12

Gauze and Leno Structures

In gauze and leno weaving certain ends—termed crossing ends—are passed from side to side of what are termed standard ends, and are bound in by the weft in these positions. The crossing and standard ends may be arranged with each other in various proportions, as 1-and-1, 1-and-2, 1-and-3, 2-and-2, 2-and-3, etc., but an essential condition is that each group of crossing and standard ends must be placed in one split of the reed. A crossed system of interlacing can be obtained when all the warp is brought from one beam, and in some cases this is essential in order to produce the desired effect. Very frequently, however, effects with such a difference in the take up are produced that it is necessary for the two series of ends to be brought from separate beams. The warp may consist entirely of crossing and standard ends, or stripes of these may be combined with stripes in which the ends interlace in the ordinary manner so as to form plain, twill, figure, etc. It is also possible for the crossing and standard ends to form the crossed interlacing alternately with straight interlacing in any required order. There is, therefore, almost unlimited scope for the production of variety of effect in striped, checked, and figured fabrics by combining gauze or leno with practically any other system of interweaving. Where the crossed interlacing occurs, an open, perforated structure may be formed, or the crossing ends may be interwoven in zig-zag form on the surface of a more or less compact ground texture. Nearly all kinds of yarns and yarn combinations can be used, but in open perforated structures particularly the threads should be as smooth, as uniform in thickness, and with as little loose fibre on the surface as possible. As the warp yarns in leno weaving are subjected to a higher degree of friction and greater stresses, their average strength should be higher than the minimum required for normal weaving.

The fabrics produced by this method are employed for curtainings, shirtings and for blouse and dress materials as well as for various industrial uses such as filter cloths, screens and sieves. Their great merit lies in a very considerable stability of the interlacing combined with its open nature. The size of the interstices can be determined precisely and will remain stable and uniform even under a degree of pressure.

The yarns used most frequently in the manufacture of these fabrics are cotton, spun rayon staple, cotton/polyester blends, filament polyamide and polyester, glass, and occasionally silk. Due to the friction associated with this system of weaving, yarns susceptible to static electrification should be well protected either by lubrication or by other techniques of static elimination or prevention.

THE PRINCIPLE OF LENO STRUCTURE

The terms leno and gauze are used somewhat indiscriminately but generally it is accepted that whilst leno may be applied to all structures in which some ends are transferred from one side to the other of the standing or standard ends, the term gauze is reserved for open structures produced in a plain or similar simple leno interlacing.

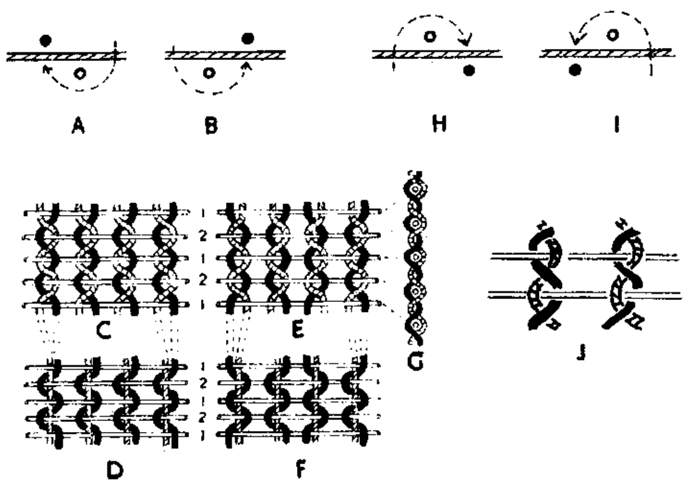


Figure 12.1

Although there exist a number of mechanically different systems to achieve the necessary lateral movement of one thread in respect of another the resultant structures produced by each of them may be identical. The thread manipulations required to produce the simplest structure of this type known as the plain leno or gauze are depicted in *Figure 12.1.* At A and B respectively cross-sectional views of two successive sheds are given in which at A the crossing end (black) forms the top shed on the left of the standard (white), and at B on the right of the standard end. Thus, in plain leno, using the bottom douping system illustrated at A and B, the crossing end is up and the standard end down on every pick but in between each successive shed the crossing end crosses under the standard end prior to each lift and the weft is held between the half-twists of the crossing end. The interlacing diagrams C and D show the appearance of the plain leno structure, the former obtained when one beam is used and the distortion of both the sets of ends is equal, and the latter achieved when the crossing ends are placed on a lightly tensioned beam and, therefore, bend prominently, and the standard ends lie straight being placed on a heavily tensioned beam. At E and F in *Figure 12.1* two other structures are given which correspond respectively with C and D but differ from them in that the alternate vertical rows of the leno in the former two are point drafted. This in effect means that whilst in one row the crossing end on a given pick crosses from left to right, in the next row the crossing end on the same pick crosses from right to left. Diagram G shows a section of a plain leno structure cut through the weft whilst the appearance of a plain leno cloth is illustrated in *Figure 12.2.*

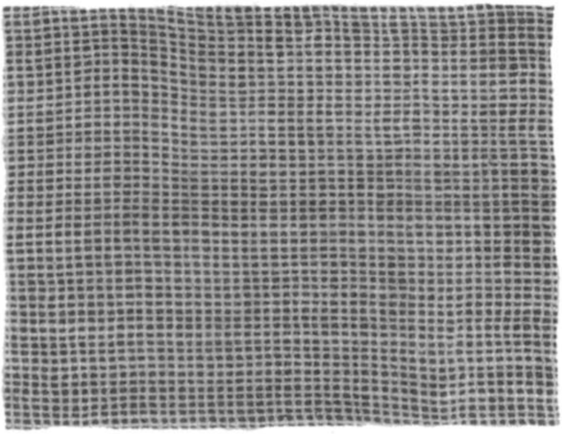


Figure 12.2

The cross-over of the crossing end may occur under the standard end as shown at A and B, which, as stated, is termed bottom douping, or it may occur over the the standard end which is termed top douping. The latter case is illustrated by the two successive shed diagrams given at H and I in *Figure 12.1* which show a situation exactly the reverse of the one depicted at A and B. At H the crossing end forms the bottom shed to the right, and at I to the left, of the standard end which on each pick remains in the top shed. Thus, in top douping the crossing ends are down and the standard ends up on every pick but as the crossing end is transferred alternately from one side of the standard to the other between each pair of sheds the weft is held securely in the half-twists of the crossing end. The interlacing diagram at J shows that the structure produced in this way is fully comparable with C except for the reversed position of the crossing and the standard ends in relation to the weft—the two could not be distinguished if one of them were to be turned over. As bottom douping is mechanically more convenient it is much more commonly encountered and most of the examples given subsequently have been worked out on the bottom douping principle.

The basic sheds of leno weaving

From the diagrams and the descriptions given in the foregoing it will be apparent that the crossing ends may be required to form sheds either on one or on the other side of the standard ends. In order to achieve this each crossing end must be controlled by two healds, the mails of which are placed one on either side of the standard end weaving in conjunction with the given crossing end. In order to prevent unnecessary see-sawing of the crossing yarns against the standard yarns upon the alternate shed formation the dual heald control over the crossing end is not direct but through an intermediary of a third element known as the doup. Thus, for the proper control of its operation each differently working crossing end requires three shedding elements. The crossing ends may be drawn through the warp beam to the front of the loom either on the left or on the right of the standard ends with which they combine to make the leno rows. If it is assumed that they are drawn on the left-hand side then each lift of the crossing end on the left will be quite a normal lift, as no transfer to the 'wrong' side of the standard is involved, provided that the heald which holds the crossing end on the other side of the standard releases its hold on the crossing end temporarily. This is ensured by the doup, and the shed on the left thus formed is illustrated schematically at A in *Figure 12.3* and is known as the *open shed.* Making the crossing end lift on the right involves first pulling it across from the normal side, i.e. the side on which it was drawn through, to the 'wrong' side which again is accomplished with the aid of the doup. This shed, known as the *crossed shed,* is illustrated at B in *Figure 12.3* and requires additionally the operation of an easer, an auxiliary element, which gives-in temporarily an extra length of yarn required during the formation of the crossed shed. Summarising: On open sheds it is necessary to raise the heald controlling the crossing ends on the normal side of the standard and the doup; on crossed sheds it is necessary to raise the heald controlling the crossing ends on the abnormal side of the standard, the doup and the easer. Although in the example given above the left has been designated as the normal, and the right as the abnormal side the situation would be reversed if the crossing ends were originally drawn through from the beam on the right-hand side of the standard ends instead of on the left.

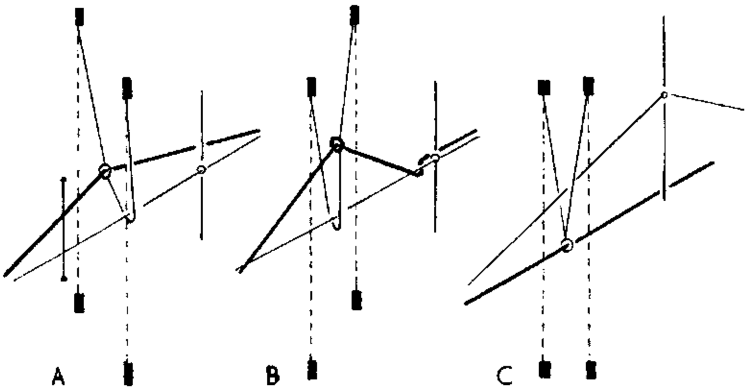


Figure 12.3

On both the leno sheds the standard end in bottom douping remains down if, however, on some picks of the construction it is required to lift the standard end to form the upper shed line whilst leaving the crossing end down then the standard heald is raised and all the elements which control the crossing end are left down. The lift of the standard end which is termed the *plain shed* is illustrated at C in *Figure 12.3.*

Methods of producing the leno structure

The method of control of the crossing end illustrated in schematic diagrams in *Figure 12.3* has at one time been used in hand-loom weaving and in slow-speed power-loom weaving to produce leno centre selvedges but is not applicable in modern high-speed weaving machinery. Equally so, the method which depended on the use of string or twine doups is at present employed only in exceptional circumstances and cannot be any longer considered as a major system of leno fabric production. For this reason it is dealt with in Appendix I together with the other traditional mountings. The main methods of production of leno and gauze structures in current use may be listed as follows:

(1) Flat steel doups with an eye.
(2) Flat steel doups with a slot.
(3) Gauze and tug reed mechanisms.
(4) Eyed needle and slider frame devices.
(5) Rotating bobbin and geared disc mounting.

