foundation (regular) twill only is used in the formation of the Diagonal.

Said foundation twill in this example (see first warp-thread in Diagonal) is a 40-harness regular twill; hence (40 divided by 4, equals) a Diagonal repeating on 10 warp-threads and 40 picks the result.

80° Grading Effects.

Fig. 5 explains this sub-division of Diagonals, having for its basis again a 40-harness (see first warp-thread) regular twill. In this instance we use only every fifth warp-thread of the regular twill in the formation of the Diagonal, what results, in our example, in a repeat of (40 divided by 5, equals) 8 warp-threads and 40 picks for the latter.

The few specimens of Diagonals given will readily explain the great variety of new weaves thus possible to be obtained, in fact the combination of new Diagonals is unlimited.

LAPPET WEAVING.

(Continued from page 61.)

Wheels are marked off or scored concentrically by means of a comb of the same pitch as the loom reed in the case of coarse sets, and of half the pitch in fine

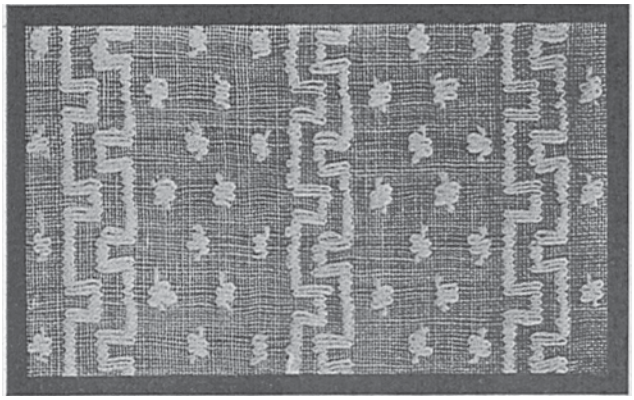

Fig. 1

sets. In the former case, the actual spacing of the splits of the reed is marked directly upon the wheel; in the fine sets every second split only is marked, and a single split is judged by the eye. As a concrete example of lappet wheel dimensions and construction let us consider the *common wheel* specimen illustrated in Fig. 1. It is a 3-frame example—two frames produce the key stripe by working continuously, while the third frame produces the intermittent spot effect.

The pattern repeats on 33 splits and 26 picks, and there are 28 splits per inch in the reed. Since it is a common wheel type there would be only 13 teeth in a repeat, but this would be doubled at 26 teeth in order to get a wheel of workable size; there would be, therefore, two repeats of the pattern cut round the wheel. If we assume a peck of $\frac{1}{4}''$ diameter, the arc between two adjacent radial lines must not be less than $\frac{1}{4}''$ in length (a shade longer), at a distance equal to the radius of the peck from the innermost circle of the groove:

$$\text{radius} = \frac{\text{circumference}}{2 \times 3.1416} = \frac{26 \text{ teeth} \times 0.25'' \text{ pitch}}{2 \times 3.1416} = 1.035,''$$

and $1.035'' - 0.125''$, radius of peck $= 0.91''$ as the distance of the innermost circle of the first groove from the centre of the wheel.

To this distance must be added the space occupied by 6 splits, or $\frac{6}{28}''$ for the extreme movements of each

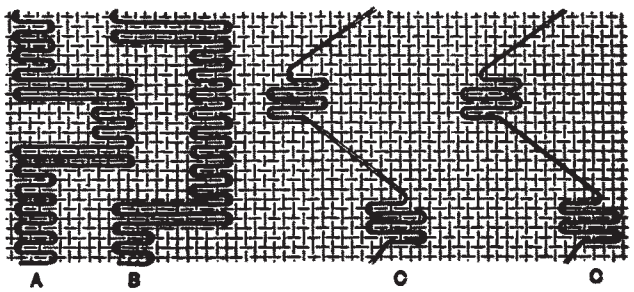

Fig. 2

of the frames 1 and 2; and 9 splits, or $\frac{9}{28}''$ for the movement of the third frame—in all, $\frac{6}{28} + \frac{6}{28} + \frac{9}{28} = \frac{21}{28}$ or $\frac{3}{4}$ inch. Further, to each distance of movement should be added the diameter of the peck, and about half an inch of wood should separate the grooves. The total distance from the centre of the wheel to the outer circle of the last groove will therefore be:

