

In the first modification the ends are controlled entirely by the Jacquard machine; in the second, some

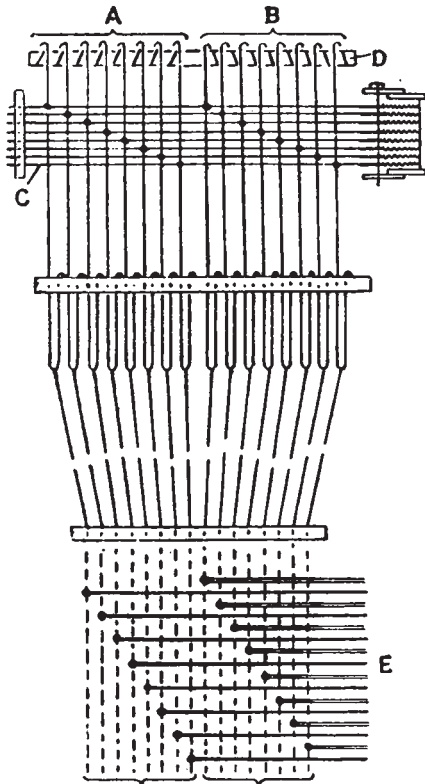


Fig. 1

of the ends are controlled by the Jacquard machine and others by the harness shafts; while in the third, fourth and fifth systems the same harness cords are operated from two sources, *viz.*, by the Jacquard machine for forming the design, and by the additional parts for producing the structure of the fabric. In some mountings, two or more of the special systems are used in combination. For every needle in the Jacquard machine the fabric produced may contain two, three, or more consecutive warp-threads, and when, compared with an ordinary mounting of the Jacquard harness, the time required for cutting the cards as well as the number of cards required, are correspondingly reduced. Again many of the special modifications are devised so as to enable one card to act for two, three, or more consecutive picks, and when a further great saving in cards and card-cutting is effected. One card is made to act for two or more picks in two ways: *viz.*:

- (a) the Jacquard machine remains stationary for a period during which the additional parts go on working;
- (b) the Jacquard machine and the additional parts continue in work all the time, but the catch which turns the card-cylinder, is put out of action as required so that the same cord is pressed against the needles a number of times.

Inverted-hook Jacquard Machine.

This type of machine is used with great advantage in weaving large designs in which two sets of warp-threads arranged 1:1, work exactly opposite to each

other. As shown in Fig. 1, such a Jacquard machine contains two sets of hooks, *A* and *B*, to correspond with the two sets of warp-threads. The hooks *A* have their crooks turned towards the card-cylinder in the ordinary manner, whereas those of hooks *B* are turned towards the spring box. One griffe *D* is employed, carrying 16 lifting blades arranged in two sets of 8 blades each, which are inclined towards the hooks that they govern. When in the normal position the hooks *A* are over their lifting blades, whereas the hooks *B* are clear of the other set of lifting blades. The harness cords are tied up in the ordinary manner, but in drawing-in the warp (as represented at *E*) one set of the warp-threads is drawn upon the harness cords connected to the hooks *A*, and the other set upon the cords connected to the hooks *B*. Only one set of needles is used, but since each needle is connected to a hook of each set, each needle thus controls one end of each set of warp-threads. A blank in a Jacquard card presses a hook *A* away from the path of its lifting blade, in turn placing the corresponding hook *B* in position for being raised, while a hole in a card leaves a hook *A* in position for being lifted, and its mate hook *B* out of action. Therefore, where ends of one set are raised, corresponding ends of the other set are left down, and *vice versa*.

A class of fabric for which the arrangement is particularly useful is a reversible warp rib structure, in which a warp figure is produced in two colors upon plain or rib ground on both sides of the cloth. In order to show the special use of an inverted hook Jacquard

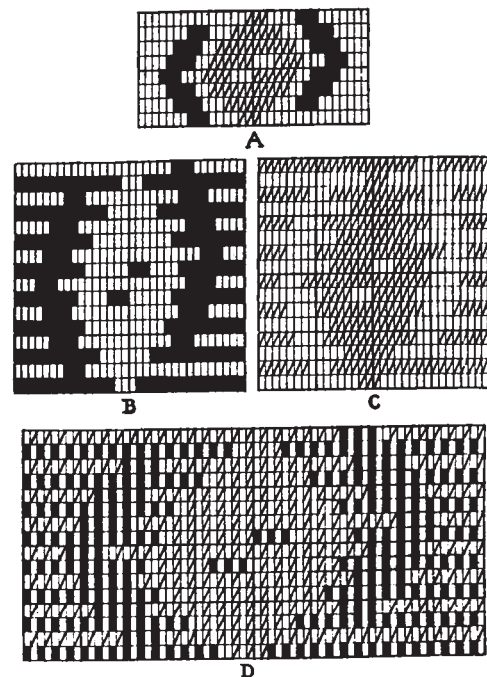


Fig. 2

plans are given at *A*, *B*, *C*, and *D* in Fig. 2, which illustrate the development of a portion of a design from the solid system of making out the design, to a diagram showing the interlacing of the complete reversible rib structure.

