Types.</i>	<i>Principal Varieties.</i>
1. Celanese . . . . .	British
2. Lustron . . . . .	American

### Reaction of Artificial Silk with Dyes.

§ 268. It will be of interest to textile designers to indicate the chief difference between certain types of artificial silk and the chief types of natural textile fibres in respect of their behaviour or reaction when submitted to the influence of dyes. Thus, the hydrated or regenerated cellulose types and varieties of artificial silk, generally, dye practically the same hues and tones as those of cotton, when submitted to the same dye-bath; and in this respect do the types of this group differ from those of the cellulose acetate or acetyl group of artificial silk which latter assumes quite a different colour from that of cotton and of the hydrated or regenerated group of artificial silk, when submitted to the same bath of dye-liquor. Also, both of these group-types of artificial silk give quite different reactions to those both of natural silk and wool, each of which assumes a different colour, from the same dye-bath. Hence, recourse to this method, known as "cross-dyeing," affords great possibilities in the production of multi-colour "cross-dyed" effects both in yarns and fabrics containing any one of the hydrated or regenerated cellulose group of artificial silk in combination with any one of the acetyl group; or with artificial silk of either group in combination with natural silk or wool.

### Multi-Colour Effects Produced by Cross-Dyeing.

§ 269. In its practical application as a method of producing "fancy yarns" and in the embellishing of textile fabrics, of almost every description, with artificial silk in combination with the natural fibres, the principle of "cross-dyeing" opens out to textile designers a wide range of possibilities in the creation of simple colour effects both in the decorative treatment of stripes and checks in fabrics of simple weave structure, as well as in brocade, damask and many other types of Jacquard-figured fabrics, without having recourse to hank or skein dyeing, or other method of dyeing the yarn, before weaving, whereby it is possible to produce two or more distinctly different hues and tones of colour in the same yarn or fabric by submitting these to a single dye-bath.

This interesting phenomenon of "cross-dyeing" is entirely dependent upon the different chemical composition and, possibly, also the difference between the physical properties and mechanical structure of the various types both of artificial silk, as well as those of the natural textile fibres. But from whatever specific cause or causes these different colour reactions may arise, and whether they are due to chemical or physical agents or to both of these influences (a problem which is receiving investigation by scientific research) the phenomenon of "cross-dyeing," whereby various hues and tones of colour are produced by the same dye-liquor, according to the different types and classes of fibres employed, and their different affinity for dyestuffs, is one of considerable technical and commercial importance to every section of the great textile industry in general, throughout the world, and one, moreover, of which the immense possibilities have not yet been fully revealed or realized by the trades immediately concerned. Further interesting developments in this direction are given by H. Kay, in the following article from a recent issue of the *Dyer and Calico Printer*, in which there is described a method of producing three-colour effects in fabrics containing acetyl-cellulose artificial silk.

### The Production of Three-Colour Effects in Fabrics containing Acetyl-Cellulose.

§ 270. Since the introduction of cellulose acetate, the production of two-colour effects has been carried on to quite a considerable extent on mixtures of this fibre with one of the other textile fibres, usually viscose or cotton.

More recently, however, the production of three-colour effects has been successfully undertaken. These are usually obtained on mixtures of wool, cotton and acetyl silk. The cotton, of course, may be replaced by viscose or other artificial silk having similar dyeing properties; and the wool may also be replaced by natural silk.

As may be observed from this combination of materials, the production of these multi-colour effects has distinct possi-

bilities, whilst the combinations and contrasts are almost endless.

The work of dyeing these effects may be successfully carried out by the one-bath process or by using two baths. The latter is best only used in case of necessity, as, for instance, when it is desired to avoid staining the woollen portion. The one-bath method is apt to result in the staining of the wool by direct cotton dyestuffs. This, in many instances, is not a serious drawback, particularly when the shade on the wool is a dull one. It is, of course, imperative to keep the wool as clean as possible in the case of bright tones.

In these effects, suitable ground tones are selected, which are usually dyed on the woollen portion, and the brighter contrasting colours are produced on the two remaining fibres. The tones which are very suitable for groundwork are fawns, tans, drabs, dull greens, slates and browns, and in contrast to these, tones of lilac, apricot, lemon, pink and saxe may be used which, when judiciously combined, give some very pleasing effects varying greatly in general character.