$$0.91'' + (\tfrac{6}{28}'' + \tfrac{6}{28}'' + \tfrac{6}{28}'') + (3 \times \tfrac{1}{4}'') + (2 \times \tfrac{1}{2}'') = 3.3 \text{ inches}$$

Another inch would be necessary on the extreme edge of the wheel for strength, and to permit of sufficient wood for cutting the teeth. The minimum radius for such a wheel would therefore be, $3.3 + 1.00 = 4.3''$.

It is sometimes possible, on account of the configuration of the grooves, as in the case of the key stripe in Fig. 1, to arrange the grooves closer together than is indicated in the above general statement, but such cases can only be considered as they arise.

Fig. 2 shows in a graphic manner the interlacing of one complete repeat of 66 ground-threads and 26 picks of the specimen illustrated in Fig. 1, in addition to the ornament shown in heavy zigzag lines, and developed by the whip-threads or the lappet needle frames. *A*, *B*, and *C*, Fig. 2, indicate respectively the effects obtained by the three different needle frames. When the pattern is detached as demonstrated by effect *C*, the part of the whip-thread which joins the

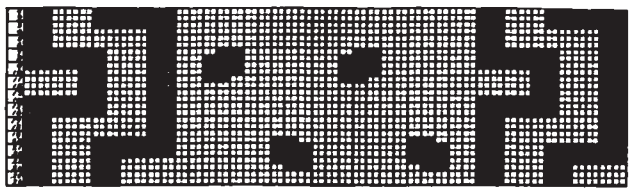

Fig. 3

figures, and shown in outline only, must be removed after the piece leaves the loom.

A more concise and simpler method of indicating the same pattern would be that of placing on design paper the figuring whip-thread only; indeed, there is

no necessity whatever for introducing the plain ground weave. The patterns, therefore, are generally marked in solid squares only, as is done for most types of textile design. If the lappet wheel is moved every pick, there is not much difficulty attached to the preparation of the design, beyond that which arises from the intricacies of the design itself, since the ordinary ruling of design paper may still be taken to represent individual threads and picks. If, on the other hand, the design is intended to be cut on a common wheel, which moves once in two picks, one horizontal line of the design paper may serve for two picks; and, for symmetry, one vertical line may serve for two warp threads, or one split of the reed; in this case some difficulty may be experienced. The rotation of the lappet wheel may take place when the needle frames are moving from left to right, or when moving from right to left. To avoid misunderstanding, we shall assume that the wheel is rotated, tooth by tooth, when the frames are moving from right to