In planning the design the figure formed by each color of warp is painted solid, as shown by the two different marks in *A* Fig. 2, each vertical space of which represents an end of both sets, and each horizontal space two picks. Assuming that the dark figure is required to be produced by the ends which are controlled by the ordinary hooks, two cards are cut from each horizontal space as follows:—

First Card: Cut all except the marks of the light figure.

Second Card: Cut only the marks of the dark figure.

B in Fig. 2 shows the lifts that are cut on the cards and are formed by the ordinary hooks, while *C* in Fig. 2, which is exactly opposite to *B*, shows how the other threads are raised by the inverted hooks. As the ends are drawn through the harness in 1:1 order, an end of *B* is followed by an end of *C*, and the complete weave is, therefore, as indicated at *D* in Fig. 2.

The inverted hook arrangement, illustrated in Fig. 1, not only enables a very simple method of designing to be employed, but a design is produced that repeats upon twice as many ends as there are needles in the machine. If, however, an increase in the figuring capacity of the Jacquard is not desired, one of the sectional arrangements, previously described, will enable the same method of designing to be employed for a reversible warp rib cloth, two cards being cut from each horizontal space of the design *A* in Fig. 1 as follows:—

Dark Warp Section: First card, cut blanks (empty) and solid (red) marks; second card, cut solid (red) marks.

Light Warp Section: First card, cut diagonal (blue) marks; second card, cut blanks (empty) and diagonal (blue) marks.

To correspond with the design *A* in Fig. 1, *B* then shows the lifts cut on the dark warp section, and *C* those cut on the light warp section.

Combination of Harness Shafts With a Jacquard Harness.

When ordinary harness shafts are employed in conjunction with a Jacquard harness, the threads which the former operate in regular order are not passed through the mails of the Jacquard harness, but are used in addition to the figuring threads. Whether to place the harness shafts at the back or front of the Jacquard harness, is largely a matter of convenience as regards space and depth of shed, but a determining factor is the relative strength of the threads, since the weaker yarn should be operated by the shedding mechanism placed at the front. Certain of the hooks of the Jacquard machine may be used in raising the harness shafts, but this prevents a card from acting for more than one pick. Either cams or a small dobbie may be employed to work the harness shafts independently of the Jacquard (positive shedding motions being most serviceable when the threads controlled by the harness shafts are heavily tensioned), and these motions enable each card to act for any desired number of picks.

One-half, two-thirds, etc., of the warp-threads are drawn upon the harness shafts, so that the figuring capacity of the Jacquard machine is correspondingly

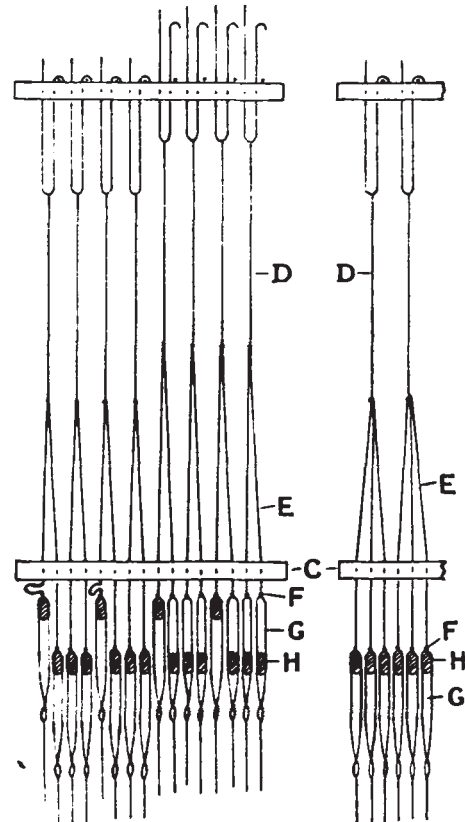


Fig. 3

Fig. 4

increased two or three-fold, etc. The limitation in the arrangement is in the weave of the ends that are operated by the harness shafts, but it will be understood that the ends controlled by the Jacquard machine may be operated as desired.