§ 271. *The Process.*—The goods are thoroughly cleansed in a bath containing about three parts of soap and two parts of ammonia per 1,000 at a temperature of 40 deg. Cen. Then follows a thorough rinsing in order to free the material from soap, etc.

The material is then entered into the dye-bath at, say, 40 deg. Cen. The temperature is raised to 80 deg. Cen.—85 deg. Cen. and dyeing is continued for half an hour. As is well known, it is necessary to limit the temperature to 85 deg. Cen., owing to the fact that cellulose acetate is liable to become blinded when subjected to greater heat. It has been found that a volume of dye-bath of 20 to 30 times the weight of goods is most serviceable. The only addition to the bath which is essential is 10 per cent. to 20 per cent. common salt or Glauber's salt.

After the dyeing operation it is frequently necessary to remove any loosely adhering colour by giving the goods a thorough rinse. In cases where this colour seriously interferes with the desired shade, it is beneficial to soap the goods lightly in a bath containing one to two parts per 1,000.

Dyestuffs that are suitable for this class of work have been selected from the following groups:

For the wool, the neutral-dyeing acid colours which give the minimum stain on the other fibres.

For the cotton, direct colours having no direct affinity for wool, and which leave cellulose acetate unstained.

For the cellulose acetate, those dyestuffs whose affinity is confined to this fibre.

Such dyestuffs are as follow:

Wool.	Cotton.	Cellulose acetate.
Coomassie Navy Blue 2RNX.	Chlorazol Fast Orange D.	Duranol Orange G paste.
Coomassie Navy Blue GNX.	CR Chlorazol Sky Blue FF.	Duranol Red G paste.
Coomassie Fast Black B.	CR Chlorazol Yellow GX.	Duranol Red 2B paste.
Coomassie Milling Scarlet G.	CR Chlorazol Violet R.	Duranol Blue G paste.
Disulphine Green B.	CR Chlorazol Fast Eosine B.	Duranol Violet 2R paste.
Disulphine Blue A.	CR Chlorazol Fast Pink BK.	Dispersol Yellow 3G paste.

The two-bath method is similar to the one already described, with the exception that the cotton portion is dyed in the second bath. In order to eliminate, as far as possible, the staining of the wool, the temperature of this bath is limited to about 30 deg. Cen., and in addition to the necessary common or Glauber's salts it is customary to use a small amount of alkali, say, 1 per cent. of soda ash or 2 per cent. of borax. As in the case of the first bath, it is usual to continue the dyeing operation for about half an hour.

As an alternative to the dyeing of all three fibres, one of them may be left undyed, and equally pleasing effects are obtainable thereby. In such cases it is customary to reserve the cellulose acetate.

On the face of it, the production of these effects appears to be quite a simple matter. It must be borne in mind, however, that in order to obtain satisfactory results it is very important that the proper conditions for the carrying out of the operations should be closely adhered to.

### Comparison of the Physical Properties of Natural and Artificial Silk.

§ 272. As a result of chemical and physical research as well as improvements in the machinery and methods employed in the production of artificial silk, very considerable progress has been made during the past few years, in the perfecting of this new textile fibre, and in the closer approximation of the physical properties and other characteristics of that fibre to those of natural silk, in respect of the more subdued lustre, the fineness or denier and density, as well as the mechanical structure of the delicate filaments, and even to the imparting, by artificial means, of the peculiar "scroop" or "rustle" which, until recently, was the exclusive and distinctive prerogative of the natural product of the silkworm. In fact, so very close a resemblance in all these respects do the properties of certain varieties of artificial silk bear to natural silk that they have been known, in some instances, actually to defy discrimination, even by experts, without, of course, having recourse to the aid of scientific tests. In view of these considerations, therefore, it will be of interest to compare the respective properties of natural and artificial silk as given in an able summary, by R. Presgrave, in a recent issue of the *Canadian Colourist and Processor*, and of which the following is an abstract:

§ 273. In order to make a true comparison, of the physical properties and relative artistic merits of natural silk and the chief types of artificial silk, it will be necessary to divide the latter into two chief groups, viz.: 1, The regenerated cellulose fibre, and 2, The cellulose acetate; each of which, having widely differing properties, must be separately compared with silk and with each other.

There are, primarily, three main divisions under which the comparisons may be made. These are very general in their nature and are really the outward manifestations of numerous physical and chemical properties which will be considered in their turn. The first of the main bases of comparison is appearance, and the second, wearing qualities. These two, of course, are of general interest, while the third—behaviour in manufacture—is of more definitely limited direct application.