The first four systems given are considered subsequently in the order in which they are listed. The last system is only mentioned because it represents an entirely different principle of twisted thread formation obtainable in weaving but as it is only applicable to the construction of leno selvedges it cannot be regarded as a cloth or a design-forming element.

In addition to the main leno-forming elements most methods of leno production require an easer the function of which has been already mentioned. In some circumstances where open or semi-open shedding motions are employed another auxiliary mechanism may be necessary and this is known as the shaker or the jumper. The device is described later—at this juncture it will be sufficient to realise that it is necessary to bring the standard heald level with the leno healds between the sheds when the transfer of the crossing end from one to the other side of the standard end is taking place.

LENO WEAVING WITH FLAT STEEL DOUPS WITH AN EYE

The simple type of flat steel doup in which the doup needle has an eye at the top is somewhat limited in terms of figuring capacity and is, therefore, mainly employed in the production of industrial fabrics in the plain leno weave as shown in *Figure 12.1.* However, it can also be used successfully for simple ornamental fabrics and is particularly useful for effects in which ordinary cloth is combined with leno in stripe formation.

The flat steel doup assembly or unit consists of a doup, shown at D in *Figure 12.4,* and two lifting healds designated H1 and H2. Each lifting heald is composed of two identical flat steel strips joined together at a point marked W by a spot weld. The doup or doup needle has an eye at the top through which the crossing end is drawn and it sits in a sliding fit between the flat strips of the lifting healds H1 and H2 thus bridging the gap between them. Each lifting heald is controlled by its own heald frame in the usual manner through the steel rods fitting at A whilst the doup needles are threaded upon their own rods at B. The two rods B are spring loaded through a double yoke arrangement to ensure the return of the doup after each lift. Each lifting heald is capable of raising the

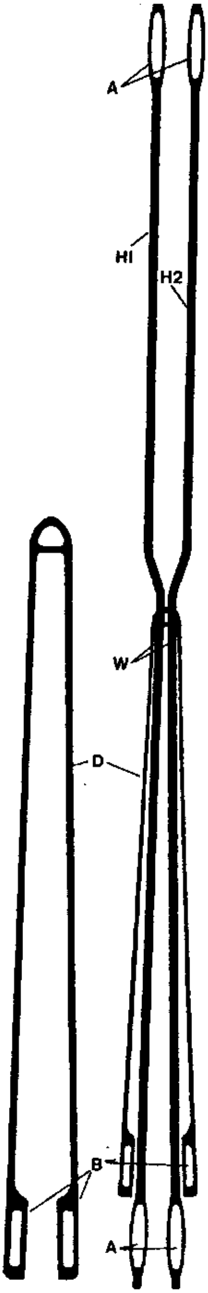


Figure 12.4

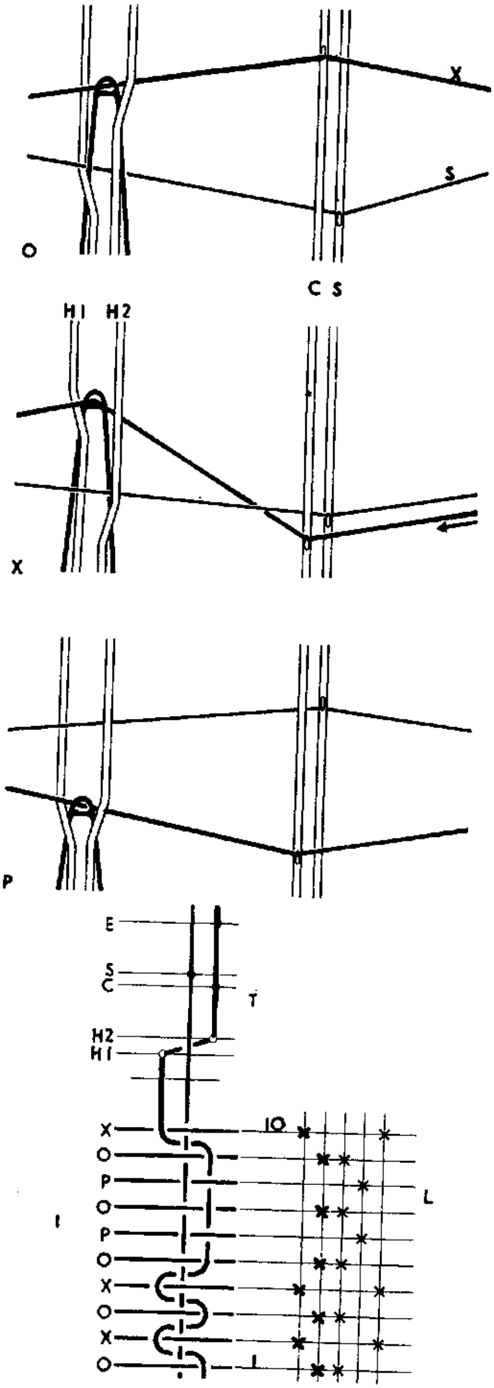


Figure 12.5

doup due to the presence of the spot weld in the flat strips and in the production of plain lenos the elements H1 and H2 lift alternately.

The formation of the leno sheds in this assembly is illustrated at O, X and P in *Figure 12.5* which respectively show the open, crossed, and plain sheds. It will be noted from these diagrams that the leno assembly is mounted at the front followed some distance behind by the heald controlling the crossing end and finally by the standard heald. The gap between the leno assembly and the first of the ordinary healds is intended to reduce the angle at which the crossing ends lift during the formation of the crossed sheds and the best results are obtained when the distance of the gap is approximately 10 cm.

In the draft T in *Figure 12.5* it will be noted that the crossing end is drawn on the right side of the standard which means that any sheds formed by this end on the right will be open sheds and any sheds formed on the left of the standard will be crossed sheds. The diagram O depicts an open shed which is achieved by the lift of the right-hand side lifting heald, H2, and the crossing end heald, C, the H2 element being responsible for raising the doup. The formation of the crossed shed is shown in the diagram X in which the left-hand side element of the doup assembly, H1, is raised. This action transfers the crossing end to the left-hand side of the standard and is assisted by the simultaneous operation of the easer, indicated by the arrow on the right of the diagram, to provide the extra length of yarn necessary to compensate for the cross-over. The heald C on crossed shed remains down. In fact, the crossing-end control heald C could be entirely dispensed with and both sheds could be achieved by the doup lifting action alone but this is rarely practised now since it was established that without this heald the sawing action of the crossing end against the standard end and standard heald upon the formation of crossed sheds is much more severe. Formation of the plain shed is depicted by the diagram P and involves the lift of the standard heald S only, all the crossing-end control elements remaining down.

In the draft, T, in *Figure 12.5* the crossing end is shown to be controlled by the easer, E, the heald C and the two lifting heald elements of the leno assembly, H1 and H2. The standard end is controlled by the standard heald alone. At I, one full repeat of the construction consisting of 10 picks, is represented by means of an interlacing diagram. In it each shed is designated by a symbol O, X or P to indicate what type of shed is formed. The correct designation of the sheds in leno weaving is important as it determines which shedding elements are pegged or cut on each pick. Thus, it will be noted from the lifting plan L that on pick 1, which is an open shed, H2 and C are pegged; on pick 2—a crossed shed—H1 and the easer are pegged and on pick 6—a plain shed—the standard heald is pegged. The doup lifts on every pick on which either one of the two lifting healds, H1 and H2, is raised.

Upon examination of the interlacing diagram I it will be seen that in one repeat of the depicted construction there are five open sheds and three crossed sheds and this illustrates a point of some importance. In leno weaving the formation of a crossed shed always creates an additional strain and, therefore, other conditions being equal the side on which there are fewer lifts of the crossing end should always be designated the crossed shed side. The diagram I illustrates the appearance of the construction when it is produced with two beams, the beam carrying the standard ends being the more heavily tensioned. However, the same construction could be equally well produced, with a single beam, only in such a case both sets of ends would be displaced similarly producing a cloth with a different appearance.

Weaving with more than one leno assembly

Using a doup with an eyelet, each different order of manipulation of the crossing end requires an additional leno assembly. The method of mounting of the additional assemblies is similar in as much as all the leno assemblies are mounted at the front, then follows a gap after which are mounted the crossing end healds in a consecutive order, then the standard healds, also in consecutive order so that the standard healds working in conjunction with the first leno assembly come first, those working with the second assembly come second, and so on. As the crossing sheds between the differently patterning leno rows occur usually on different picks each assembly normally requires its own separate easer bar each of which must be individually controlled. It is obvious that each additional leno assembly results in a greater complexity of the draft and of the weaving process and for this reason more than two leno assemblies are rarely employed on any one loom. A construction produced with the aid of two leno assemblies or units is illustrated in *Figure 12.6* and is described in the following section.

Point draft or counter leno

By referring to *Figure 12.5* it will be seen that by drawing in the crossing end in a neighbouring leno row on the left of the standard instead of on the right and crossing it to the right it would be possible, using the existing elements, to produce a novel structure in which the alternate leno rows would work in a mirror image order. The point draft or counter leno is often employed because it permits the creation of new and different effects with a considerable economy in the number of the shedding elements used.

Figure 12.6 illustrates quite an ornate tie cloth construction produced on the counter leno principle with the use of only two leno units and six ordinary healds. The actual appearance of this cloth made from filament polyester yarns is shown at A in *Figure 12.7*, whilst at B the same cloth is given enlarged four times.