In connection with the use of what is known as *Compound Harnesses*, the harness shafts then used in connection with the Jacquard harness are of a special form (the eyes of the heddles are then sufficiently long to permit in it, when at rest, the formation of a shed by the Jacquard machine only) and in this case, the same warp-threads are drawn through both the mail of the Jacquard harness and the eyes of the heddle of the shaft harness and thus are operated from the two sources, which results in the weave being limited in both the figure and the ground.

Combinations of Lifting Rods or Bars With Jacquard Machines.

This system enables the harness cords to be operated in longitudinal rows quite independently of the figuring hooks, and at the same time does not prevent the cords from being operated by the Jacquard. The method is employed, on the one hand, in order that each needle of the Jacquard may control two three or more consecutive warp-threads, as in the split-harness mounting (described next) and in twilling Jacquards, and, on the other hand, it is used for the purpose of enabling warp-threads to be lifted in a definite order without the lifts being cut on the figuring cards, as in certain classes of tapestry.

The Split Harness or Shaft Monture.

The split harness or shaft monture (also known as the scale or bannister harness) is used in weaving fabrics which are very finely set in the warp, in order to double, triple, or quadruple the compass of the Jacquard machine. Rich silk fabrics, of the non-reversible damask and other types, are frequently woven with only a comparatively few picks per inch, but contain a very large number of ends per inch (400 and upwards in some cases), so that with an ordinary Jacquard harness a very large machine would be required in weaving a pattern of a wide repeat.

In the most common form of split harness, which is illustrated in Figs. 3 and 4 an ordinary single-lift Jacquard is used, but some distance above the comberboard *C* each single cord *D* from the neck cords is connected to two or more double harness cords *E* each of which is passed through a separate hole in the comberboard. A knot *F* is tied in each double harness cord, so as to form, above the mail, a loop *G* which is sufficiently long to allow the proper depth of shed to be made. Also, the comberboard is placed high enough above the knots *F* to permit the cords to be lifted the proper height without obstruction.

Fig. 3 represents an 8-row machine, in which the scale is doubled, *i. e.*, two looped harness cords are connected to each single cord *D*, giving 16 rows of harness cords in the comberboard *C*.

In Fig. 4 three looped harness cords are shown connected to each single cord, which, in an 8-row machine, gives 24 rows in the comberboard.

OPERATION OF THE LIFTING RODS.

A bannister shaft or rod *H*, which is rather longer than the width of the Jacquard harness, is passed loosely through the loops of each long row of harness cords, so that each rod is capable of lifting one end in every sixteen or every twenty-four, etc., according to the number of rods employed quite independently of the figuring cards. The arrangement does not prevent the Jacquard machine from lifting the ends in forming the desired figure, but they are necessarily raised by the hooks in groups of two or more, to correspond with the scale of the harness. By lifting the rods, the ends that are left down by the Jacquard machine may be raised singly and produce any ground weave (plain, twill, satin, etc.), which repeats upon a number of ends that is a measure of the number of bannister rods employed. Thus, in Fig. 3, the hooks 1 to 4, which are shown raised by the Jacquard machine, lift up the harness mails 1 to 8, but the bannister rods are raised in $\frac{1}{3}$ order, and lift up one-fourth of the mails, *viz.*, the twelfth and sixteenth (see loops formed in illustration) which are left down by the Jacquard machine.

Only warp figures can be formed on the surface as the cloth is woven, and a filling figure is therefore produced by weaving the texture wrong side up.

As a general rule, as the cloths do not contain a large number of picks, each card acts for only one pick.

The rods *H* may be operated by means of a dobbie, but it is generally found more convenient to use a number of specially strong hooks in the Jacquard machine for this purpose, the cords from which are passed through guide holes in the comberboard near each end of the rods. If the card cylinder is at the back or front of the loom a row of special hooks should be used at both sides of the figuring hooks, in order that the weight will be evenly distributed on the machine. In some cases the needles and hooks, by which the lifting of the rods is governed, are situated a sufficient distance from the figuring needles and hooks to enable them to be operated by a separate small set of cards. This method has the advantage that a design may be woven in different ground weaves simply by changing the small cards.