Many of the underlying physical properties have a direct bearing upon each of these three.

*Lustre*.—Under appearance, lustre is the most probable point to first suggest itself. Silk has a particular richness of sheen and bloom, and a loftiness not yet entirely simulated by artificial silk which is usually of a harsh brilliance. Both fibres have a high lustre, but there is a difference which may be illustrated by comparing silk to a well-dressed person and artificial silk to one who is over-dressed. That this difference will be corrected soon there is little doubt, especially as it seems to find part of its cause, if not all, in the degree of fineness of the component filaments. In the common artificial silk the individual fibres are probably five or six times as heavy as those in silk yarns. However, recent developments are altering this, and already there are artificial silks (typified by Bemberg by the cuprammonium process) having filaments in the neighbourhood of one denier in size, from which is derived a sheen quite comparable to that of silk. Other manufacturers are working along similar lines, and there will no doubt be interesting developments very soon. The cellulose acetate in general bears a closer resemblance to silk than do the other artificial silks. The component filaments are fairly fine, but the fibre has its own specific lustre of a more or less waxy appearance that is fairly readily apparent to the trained eye, and, while differing from that of pure silk, is quite rich and pleasing.

These differences of lustre are affected somewhat by variations in fabric construction, and are often less evident than might be supposed. Where comparisons are to be made they should be drawn between fabrics of similar type, and due allowances made. For instance, in brocaded or embroidered goods the artificial silk's brilliant lustre frequently gives it more decorative powers than silk would have, while in such fabrics as glove silk the richness of pure silk has not so far been reproduced by artificial silk knit-goods, although it is closely approached by cellulose acetate.

§ 274. *Dyeing Qualities*.—In connection with lustre it is pertinent to touch on dyeing properties. Artificial silks, with

the exception of the acetate, are readily dyed to any degree of brilliance or intensity in all shades. This property is further enhanced by the lustre, and gives the yarn vast possibilities from an optical standpoint. At the same time silk, while capable of almost equal brilliance, may be dyed in pastel shades of an extreme delicacy that is not to be found in artificial silk. Most probably the high lustre accounts largely for this æsthetic drawback to artificial silk. Until recently there has been considerable difficulty in getting certain types of artificial silk, particularly that by the nitro process, to dye evenly. This has been practically overcome by closer chemical control and better knowledge of the reactions underlying the processes of manufacture.

Cellulose acetate is not coloured by the usual dyeing methods, and, while it is now possible to dye it any shade by more recently devised dyestuffs and processes, it has so far achieved notable successes in cross-dyed effects in conjunction with other yarns. This phase promises much for the future. The other types of artificial silk may also be used for fancy effects by cross-dyeing but with less range perhaps than the acetate. For instance, it is quite difficult to produce specified two-tone effects with ordinary artificial silk and cotton, although relatively simple if silk or wool replace the cotton. For the manufacturer the dyeing of all artificial silks presents many technical problems, most of which are being solved satisfactorily. Their discussion, however, is outside the scope of this treatise.

§ 275. *Handle or Feel*.—Along with appearance may also be considered "feel" or "handle" as it is called. Silk undoubtedly has the advantage here so far, for the common artificial silks are mostly rather harsh in comparison with the delightful soft vitality of good silk. It is conceivable that the size of the filaments may have some bearing upon this also. That it is being corrected is apparent to all who have been handling artificial silk for some time. The cellulose acetate yarns are somewhat softer to the touch than are most of the other artificial silks, and have an unmistakable but pleasant feel of their own of a somewhat waxy nature in common with their appearance.

§ 276. *Conductivity*.—Part of the difference in feel is no doubt due to the fact that silk has a high insulating capacity, and so does not conduct heat at all rapidly. Consequently, it feels soft and warm to the touch, in which respect the acetate artificial silk runs it a close second, being also an excellent non-conductor. On the other hand, the regular artificial silks usually feel quite cold, and sometimes even clammy, by reason of their being much better conductors, resembling, of course, cotton in this respect. In some cases this is a disadvantage and in others an asset. This dielectric power of silk makes it ideal for garments from the standpoint of warmth, and has also caused it to be employed a great deal in electrical insulation work, a field upon which the acetate is now encroaching. From the manufacturing standpoint the electrical resistance of silk and cellulose acetate is sometimes an objection by reason of the generation of static electricity. This, however, may be overcome by simple means, and is not at all serious.