The diagram I in *Figure 12.6* provides a pictorial representation of two weft repeats and one warp repeat of this cloth from which it will be seen that the construction consists of four leno groups, each with one crossing and two standard ends, but only two leno assemblies. This is achieved by making each pair of neighbouring leno groups operate on the counter leno principle thus utilising the same lifting unit twice over in a point draft fashion. The crossing ends 1 and 4, numbered at the bottom of I, are both raised on exactly the same picks but whilst 1 makes open sheds on the right, and crossed sheds on the left of the standard ends, 4 makes open sheds on the left and crossed sheds on the right. In this way two crossing ends are made to converge towards, and diverge away from, each other forming a cell-like structure. The crossing ends 7 to 10 work similarly but on different picks and between them utilise the second leno assembly. The full draft is shown at T from which it may be noted that two easers, E1 and E2, are used and the two sets of ends come from separate beams to permit full sideways deflection of the crossing ends whilst keeping the standard ends straight. The order of pegging or cutting of the various shedding elements is given in the lifting plan L.

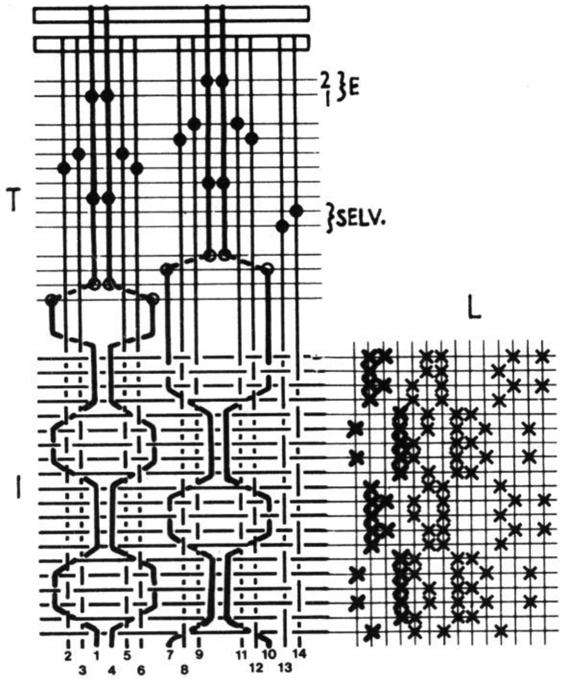


Figure 12.6

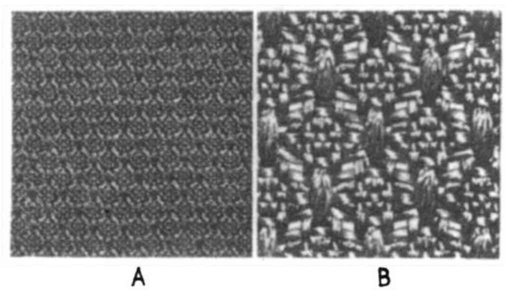


Figure 12.7

The ends 13 and 14 which are shown in the construction in *Figure 12.6* are not part of the leno structure but represent the selvedge ends. They are included to illustrate the most advantageous point at which the staves which control the selvedge ends can be placed. It may be noted at this juncture that whilst the standard healds may occasionally be used for the selvedge end control in leno weaving, particularly when they are operated in a continuous plain or other simple weave order it is generally preferable to use separate healds for the selvedges. When separate healds are used, as in the example given, then they should be placed in front of all the other ordinary healds and behind the leno units exactly as shown in *Figure 12.6.* In this way the 10 cm gap between the leno assemblies and the other healds is partially utilised without the slightest interference with the structure as these selvedge staves, obviously, do not carry any mails in the centre of their span.

In the structure in *Figure 12.6* as in the previous structure the open shed side has again been designated as the side with the greater number of lifts of the crossing end and it may be noted that the crossing end lifts five times on the open, and only twice, on the crossed shed side in each weft repeat. Although in the example given two leno units have been employed it will be readily appreciated that a considerable variety of effect in counter lenos can be achieved with only one unit and this type of work is exemplified by the left-hand side portion of I in *Figure 12.6* in which the cell structure achieved by ends 1 to 6 utilises only one leno unit.

Special lifts of the standard ends

As the doup with an eyelet is somewhat limited in the figuring capacity and the multiplicity of the leno units increases the difficulty of weaving, structural variation is sometimes achieved with considerable economy by an ingenious order of lifts of the standard ends.

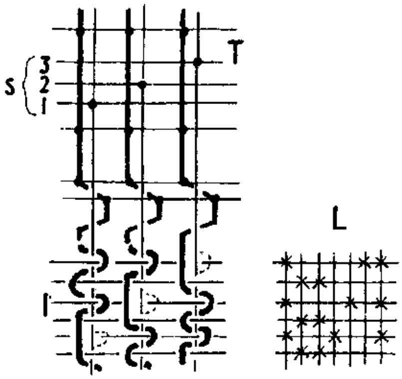
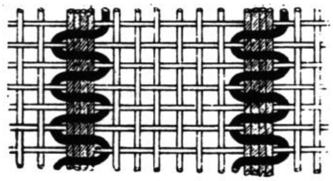


Figure 12.8

At I in *Figure 12.8* a structure is shown in which a twilled leno effect is produced which at first sight appears to require three leno assemblies. On closer scrutiny, however, it becomes clear that it can be obtained with a single leno unit and the use of three standard healds. The two lifting healds of the leno assembly operate alternately forming open and crossed sheds as in the plain leno. On certain selected crossed sheds, however, the standard end is also lifted which ensures that the crossing end cannot remain in the crossed position because there is nothing to retain it there and will return to the open shed side due to tension thus creating a long float. The temporary crossed shed positions of the crossing end are indicated in the diagram I by the dotted lines. The draft for this structure is given at T and the lifting plan at L in *Figure 12.8*. The frequency at which the trick lifts of the standard ends occur must be judged carefully otherwise a loose structure is liable to result.

Russian cords

Figure 12.9 shows a leno and plain weave stripe fabric termed a Russian cord. The structure is quite solid and consists usually of a number of ends weaving plain in a stripe arrangement interspersed by ends in a strongly contrasting colour which produce the leno stripe. The leno stripe contains one or two thick standard ends or a larger number of fine standard ends over which the crossing end passes from side to side on succeeding picks. The weft in the leno stripe is entirely concealed, the surface being formed by a distinctly bulging cord effect. The face side of the cloth is given in the interlacing diagram at R in *Figure 12.9* but the fabric is normally woven face side down with a bottom douping arrangement. It will be noted from the diagram that the crossing ends form crossed and open sheds on alternate picks and, therefore, the two lifting healds of the leno assembly work exactly as in the plain leno. Cords as wide as 6 mm have been successfully woven in flat steel doup assemblies using the simple doup with an eyelet.



R

Figure 12.9

Fabrics of this type are comparatively densely wefted which causes the oscillating crossing ends to create a solid wrapper effect. Heavy cord lines are thus produced which, on account of the contrast in colour with the ground warp and weft, appear to be formed in extra weft. The crossing warp requires to be very much longer than the standard warp, and in the example is about four times as long, but the proportionate lengths vary according to the reed, the picks of the cloth, and the bulkiness of the standard ends. Variety of effect is sometimes given to these styles by having the standard ends different in colour from the crossing ends, and ceasing to form either the crossed or the open sheds for a number of times in succession. The thick standard ends are thus left uncovered by the crossing ends for a space, the latter lying straight in the cloth and being practically concealed by the former, hence the continuity of the coloured line is broken by spots of another colour.

Simple net lenos

The term net or spider leno is commonly applied to doup styles in which the crossing ends are mostly floated on the surface of the cloth, and are interlaced so as to form waved lines. The effect formed by the crossing ends is usually a chief feature of the pattern, and these ends, therefore, require to be of special material, colour, or thickness so that they will show in clear contrast with the ground. Each group of standard ends generally forms a compact ground structure across which the doup ends are traversed, the latter ends being really introduced on the extra warp principle. An open appearance is, however, sometimes given to a fabric by suitably missing splits between the groups of ends.

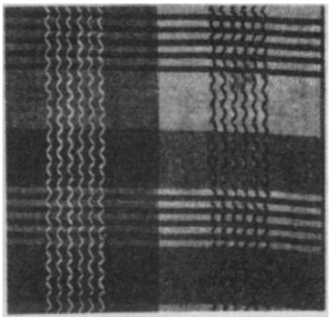


Figure 12.10

Figure 12.10 illustrates a style in which the crossing ends are all drafted in the same direction across four standard ends. A portion of the structure, showing how the threads interlace, is represented at I in *Figure 12.11*, while the draft is given at T, and the lifting plan at L. The standard ends, as is very frequently the

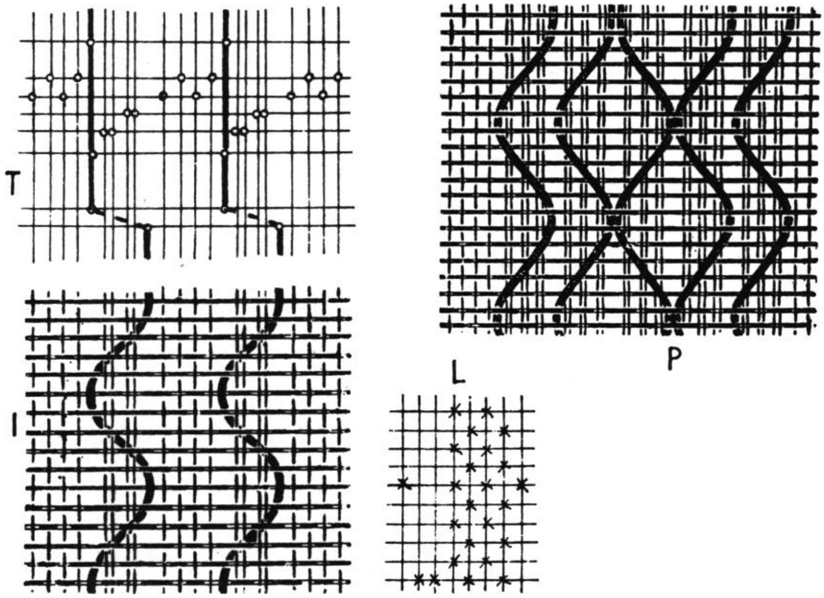
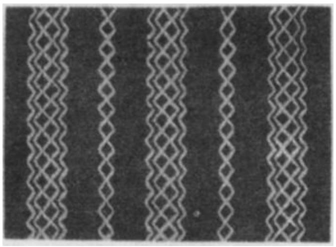


Figure 12.11

case in these styles, work two ends together in plain order throughout, so that they will spread out as much as possible; and they are also kept as straight as possible in the cloth, so that the maximum amount of traverse will be given to the crossing ends. *Figure, 12.11* illustrates the production of the effect wrong side up with a bottom doup, the crossing ends being lifted on one pick in every five. The order of lifting fits with the plain interweaving of the standard ends; thus, where a crossing end is raised, the double standard end next to it is left down, and the former is held by the weft against the latter. *Figure 12.10* illustrates a good method of colouring the ground of a net leno style. Thus, light crossing ends are introduced on a dark ground and dark crossing ends on a light ground, while to correspond with the vertical lines formed by the crossing ends narrow horizontal lines are formed by light picks on a dark ground, and by dark picks on a light ground. The fabric represented in *Figure 12.12* shows a modification of the last style produced by point drafting, a method which can be used very effectively for giving prominence and variety to the zig-zag interlacing. A flat view, showing the interweaving of the threads in the broad leno stripe, is given at P in *Figure 12.11*, in this case the effect being shown face side up although normally it would be produced face side down using the bottom douping system.