The split mounting is sometimes arranged with two neck-cords (which pass separately through a board) to each hook, and with the loops, through which bannister rods are passed, formed in the neck-cords. It is claimed for this arrangement that the rods are situated where there is most space and are out of the way of the weaver. The double neck-cord system thus referred to is also used in conjunction with a double-lift single-cylinder Jacquard machine.

SYSTEM OF DESIGNING.

In painting out designs no ground weave requires to be filled in, as this is produced by the lifting of the

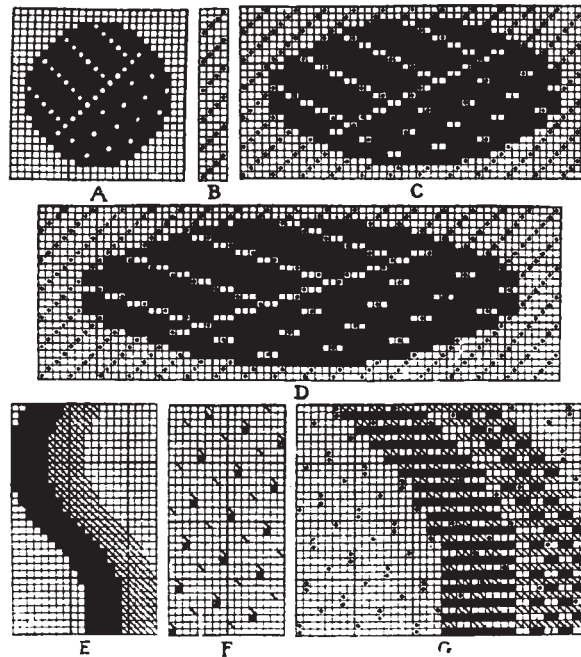


Fig. 5.

bannister rods, but the long floats of the figure require to be stopped in the ordinary manner. Thus, *A* in Fig. 5 illustrates the method of preparing a design for the card-cutting, the particulars of which are: Cut full squares, painted in practical work red. Assuming that the bannister rods are raised in $\frac{1}{3}$ twill order, as indicated at *B*, the full design will be shown at *C* in a double-scale mounting, and as represented at *D* in a treble-scale mounting. At the edge of the figure

each step of one end in *A* corresponds to a step of two ends in *C*, and three ends in *D*; while, similarly, each single binding point in the figure represents two ends in *C* and three ends in *D*. In the ground, however, the ends are operated singly, as shown by the dot type.

It is necessary to take into account that the lifts produced by the rods are liable to occur where ends have been left down by the Jacquard machine for the purpose of binding the figure. The dots inside the

up the figuring filling floats on the right side of the cloth, particularly if satin weaves are used, in such a manner that the remedy is worse than the defect.

The split harness system greatly simplifies the processes of making Jacquard designs and cutting Jacquard cards, and there is scarcely any limit to the diversity of weave development that can be obtained in a design, nor to the variety of ground weave that may be used. The outline and binding lines of a figure, however, are rather steppy, but the figure shows