§ 277. *Hygroscopicity*.—Rounding out the items of feel, insulation and so on we may mention the property of hygroscopicity, or the faculty of absorbing moisture from the atmosphere. Normally both silk and the ordinary artificial silks contain about 11 per cent. by weight of water without of course feeling damp. But silk can absorb a much greater percentage, probably up to 40 per cent., before it begins to show very plain traces of moisture, while the artificial silks very soon begin to feel clammy to the touch and are quite seriously affected by variations in atmospheric humidity which would not register on silk at all. To the manufacturer this is a drawback to artificial silk, for it is exceedingly difficult to handle the yarn when the weather is damp, for instance. In consequence, air-conditioning apparatus must be installed to ensure the best results, which are only achieved when the artificial silk is dry. Silk, on the other hand, runs best in a humid atmosphere, as also does the cellulose acetate, which is but slightly hygroscopic. This last is a distinct advantage in that garments made from the acetate feel dry and warm under almost any conditions, the same being true of silk also.

It might not be out of place to note here that some of the processes for dyeing cellulose acetate are such that they depend upon the saponification of the acetate group, which means, without going into technicalities, that the fabric is no longer then cellulose acetate but plain regenerated cellulose like the other artificial silks, and so subject to the same virtues and disabilities.

§ 278. *Tensile Strength*.—Silk is out and out the strongest textile fibre, which naturally makes its wearing qualities ideal and gives it the advantage over artificial silks of both types, these being low in comparative tensile strength. For instance, silk can be used in fine sewing threads while artificial silks may be employed only in such as embroidery flosses where strength is non-essential. On this account silk can be wrought into much lighter and more delicate fabrics than can artificial silk. Strength also makes it easier to manufacture, and the manufacturer often turns with reluctance from silk to artificial silk, for he knows the difficulties he will encounter. A defect of the usual artificial silk, and probably the most serious of all, is its weakness when wet. Silk is hardly affected by water, while artificial silk loses practically all its strength. One can poke one's fingers through a wet artificial silk cloth without any difficulty.

The strength recovers unimpaired when the fibre is dried, but the difficulties are obvious and necessitate a vast amount of care and the development of absolutely new technique in dyeing, manufacturing and laundering. Cellulose acetate yarns are not weakened by water to any great extent, which is a point in their favour.

§ 279. *Elasticity*.—Following tensile strength we may consider elasticity as a related property. It is the textile "shock absorber," and indicates the degree to which a yarn may be stretched and still return to its original length. Silk has an elasticity of about 20 per cent., which is quite high and is a valuable asset, for it assists in preventing "bagging" and permits garments to hold their original shape and freshness. To the manufacturer it is the secret of a great deal of the ease in knitting or weaving silk, for it enables the threads to

overcome momentary stoppages and jerks which would snap a less elastic yarn. Artificial silks of both types are rather inelastic, and consequently show many more breakages in manufacture and permit the finished goods to bag more easily.

§ 280. *Ductility*.—A companion property with elasticity is ductility. It is, however, of less importance, being that faculty which permits the yarn to stretch even after the maximum of elasticity is reached, with the difference that it cannot return to its original length. In garments the ductility of artificial silk permits bagging instead of breaking. Artificial silk when damp is very ductile and is inclined to stretch even under the light strain of winding. This stretching appears in some way to alter the constitution of the yarn so that it subsequently behaves differently towards dyestuffs than does the rest of the thread, and causes bright defects in the finished cloth aptly known as "shiners." Silk and cellulose acetate are not subject to this defect, although both are fairly ductile.

§ 281. *Friability*.—A property, probably having its basis mainly in strength and elasticity, is that which, for want of a more exact term, may be called "friability." It may be illustrated by comparing a silk satin with an artificial silk cloth of the same construction. The latter, on being rubbed with the finger or scratched with the nail, becomes rough and hairy much more readily than does the former by reason of the apparent brittleness of the minute filaments. When wet this weakness of artificial silk is even more demonstrable, as anything but the most gentle treatment in dyeing will show. These "chafe" marks are a source of considerable trouble in artificial silk manufacture, and in silk to a lesser extent. Friability when dry makes artificial silk somewhat difficult to handle in manufacture, and it is axiomatic that all parts with which it comes in contact in winding and so on be as smooth as possible. It should not be forced to make any sharp deflections during winding or warping, and the points of contact with the machine should be as few as possible. All this because of the ease with which the yarn splits or roughens and becomes fractured.