Figure 12.12



As each group of crossing and standard ends must be placed together in one split of the reed, the denting of these styles is a very important feature. For example, in the fabric represented in *Figure 12.12* there are 22 ends in each plain stripe which are dented two per split, while in the narrow doup stripe there are two groups of ends which must be placed in two splits, and in the broad doup stripe five groups, which must be placed in five splits. The narrow doup stripe, however, occupies the width of 12 ends, or six splits of the plain stripe, and the broad doup stripe the width of 26 ends or 13 splits. As a general rule, the effect can be produced by suitably missing splits between the groups of ends, the double standard ends, in working plain, readily springing out and filling up the spaces created.

Simultaneous bottom and top douping

The system in which the two ends which form a leno weave are both drawn through the eye of a doup needle, one operating as a bottom doup and the other as the top doup, is particularly useful in weaving yarns which are susceptible to sideways deflections. In ordinary forms of leno weaving formation of the crossed shed inevitably results in severe angular deflections of the crossing ends and a degree of rubbing between the yarns or between the yarn and the healds. Some materials, such as fibre glass or low twist woollen yarns, would be difficult to weave in those conditions which can be appreciably alleviated by the use of the double-doup mounting.

The principle of operation of this type of mounting is illustrated at X, O and P in *Figure 12.13* from which it can be observed that the crossing end is mounted in the leno assembly operating as the bottom doup whilst the standard end is

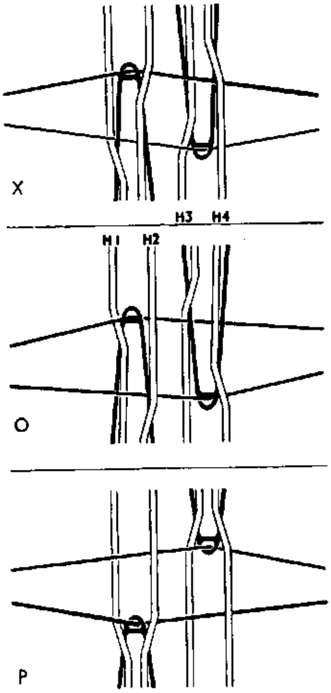


Figure 12.13

mounted in the top doup leno assembly. As opposed to the normal system where the crossing end is displaced in respect of the standard, in the double-doup mounting the two ends are mutually displaced one in respect of the other by the opposite movements of the two respective doups. At X the crossed shed is formed by the crossing end moving up (H2 lift) on the right of the standard as the standard end is simultaneously moving down on the left of the crossing end (H3 drop). Exactly the opposite situation occurs at O in which H1 is raised and H4 is dropped. The position of the lifting healds during the formation of plain sheds is shown at P. It will be realised that the bottom doup needle is spring-loaded in the downward direction so that it is pulled down after any lifts by either H1 or H2 whilst the top doup needle is springloaded in the upward direction being pulled up after each downward pull by either H3 or H4.

Although the above system offers the advantage of reduced bending or deflection of the yarns it is rather limited in its figuring capacity. For greatest ease of weaving the number of the crossed sheds in the weft repeat of the weave should be balanced by an equal number of the open sheds. This, however, does not preclude the plain lenos which are frequently produced on the double-doup systems or such simple fabrics as those illustrated in *Figures 12.14* and *12.15*. The construction illustrated in *Figure 12.15* is suitable for cellular woollen blankets and shows the possibility of using the double-doup mounting for the production of point or counter leno effects. In both the above figures the

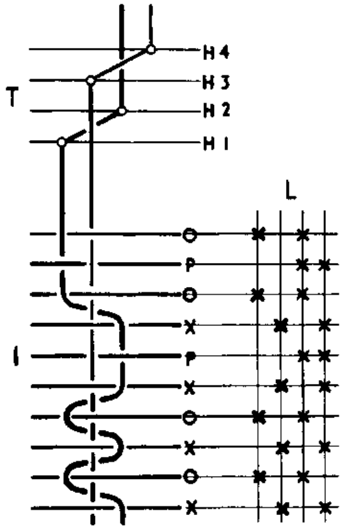


Figure 12.14

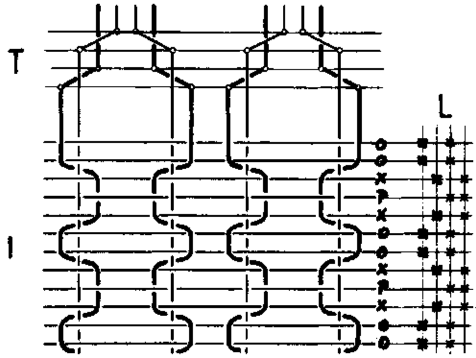


Figure 12.15

interlacing diagrams are designated by the letter I, the drafts by T and the lifting plans by L whilst the types of shed formed on each pick are marked by X, O and P referring respectively to the crossed, the open, and the plain sheds. The actual appearance of a cellular blanket is shown in *Figure 12.16.*

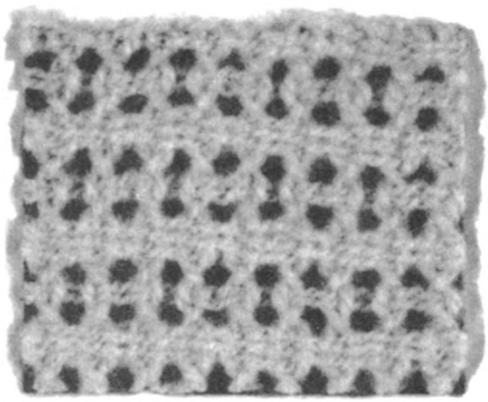


Figure 12.16

The mounting offers an additional mechanical advantage in that, due to an equal amount of displacement in both sets of ends, there is no need for an easer motion and neither is there any necessity for a shaker device.

LENO WEAVING WITH FLAT STEEL SLOTTED DOUPS

When the doups with an eyelet are used any differences in the order of interlacing between vertical rows of the structure.require normally the use of additional leno assembly frames. This, as has been stated, adds to the difficulties of weaving and for this reason is avoided if possible. The slotted doup offers a possibility of obtaining different interlacings in the neighbouring rows of leno with the use of only one leno assembly frame and is, therefore, employed in all figured leno constructions.

The slotted doup needle is shown in *Figure 12.17* at D where it will be seen that whilst one leg of the needle is open the other one is solid. The needle could be reversed either way so that the slotted or open leg could be placed on the right or on the left. The leno unit or assembly with the slotted doup is illustrated side by side and the principle of operation of this unit is identical with the one given in *Figure 12.4* in connection with the simple eyelet doup. The difference between the two lies in the fact that when the lifting heald, H2, of the assembly is raised the crossing end does not need to rise with it. It may remain in the bottom shed by running down into the slot if an additional control heald, through which it is also threaded, remains down as well. If there are, say twelve separate control healds through which the adjacent crossing ends are drawn then twelve different interlacings on the slotted side are possible and the control healds must, therefore, be regarded as figuring healds. The slotted side is the open shed side of the structure, therefore, the choice of whether a lift does or does not take place exists only on the open shed side. No such choice exists on the crossed shed side because when the lifting heald, H1, lifts the doup it bars the slot and the crossing end must lift to the top with the doup. As already stated the position of the slot may be reversed and in addition to the freedom of choice of the lifts on the slotted side there is also the possibility of point draft or counter leno operation.

The principle of weaving lenos with slotted doups is illustrated in *Figure 12.17* where a construction is shown in which a crossing end operates in conjunction with two standard ends—an arrangement frequently employed in the production of marquisettes. The two standard ends usually weave plain but may be operated in other weaves if desired. The crossed shed is formed as before with the lifting heald, H1, of the leno assembly up and the easer operated to release a length of yarn as indicated at X, the leno figuring heald F remaining down. The normal open shed shown at ON is also formed in the same way as in the eyed doup, i.e. with the lifting heald of the leno unit, H2, up and the crossing end control heald (or figuring heald) F up. At OA the open shed is shown upon which the option to lift the crossing end to form a leno binding is not exercised because the heald F has been retained in the low position and the crossing end is thus permitted to slide down the slot. If necessary, plain sheds in which all the elements controlling the crossing end are down and one or both standards are up can also be made and such a shed is shown on pick 7 at I in *Figure 12.17* but as there is no advantage in this the interruption of leno binding is normally produced by lowering heald F on open sheds as illustrated at OA and at I on pick 5. The construction given in the interlacing diagram at I with the draft at T and the lifting plan at L has been selected to illustrate all the possible shed formations in slotted doup weaving and, apart from the two sheds already referred to, it will be noted that crossed sheds are formed on all the even picks, normal open sheds on picks 1 and 3 and an open shed combined with a trick lift of the standard end on pick 9. On the latter pick due to the lift of the second standard end crossing end binds across only one standard instead of two as on picks