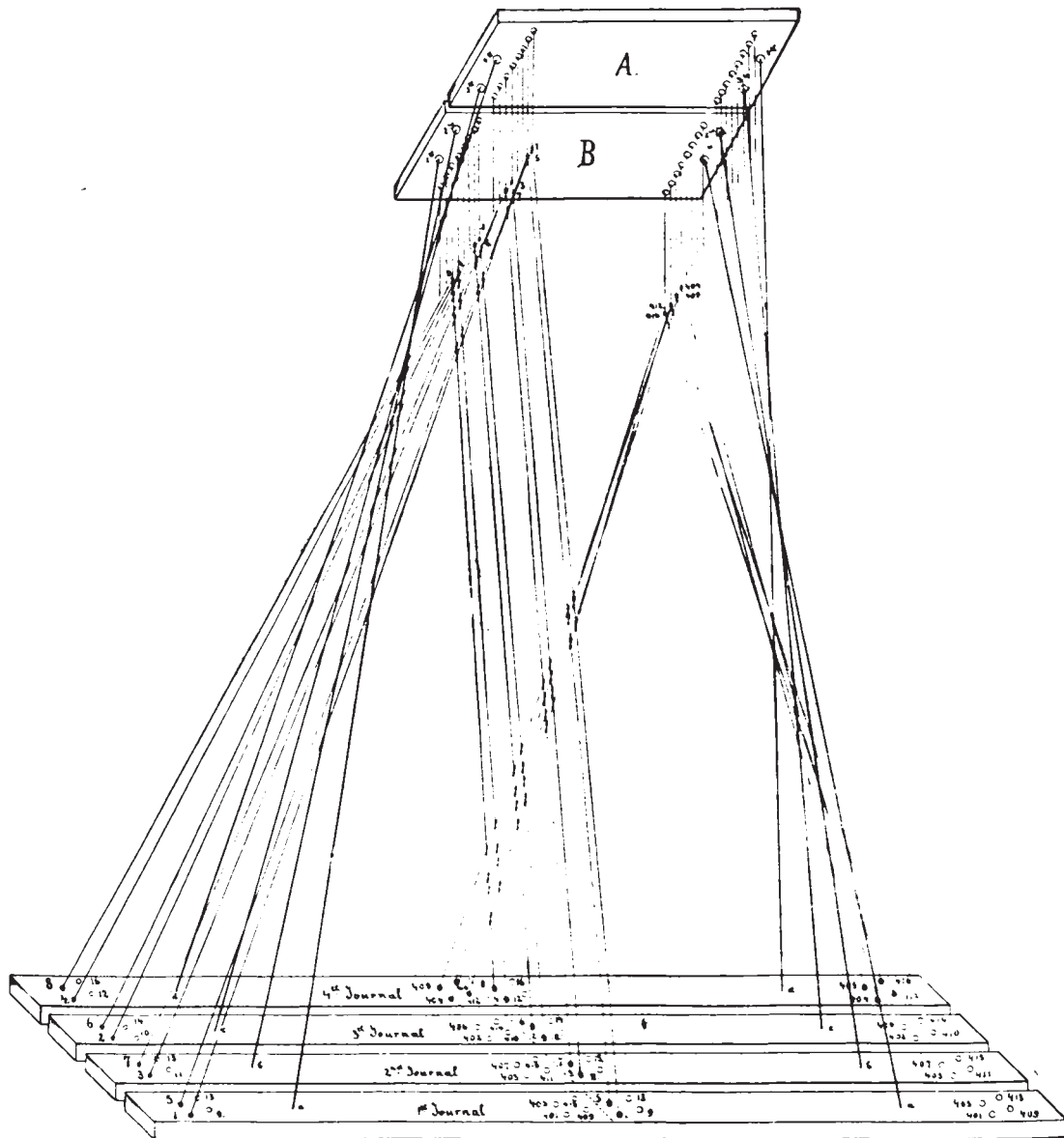


Fig. 6.

figure in *B* and *C* indicate such lifts and it will be seen that the binding of a warp float is neutralized at each place. In fine cloths, which have a filling figure upon a warp sateen ground (produced by weaving the cloths wrong side up), the defective warp float is on the wrong side, and the fault is considered of such little importance that it is generally ignored in painting out designs. However, the defect can usually be avoided by inserting each binding place in the figure upon two consecutive vertical spaces, but this is liable to break

up very bold and clear upon the fine ground effect that is generally formed. The system is readily applied to elaborately-figured multiple-filling fabrics, and diagram *E* in Fig. 5 illustrates the method of designing a figure in two fillings, which are inserted in pick-and-pick order. Two cards are cut from each horizontal space of *E* as follows:

First Card: Cut the marks of the first color and those of the second color plain.

Second Card: Cut the marks of the second color

and those of the first color plain.

Assuming that the scale of the harness is doubled, and that the rods are raised in the order indicated at *F* (by which one of the fillings is interwoven in 8-leaf satin and the other in 16-leaf satin order in the ground), the full weave to correspond with the lower portion of diagram *E* is indicated in diagram *G*. It will be seen that the plain cutting of the figure produces a $\frac{2}{2}$ filling rib weave under each kind of filling float.

Working Comberboards.

In this system of Jacquard harness mounting each harness cord is knotted in such a position that the knot rests on the comberboard when the harness mail is at the bottom line of the shed. The knots do not prevent the cords from being raised individually by the Jacquard machine in the ordinary manner, whereas by lifting the comberboard all the cords, whose knots rest upon it, are raised together. In the manufacture of Brussels and Wilton carpets only one comberboard is employed, but for Marseilles quilts and satin quilts the board is made in two longitudinal sections, and for 2-ply Ingrain carpets in four longitudinal sections, which enables the ends to be raised in groups separately. The latter system of mounting is shown in diagram Fig. 6.