§ 282. *Resiliency*.—Resiliency is probably a function of elasticity. The resiliency of silk is quite notable, giving it a vitality lacking in the usual artificial silk, but more evident in cellulose acetate. On account of their lack of resiliency artificial silks are much subject to creasing, an objectionable feature under certain conditions. A feature in the resiliency of silk is the well-known “scroop” which may be artificially imparted to artificial silk with more or less success.

§ 283. *Specific Gravity*.—Silk has a comparatively low specific gravity of about 1.3, which in terms of practical application means that it occupies more space, weight for weight, than do other fibres. Artificial silk has a higher specific gravity, and everyone who has handled it at all is well acquainted with its seeming heaviness. This means that, count for count, silk has the greater covering and filling power, which is plainly an important consideration in use or in manufacture. Cellulose acetate is also heavier than silk, but to a somewhat lesser extent than other varieties.

It is worth noting that in a new artificial silk with hollow filaments an attempt is being made to give a lighter yarn for its size, and so offset the lack of covering power.

§ 284. *Cleanliness*.—The hygienic value of fibres is a new field now opening up to research. It is well known that silk does not so readily support the growth of moulds and bacteria as does cotton, for instance. How artificial silk behaves in this respect does not seem to be fully established, but one would imagine it a fairly simple matter to render the yarn sterile. Cellulose acetate has lately achieved notoriety from the discovery that it is transparent to the health-giving ultra-violet rays. It is quite conceivable that this will open new developments along hygienic lines. However, the comparative transparency of the different fibres does not seem to have been fully investigated as yet, so it will not be discussed here.

§ 285. *Plasticity*.—Silk has a decided advantage in being non-plastic within limits at which the artificial silks are destroyed. Under pressure, with moisture or heat, artificial silk is plastic and may change its shape and even its chemical

constitution. Cellulose acetate may be easily melted when dry by an iron that is not too hot for pressing silk or other artificial silks. In very hot water cellulose acetate almost loses its identity and becomes fuzzy and lustreless.

These weaknesses, like many others, are not serious when one considers that they may be avoided with the exercise of a little care. However, until the general public is fully informed on the subject, they will show up detrimentally to artificial silk from time to time, and it is very likely that one of the next steps in artificial silk development will be the systematic education of the people, still woefully lacking in information in spite of the great publicity artificial silk has had.

§ 286. *Imperfections*.—Silk, being a natural product, subject to human judgment and lacking the exact control of machinery, is subject to greater variations in size than is artificial silk, which, entirely under chemical and mechanical control, is, or should be, uniform to a much higher degree. This property of artificial silk gives it a decided advantage from several angles, but on the other hand the well-known lack of uniformity in silk gives that fibre a personality and charm that the other misses. Providing the irregularity of silk is held within reasonable bounds, as it sometimes unfortunately is not, it does not appear to be a serious fault. The same remarks apply more or less to the various reeling defects in silk yarns. Artificial silk, of course, may have analogous flaws, but they are, or should be, more controllable.

#### Artificial Silk Staple Fibres.

§ 287. Of the many significant developments in the artificial silk industry, one that is of considerable importance, in that it opens out to every branch of the textile industry many new prospects, with an immense range of possibilities, is provided by what is termed “staple fibre,” produced by cutting the filaments of artificial silk into definite staple lengths corresponding, approximately, to those of cotton, wool and waste silk, respectively. These “staple fibres” of artificial silk are then intermixed and blended, in varying proportions, with

one or other of the natural fibres, according to the particular class of trade for which they are intended, and afterwards spun together to produce "mixture" or "union" yarns of various classes. By blending together, in this manner, the different types of artificial silk with the natural fibres in various combinations and proportions, and afterwards submitting the resultant yarns to the process of "cross-dyeing," as described previously in §§ 268 to 271, many very pleasing and interesting mingled colour effects are thereby obtained.

In fact, the possible uses and application, in the great textile industry alone, of this wonderful new textile fibre, artificial silk, are only prescribed by the limitations imposed by the human faculties and the creative and inventive ability in artists and textile designers.

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