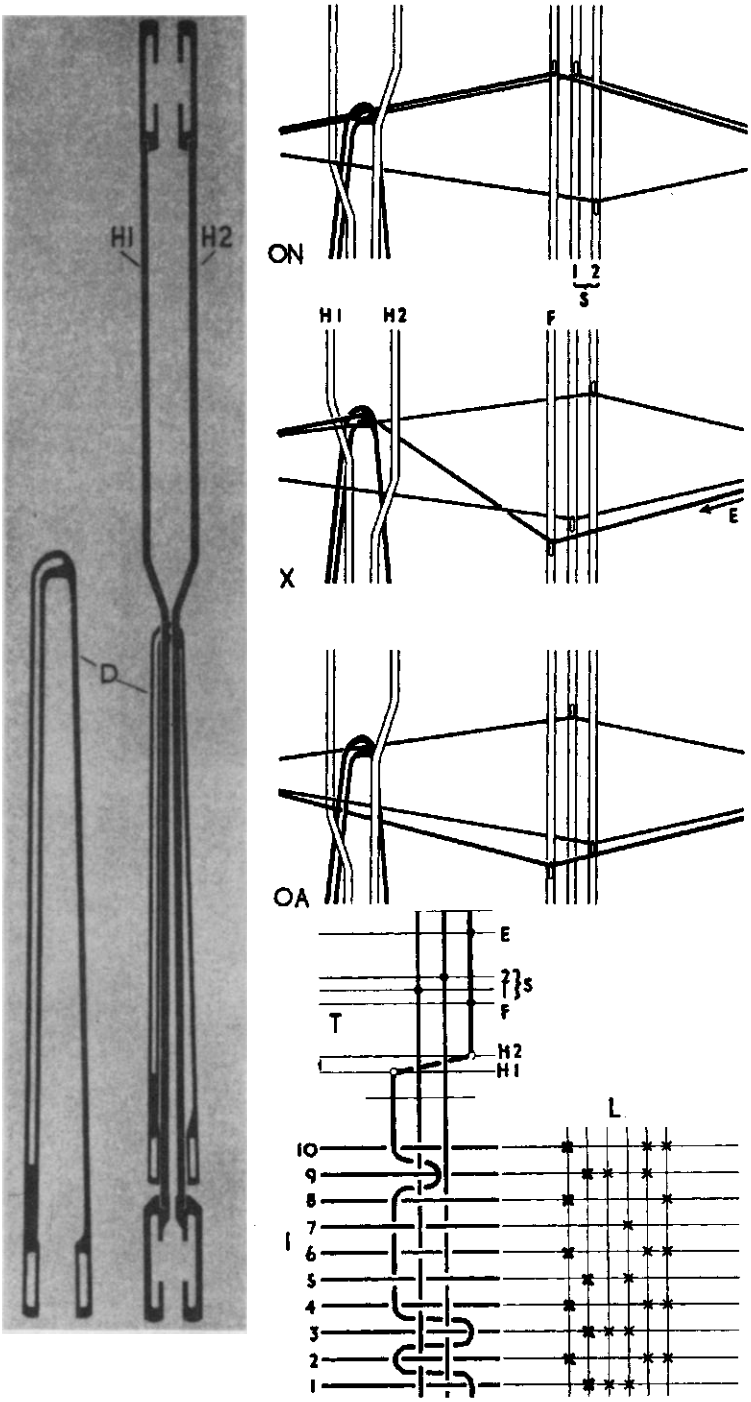


Figure 12.17

1 and 3. Trick lifts of the above type could, of course, be operated in reverse on the crossed sheds.

Frequently, in weaving lenos on slotted doups the two lifting healds of the leno assembly, H1 and H2, are operated alternately throughout and structural variations are obtained by suitable manipulations of the leno figuring healds. This has the advantage of never lowering the doup to the bottom as between sheds it only descends half way down before it is taken up again so that reduced spring loading can be applied to the doup return motion with the resultant reduction of strain and wear on the leno assembly. On the other hand if it is required to make several sheds in succession the lifting heald H2 and the doup can stay up for as long as necessary with only the leno figuring healds working and this also results in less wear.

Simple figured effects

The slotted doups when combined with a large number of figuring healds lend themselves particularly well to the production of twilled or diamond effects in

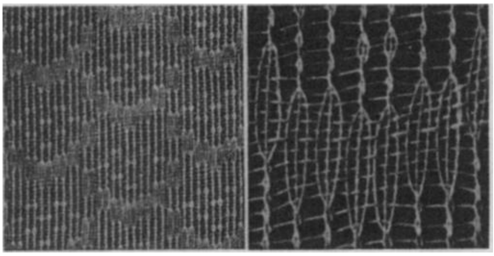


Figure 12.18

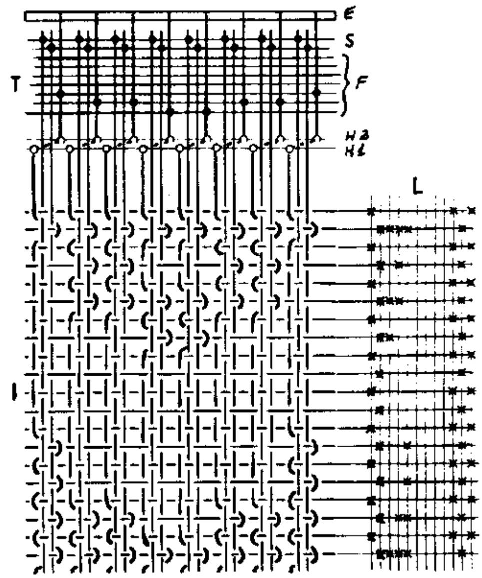


Figure 12.19

open curtaining fabrics. A cloth of the above type is shown in *Figure 12.18*—actual size on the left, enlarged on the right. It repeats over 24 leno groups, each containing three ends, one crossing and two standard, and requires only one doup assembly, seven leno figuring healds point drafted in pairs, and two standard healds. The size of the full repeat weft-wise is 32 picks. A portion of the repeat which corresponds with the enlarged illustration in *Figure 12.18* is shown in the interlacing diagram I in *Figure 12.19.* The two lifting healds of the leno assembly operate up and down alternately as indicated in the lifting plan, L, forming crossed sheds on every even pick and permitting open sheds to be formed on every odd pick. However, as will be noted, the figuring healds F are dropped on some open sheds thus ensuring that these do not take place. As a result the crossing end on those occasions stays down and remains on the crossed shed side of the standards producing the figured effect which is clearly visible. The standard healds, S, operate a continuous plain weave and the easer bar, E, is raised on every crossed shed as usual. In the draft, T, only the first three figuring healds are shown drawn through but the full draft can easily be constructed by reference to the cloth in *Figure 12.18.*

Structures produced with two crossing ends per slot

In addition to the effects in which one crossing end works in conjunction with two or more standard ends attractive effects are frequently produced in 2-crossing-2 styles in which two crossing ends are threaded through each doup

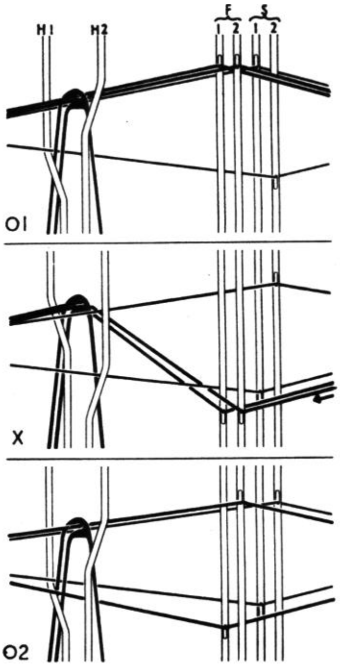


Figure 12.20

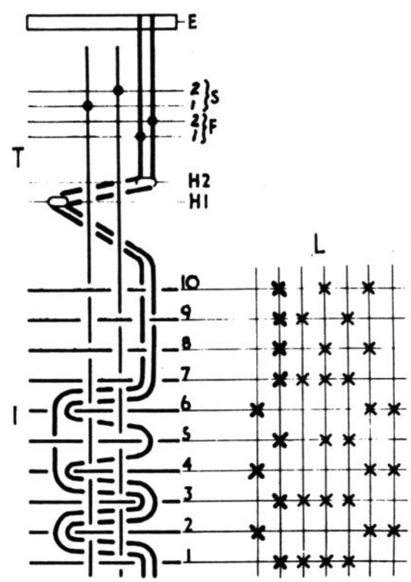


Figure 12.21

slot. The operation of the doup assembly in such a structure is shown at X, O1 and O2 in *Figure 12.20.* At X a crossed shed is formed and both the crossing ends in the slot must lift to form this shed. On the open shed side, due to the control exercised by the figuring healds, the crossing ends may both be lifted as at O1, or only one may be lifted, the other remaining down as at O2, or indeed, if so required, both may remain down.

In the interlacing diagram shown at I in *Figure 12.21* various interlacings are shown. Crossed sheds are produced on picks 2, 4 and 6 and straightforward open sheds with both crossing ends lifting on picks 1, 3 and 7. On pick 5 a special effect is produced because one crossing end makes an open shed in an orthodox manner whilst the other stays down and because it is down between two crossed sheds it remains on the crossed shed side so that one crossing end is on the side of the standards and one on the other side. On picks 8, 9 and 10 the crossing ends make open sheds alternately which in effect results in a bar of plain weave across the cloth. The standard ends operate in a continuous plain weave but in common with other leno structures this operation could be interrupted to produce trick lift effects or weaves other than plain in conjunction with the crossing ends. The draft at T and the lifting plan at L indicate the manner of operation of the shedding elements, the healds being designated as in the previous diagrams.