The four longitudinal sections of the comberboard previously referred to are now termed Journals, indicated that way respectively in our diagram, which illustrates the arrangement of neck-cords with the heddles (through the harness-cords). There are two separate bottom boards in the machine indicated by *A* and *B* respectively for ground and figure, also two corresponding lifter-boards, or inverted Jacquards, as the case may be.

With reference to threading the four Journals,

The 1st warp-thread is drawn on Journal 1	
" 2nd " " " " " "	3
" 3rd " " " " " "	2, and
" 4th " " " " " "	4.

This arrangement of threading 1, 3, 2, 4 is repeated until the complete warp is taken up.

The Journals are arranged as follows: 1st and 2nd Journal for ground, 3rd and 4th Journal for figure.

The tie-up shown refers to a texture what is termed *extra fine*, *i. e.*, calling for 416 warp-threads to one-half yard wide fabric, of which 208 each refer respectively to ground and to figure effect. Two repeats (*i. e.*, the regular yard wide fabric) are given, more are used when dealing with Art Squares. In the illustration are only shown the first 8 harness-cords and the last four harness-cords (404, 408, 412 and 416) passing through the rear Journal. The first row (1 to 8) illustrates the principle of tying-up the harness and the leasing of the heddles; whereas the four heddles in the rear (404, 408, 412, and 416) show the practical commencement of the tie-up, *i. e.*, four neck-cords in succession to four heddles of the Journal.

Besides the Jacquard and shaft mountings thus referred to there are any number of mountings for special fabrics met with, *viz*: book-harness mounting,

pressure harness, self twilling Jacquard, tapestry mounting, double-plain cloth Jacquard, special gauze Jacquard, Madras gauze mounting, and pile carpet Jacquards.

WARP SPOTTING

(Continued from page 62.)

Using Ground and Combined Ground and Figure Warp.

In this instance some of the threads are used throughout the repeat of the weave as ground warp-

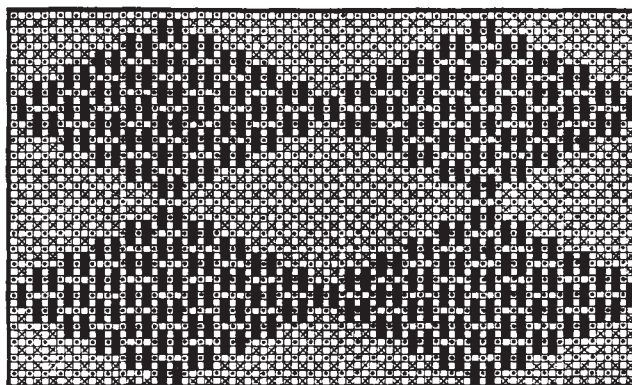


Fig. 20

threads, while others are used part ways as ground, part ways as figure warps. The arrangement of these threads is either:

- 1 figuring and ground: 1 ground, or more often
- 2 figuring and ground: 1 ground.

Weaves Figs. 20, 21, 22 and 23 are given to illustrate subject.

Fig. 20, arrangement: 1 ground 1 figuring and ground warp $\times 20 = 40$ warp-threads and 24 picks

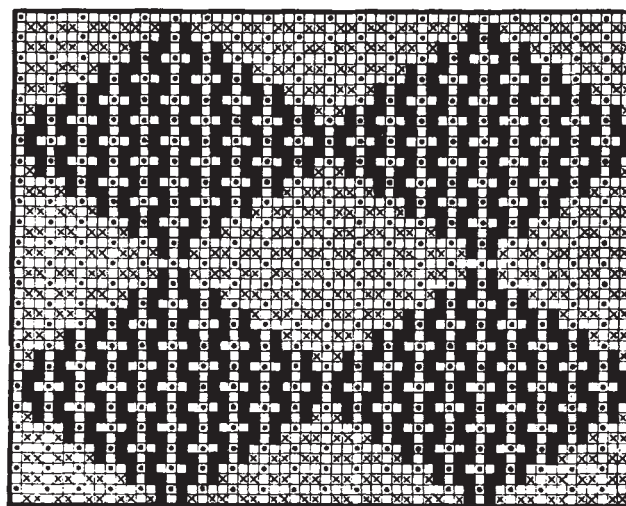


Fig. 21

repeat of pattern. Two repeats of the pattern each way are given to better illustrate the general effect of the design in the fabric.

The figure float (see *full type*) floats alternately over three picks and below one; when not forming figure effect the threads then form with their mate ground warp-threads, plain weave.

Fig. 21 shows the arrangement of one end ground