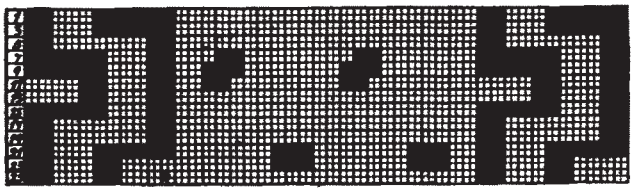

Fig. 4

left, and that the solid marks in Fig. 3, beginning at the top of the figure, represent the odd picks when the lappet frames travel from left to right, while the crosses represent the even picks when the lappet wheel is turned and when the frames travel from right to left. The design paper is ruled in faint lines and heavy lines alternately to indicate more distinctly that two threads, or one split of the reed, and two picks are contained between each pair of heavy lines. If the pattern were painted on single rows of squares, ignoring the faint lines, it would evidently be complete on 33 vertical and 13 horizontal spaces. When the faint line appears between each pair of thick lines, the pattern is identical with that shown in Fig. 2, but if painted on single squares, it would appear as illustrated in Fig. 4, where the solid marks from Fig. 3, *i. e.*, the odd picks only, have been reproduced. The even picks are not shown in Fig. 4, and on comparing this figure with Fig. 3 it will be seen that the three successive long floats in the key portion of Fig. 3 are represented in some parts of Fig. 4 by two picks, and in other parts by only one pick. Similarly, in the spot effect, a difference is found; these apparent irregularities are due entirely to the fact that the even picks are omitted. Since one row of the spot patterns begins on odd picks, and the other on even picks, it is necessary (although we have not done so in the figure) to indicate this in some way on the design paper, if the squares of such paper are not divided by faint lines; for continuous patterns, no such indication is required.

Fig. 5 represents the full wheel necessary for the production of the above pattern. Three grooves are shown—inner, central, and outer—the two former being for the key stripes, and the latter for the spot effect. The numbers 1, 3, 5, etc. up to 25 correspond with the same numbers to the left of Figs. 3 and 4; while the dots within the grooves indicate the extreme positions of the centre of the corresponding peck on the respective odd picks. Short radial lines joining any two dots indicate the travel of that peck from left to right, *i. e.*, while the wheel is stationary, and diagonal lines joining two peck centres indicate the movement of the peck from right to left, *i. e.*, when the wheel is being advanced one tooth. Peck centres, of course, always move horizontally on one or other of the radial lines when the latter are in the position shown by *C-D* in which position they are to the right of the wheel centre. The wheel in this case is placed at the left hand end of the lay of the loom as viewed from the weaver's position. Dotted concentric circles in the wheel illustrated have been spaced, chiefly for greater clearness, the distance of two splits apart, so that one concentric space on the wheel represents two splits in the reed (4 threads) and two large vertical spaces in Figs. 3 and 4. Consequently, since 7 splits are required for the diameter of the peck ($\frac{1}{4}'' = \frac{7}{28}''$) and 2 splits for the travel, we have, 9 splits $\div$ 2 = $4\frac{1}{2}$ spaces of the wheel for the narrow part of the key stripe. (In Fig. 5 we have made this $4\frac{1}{2}$ into 5 in order to avoid complications in drawing.) All other portions may be calculated in a similar manner. In the outer groove, the peck centres are shown solid where the frame is lifted to form the spot pattern, but dotted where that frame, although traversed, is not lifted at that time. The frame is lifted or not lifted according to the presence

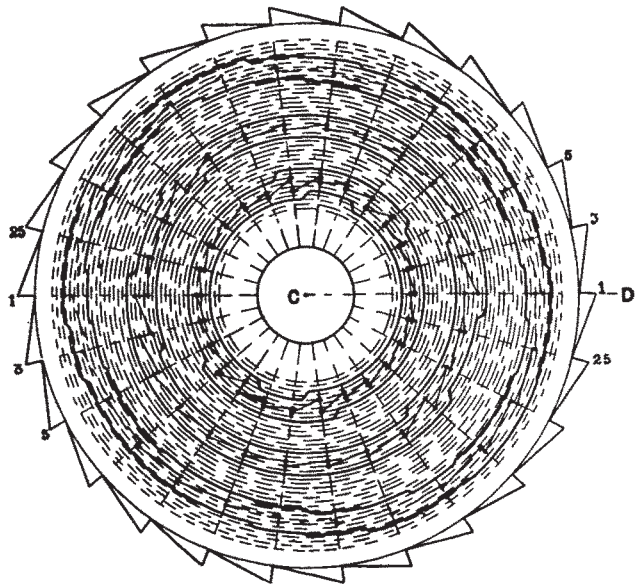

Fig. 5

or absence of a metal ring which is properly fixed in a circular groove formed in the back of the wheel; this is not shown in illustration.

(To be continued.)