Use of slotted doups for point draft or counter lenos

The actual and enlarged views of the cloth in *Figure 12.22* represent a cellular shirting or blouse materials frequently made on the point draft leno principle. The technique of counter leno weaving in the slotted doups does not differ from that explained in connection with the eyed doups apart from the freedom which exists on the open shed side due to the presence of the slot. In the first fabric illustrated by the interlacing diagram I in *Figure 12.23* this freedom of patterning is not utilised and, in fact, the construction at I, which represents the cloth illustrated in *Figure 12.22,* is so simple that it could have been

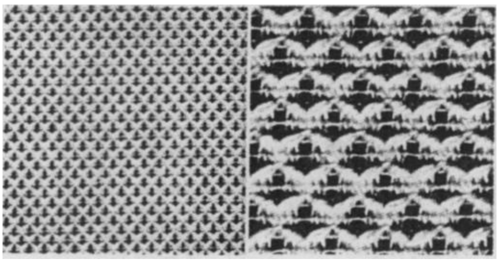


Figure 12.22

produced on the ordinary eyed doup. It is given mainly to show the various drafting possibilities which exist when two doup assemblies are used. The need for the two doup assemblies in this case exists not as a result of the complexity of the structure but solely due to the density of the cloth. The interlacing diagram I and the lifting plans L1 and L2 represent the fabric as it is woven,

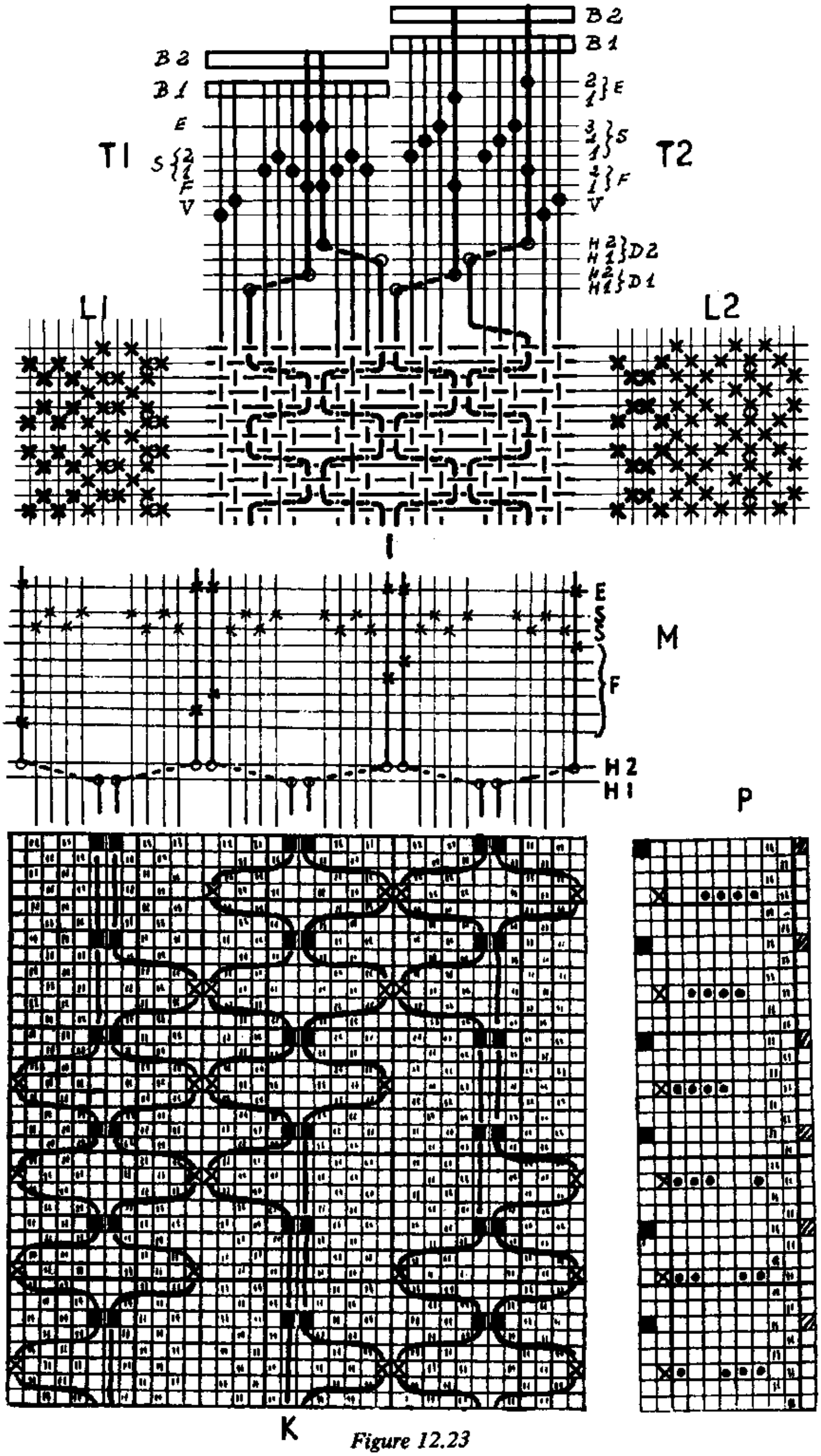


Figure 12.23

which is face side down. Due to considerable displacement of the crossing ends two beams are required and these are designated B1 and B2.

At T1 and T2 two drafts are illustrated. Draft T1 is the normal draft in which the crossing ends in the leno assemblies cross the standard ends to the left and to the right in alternate leno groups. All the crossing ends are drawn through the same figuring heald. The three standard ends which together with one crossing end form a leno row or group are drawn point draft fashion over two standard healds and, as the crossing ends which belong to the first and the second leno assembly make the crossed sheds on the same picks, one easer is sufficient. In the alternative draft, T2, the two leno assemblies are drawn so as to permit one set of crossing ends to form an open shed as the other set makes the crossed shed. In this way the tension across the warp is equalised better and more even running of the loom can be expected. Due to this arrangement two figuring healds and two easers become a necessity. The standard ends are straight drafted over three standard healds. The space between the leno assemblies and the figuring healds is, as usual, occupied by the selvedge frames, V, in both drafts.

To indicate that much more elaborate effects can be produced on the point draft system with the slotted doups than the one given at I in *Figure 12.23*, another construction is illustrated at K. This structure is portrayed with the aid of design paper which represents a quicker technique of designing than the interlacing diagram. The lifts of the standard ends are shown by the double vertical marks, the crossed sheds by the solid marks and the open sheds by the crosses whilst the floats of the crossing end between the lifts are represented by the thick continuous lines. Using bottom douping the cloth would be woven face side down as indicated in the lifting plan P. It will be noted that in the design a separate vertical row has been allocated to every crossing end on each side of a group of four standards under which the crossing end floats. Two vertical rows of design paper are required for each crossing end as space must be available to show the lifts of the crossing ends on the open *and* on the crossed shed side of the standards.

In the draft M the shedding elements are marked according to the previously established designations and from the design it is clear that quite elaborate and large repeats, in this instance 30 ends × 36 picks, can be achieved with a single point drafted doup assembly if the density of the cloth is not very high.

The double-slotted flat steel doups

This form of doup shown in *Figure 12.24* permits further extension of the patterning capacity of the flat steel doup and ensures particularly efficient locking of the threads within a leno row thus making the unit especially valuable for very open figured leno fabrics.

The leno assembly with the double-slotted doup has two crossing ends each threaded through its own slot. A number of standard ends, usually not less than two, are drawn on the standard healds and pass between each pair of lifting healds H1 and H2. When one lifting heald of the leno unit is raised one of the two crossing ends compulsorily forms a crossed shed whilst the other is at the same time free to make an open shed. As both ends are also drawn each through its own figuring heald the freedom to produce an open shed exists for either of them. The drafting in the assembly is such that when both the crossing ends are raised on one side of the group of standards with which they form a leno row one of the crossing ends is in the crossed, and the other in the open shed position. This means that for the double-slotted assembly two easer bars are a necessity. Both the crossing ends may be raised together on one or the other side of the standards or each can be made to operate on the opposite sides of the group of standard ends.

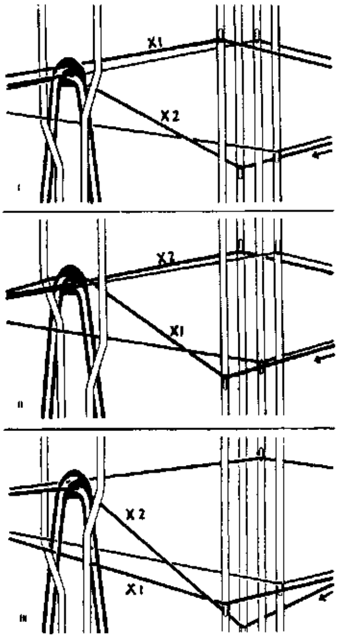


Figure 12.24

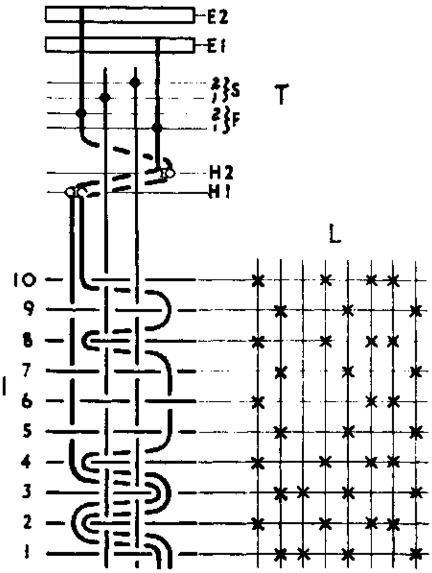


Figure 12.25

The essential manipulations of this assembly are shown at I, II, and III in *Figure 12.24* where at I both crossing ends are raised on the right of the standard ends, crossing end 1 in the open and crossing end 2 in the crossed shed; at II both are raised on the left but now with X1 in the crossed end X2 in the open shed; at III X2 is up in the crossed shed but X1 remains down. The effect of these manipulations is shown in the interlacing diagram I in *Figure 12.25* where on picks 1 and 3 operation of healds as given at I is necessary; on picks 2, 4, 8 and 10 the healds operate as at II; on picks 5, 7 and 9 as at III; and on pick 6 the situation opposite to that shown at III takes place. The method of drafting for the double-slotted doups is indicated at T and the lifting plan for the construction is given at L.

A more elaborate structure produced on a double-slotted doup assembly is shown in the actual and enlarged views in *Figure 12.26* for which a partial interlacing diagram, I, with the draft T, and lifting plan L to correspond are given in *Figure 12.27.* In this structure two leno ends are drawn in each slot and these operate in conjunction with four standard ends so that each leno row consists of eight ends. In the leno working portions of the design the four crossing ends cross the four standards on every pick thus drawing the eight ends together very closely. The figure is produced by permitting the eight ends to spread apart in selected areas by operating them in a double-ended plain weave.

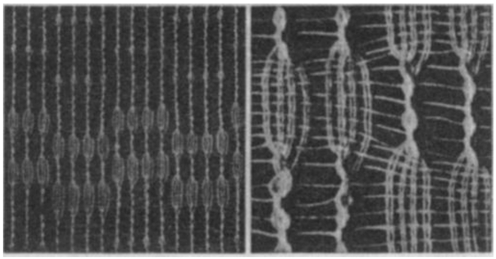


Figure 12.26

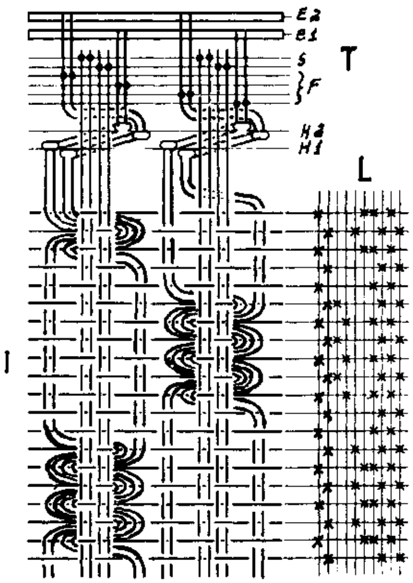


Figure 12.27

As shown in *Figure 12.26* quite a large figure repeat is achieved with the use of only one double-slotted doup assembly, four leno figuring healds, two standard healds and two easers.

It will be noted from the two examples given that a feature of the double-slotted doup operation is the alternate lifting of the two lifting healds of the leno assembly. In this way on every pick one of the two crossing ends forms a crossed shed whilst the other is free to be raised or dropped by its figuring heald as desired.

EQUALISATION OF YARN TENSION IN OPEN AND CROSSED SHEDS

The crossing ends in leno weaving may at any given pick form crossed, open or plain sheds (q.v.). The latter two types of shed do not place any extraordinary strain upon the ends but the formation of the crossed shed involves the transfer of the crossing end and its lift on the wrong side of the standard. To form a clear shed at the front the crossing end must be so placed that it does not lift the standard ends under which it has crossed. This placing is achieved normally by the control heald which on crossed sheds is down holding the crossing ends behind the doup well clear of the standards which in effect results in an acutely angled back shed. The combination of the acute back shed with the lateral movement of the crossing end would extend the crossing end severely and to prevent this, on the formation of a crossed shed, an extra length of yarn should be provided. This is achieved by the easing action which may be negative or positive in nature.

Negative easing action

One of the simplest devices for providing an extra length of yarn during leno weaving is a spring loaded equaliser bar. This is, as a rule, placed behind the standard healds in the manner shown in *Figure 12.28* and is particularly useful in tappet looms as it saves the use of a crossing end control heald frame. The bar is operated by the varying tension in the crossing ends and is shown at A in *Figure 12.28* in a high position to which it is pulled by the crossing ends when they form an open or a crossed shed although it will be realised that the position

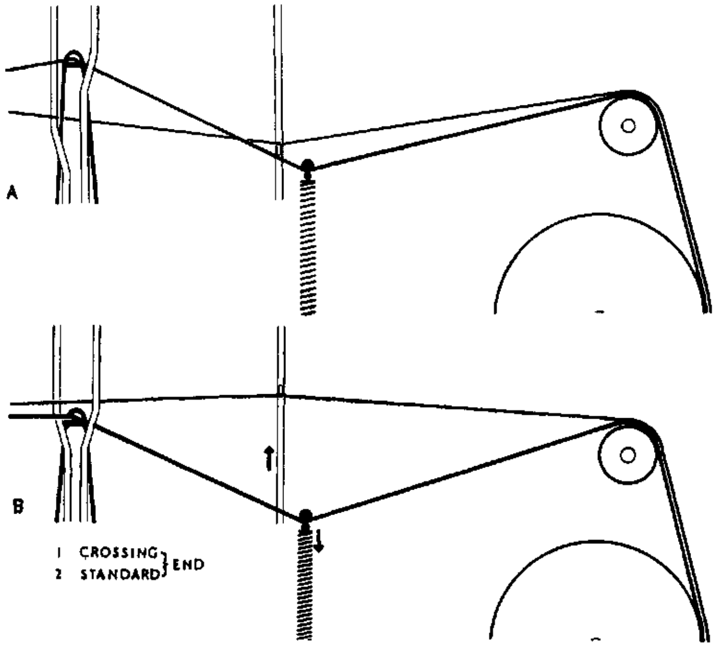


Figure 12.28

of the bar will be marginally higher at crossed than at open sheds. At B, the position of the bar is shown between the sheds when the doup descends relaxing the tension on the crossing ends with the spring taking up the slack by pulling the bar down. If there are a large number of standard heald frames the positioning of the equaliser bar behind them may cause the crossing ends to descend down so low that they may, at the back, brush against the top driving shaft of the loom. To avoid this the equaliser bar may be placed in front of the standard frames maintaining, however, the recognised distance of 10 cm between itself and the doup assembly. This situation arises invariably in jacquard lenos where the depth of the figuring harness makes it necessary to place the bar in front.

In high density or coarse lenos some difficulties are occasionally experienced with the twisting together of the neighbouring crossing ends on the equaliser bar. When this occurs the solution is provided by the substitution of an equaliser heald frame for the bar. This is placed in front of the standard frame, is also negatively controlled by springs but prevents the twisting of ends by having each crossing end drawn through a separate mail eye. As in respect of the bar the oscillations of the equaliser frame are controlled by the increase and relaxation of tension in the crossing ends. Both the devices operate within slides which maintain their horizontal displacement and are also provided with stops which limit the maximum permissible fall and rise of the device.

Faller rollers represent another type of a negative easing device which is sometimes used. In this case the weight of the roller takes up the slack in the crossing ends which upon shed formation pull the rollers up to provide themselves with the extra length of yarn and between sheds permit the rollers to fall down within their slides. Obviously, the weight of the roller must be adjusted correctly according to the amount of tension which it is intended to impose.

The negative devices are suited mainly for the production of open, lightweight leno fabrics and can operate only in conjunction with the eyed doups. For slotted doups positive easing action must be used.

Positive easing action

Positively acting easer bars are normally mounted in the proximity of the back rest, usually slightly above or below it. All the crossing ends are passed over the bar which at the required point is moved forwards either by a dobby or by cam action to release a predetermined length of yarn. As the extra length is required only temporarily, after each release which coincides with the crossed shed, the extra length is taken back either by a spring return action or by a cam.

In *Figure 12.29* a commonly used dobby-controlled device is illustrated. The easer bar, E, fulcrumed at F, is attached to a dobby jack connection, J, via the long arm, L. In the diagram O, during the formation of an open shed—and also on plain sheds—the easer remains in the normal position with the arm L held against the stop, P, by the stout return spring, R. In the diagram X, i.e. on crossed sheds, the arm L is raised by the dobby jack connection which causes the easer to swing forward thus delivering a required length of yarn. Ample adjustment of the movement is possible ensuring that for each structure just sufficient length of yarn is provided, as an excess would result in a slack shed. A slightly different arrangement operating, however, on the same principle is used when the crossing ends are placed on a separate beam mounted above the back rest.

In constructions such as plain gauze in which all the crossing ends form open and crossed sheds on alternate picks the easer bar may be operated by a cam fixed to the bottom shaft. The diagram given in *Figure 12.30* illustrates such a motion which is of particular value in tappet looms. The diagram shows the

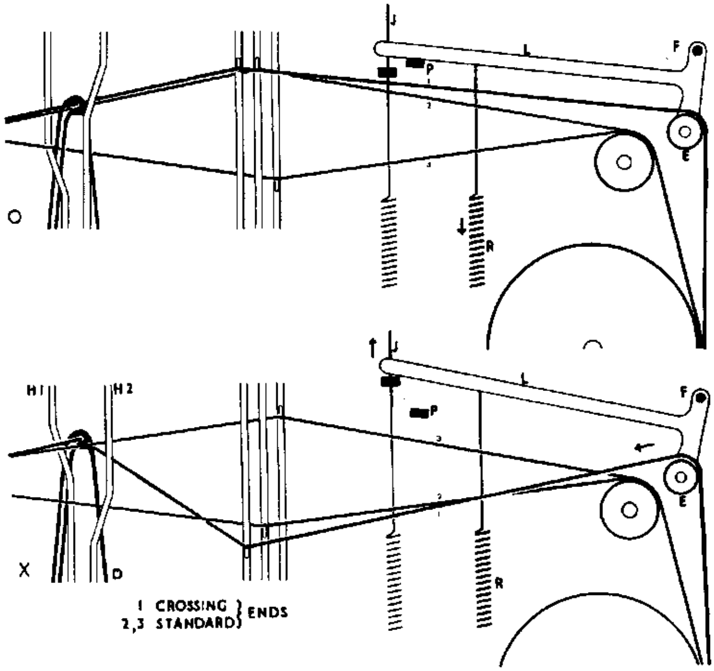


Figure 12.29

crossed shed in which the easer bar, E, is forward, delivering the extra length of yarn. On the following open shed this extra length will be taken back by virtue of the action of the increasing diameter of the cam, C, upon the anti-friction roll, A, attached to the easer bar lever L. The lifting of the lever L will force the easer back. The spring, R, ensures that contact between the cam surface and the anti-friction roll is maintained throughout the rotational cycle.

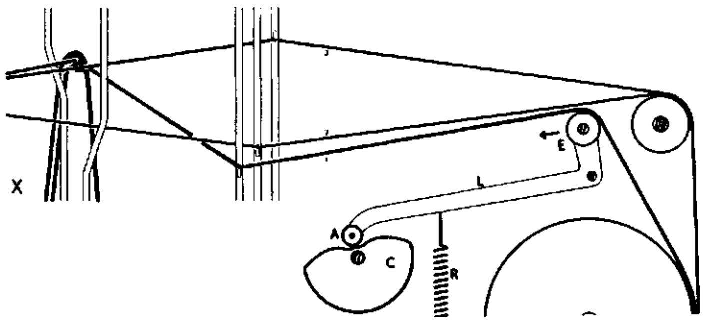


Figure 12.30

In structures in which one set of crossing ends forms crossed sheds on different picks from another set two independently controlled easer bars may be necessary. This arises when more than one leno assembly is used or when double-slotted doups are employed. In *Figure 12.31* a two easer arrangement is shown operating

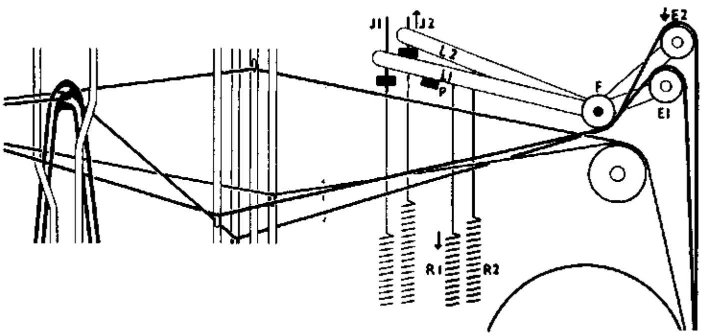


Figure 12.31

in conjunction with a double-slotted doup assembly. In this system the two easers are operated alternately because the two sets of crossing ends form the crossed sheds on alternate picks but as each easer bar is controlled by a different dobby jack any order of operation can be achieved. The action of this type of easer is exactly as described with reference to a single dobby-controlled easer given in *Figure 12.29.*

The shaker device

As stated at the beginning of this chapter the shaker or jumper device is required when lenos, in which the crossed sheds follow the open sheds (and *vice versa*) on succeeding picks, are woven in open or semi-open shedding mechanisms. In bottom douping the function of the shaker is to bring the standard ends half way up the shed between the sheds to permit the cross-over by the crossing ends without undue friction or tension on the standards (in top douping the standards would be brought half-way down). The reason for this action becomes apparent by reference to the plain gauze or leno weave where the crossed and open sheds occur alternately. In this structure the crossing ends are up and the standard ends down on *every* pick the cross-over taking place between the picks. Between the picks the crossing end is half-way down the shed having been taken down by the doup which follows the falling heald of the leno assembly before at that point the doup needle starts rising again to follow the rising heald, the two operating up and down alternately in plain leno weaving. However, the standard end is never pegged to rise from the bottom shed and would, therefore, never reach the level at which the cross-over can be accomplished if it were not for the shaker.

It will be clear that when one or a number of plain sheds separate the crossed from the open sheds no shaker is necessary because the doup is at the bottom and a cross-over can be effected without difficulty. There are, however, other cases in which the shaker can be dispensed with even though successive crossed and open sheds do occur and these can be listed as follows:

(1) When simultaneous top and bottom douping assemblies are used to produce the leno weave.

(2) When there are two or more standard ends in each leno group which weave plain, as in this instance all the standard ends are in mid-shed positions between picks as well as the crossing ends and the cross-over can be effected without any difficulty.

It will be obvious, of course, that if closed shed mechanisms are used the shaker is entirely unnecessary because all the ends after each shed are at the same level.

The half-lift of the standard heald is obtained in various ways, either by cam action or by a special attachment to a dobby which most makers now provide for the purpose. The attachments operate in a fixed manner and produce the shaking movement in between every pick whether it is required or not. The additional vibration of the standard ends is obviously detrimental therefore the shaker device is used only if absolutely necessary. Whatever means are employed to achieve the shaking movement it should be remembered that the connections must be made in such a manner as not to interfere with the normal full lifts of the standard healds for the purpose of ordinary interlacing.

JACQUARD LENOS

Apart from Madras muslin, which is dealt with separately in a section which follows, jacquard lenos fall into three distinct groups of structures:

(1) Open structures produced on the 1-crossing-1 principle in which the leno groups weave plain leno in the ground and also produce a plain weave and warp or weft float figure in selected areas. These are usually produced with the aid of one slotted doup assembly placed in front of the jacquard harness.

(2) Figured marquisette type fabrics produced on the basis of 1-crossing-2 in which in addition to a slotted doup assembly two standard healds are mounted at the back to control the standard ends which weave plain throughout.

(3) More solid 2-crossing-2 structures in which open leno areas alternate with brocade figuring thus achieving the effect of an opaque figure on a semi-transparent ground. This type of structure is woven without any heald frames using individually controlled slotted doup assemblies in which each lifting arm of every assembly is connected to a separate harness cord at the top and its own lingo at the bottom. The return movement of the doup needle itself is also achieved by individual lingo weighting.

As all the jacquard lenos are usually woven in quite open settings comparatively small jacquard sizes are adequate in most instances. Frequently, the centre closed shed jacquard motions are employed being particularly well suited for the leno structure.

One-crossing-one styles

A typical jacquard mounting for this style of leno is illustrated by means of the comber-board diagram at D in *Figure 12.32.* The crossing and the standard ends are all drawn through the figuring harness in a transposed draft order. The draft transposition is a matter of convenience which simplifies the construction of the detailed weaves for the purpose of card cutting. It will be noted from the interlacing diagram, C, that in the figured portions of the design the standard ends are the odd ends and the crossing ends are the even ends. Therefore, unless the standards are drawn on the odd long rows and the crossers on the even ones, as in the transposed draft, the transposition of the design itself in vertical pairs needs to be carried out in the figured areas for the purpose of card cutting. The use of the transposed draft avoids the need for that operation. The doup assembly frames are placed the usual distance of 10 cm in front of the harness and the lifting healds H1 and H2 are raised on alternate picks being controlled from the hooks in a spare row. The operation of the doup assembly is shown to the left of the detailed weave plan B in *Figure 12.32* from which it will be seen that in the arrangement illustrated crossed sheds are produced on even picks and open sheds on odd picks. As slotted doups are used, all crossing ends must lift on the crossed shed side on every even pick, but they are free to be manipulated at will on the open shed side by the figuring harness.

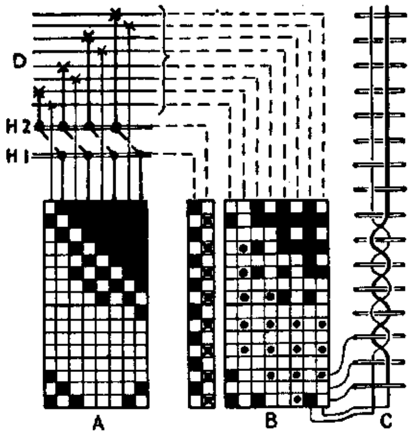


Figure 12.32

The simplified design at A indicates the method of painting–the warp float is indicated by the solid marks and each area of warp float figure is, as is usual in leno brocades, surrounded by an area of plain weave, the purpose of the surround being to spread out the standard and the crossing ends to make a fuller float figure. Without it the ends would tend to cling together in pairs in which they were twisted together in the plain leno ground. The leno ground in the design is left blank. The detailed cutting plan is shown at B from which it will be observed that the crossing ends on odd picks are raised by the harness to produce the open leno shed, the lifts being indicated by the dots. The harness on the even picks of the ground area must remain down because that is when the crossed shed is produced by the lift of the H1 element of the doup assembly. In the figure and plain weave areas every mark of the simplified design is cut except for the marks which indicate even end lifts on even picks; at these points the crossing (even) ends are raised to the top shed by the frame H1 automatically. The detailed weave for the figure and plain weave areas is indicated by the solid marks in plan B. The diagram C represents the interlacing of the last leno group in the portion of the design given. As every crossing end in this arrangement makes the crossed shed on alternate picks the easing operation can be controlled by means of a cam.

One-crossing-two styles

Figured marquisette styles are frequently produced in jacquards assisted by a heald mounting. The arrangement is shown by the comber-board draft given at D in *Figure 12.33.* In front of the harness there is a slotted doup leno assembly operated exactly as described for the 1-crossing-1 styles above. The crossing ends are additionally drawn through the jacquard figuring harness but the standard ends are not jacquard controlled and are drawn through a pair of ordinary healds placed at the back of the harness and operated in plain weave order from two of the spare hooks in the jacquard. Thus the two standard ends which in

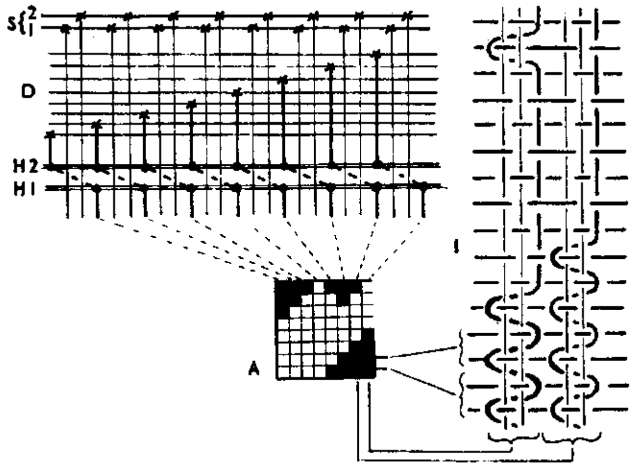


Figure 12.33

conjunction with the one crossing end form one leno group weave plain uninterruptedly. As the crossed sheds are formed also continuously on alternate picks the patterning consists of areas in which the freedom to form the open shed is exercised and which, therefore, produces the orthodox 1-crossing-2 leno, and areas in which the option to make the open shed is not taken up resulting in a three-ended plain weave. The two different areas are shown by the interlacing diagram I which represents a small portion of a repeat. In the leno portion the three ends of the leno group are drawn very close together resulting in an open fabric appearance; in the plain weave areas the three ends spread out assisted by the fact that the outside ends of each group of three weave the same tabby and thus tend to migrate together overcoming the natural tendency to remain apart induced during weaving by the dents of the reed which separate them. As only the crossing ends are jacquard controlled the painting of the design is very much simplified being condensed by 2 weft-wise and consisting of marks to indicate the 1-crossing-2 leno portions as shown at A. The construction is implemented as follows–on the picks on which the crossed shed is produced a blank card is inserted as all the crossing ends remain down in the harness but are raised by the H1 frame of the doup assembly; on the picks on which the open shed is formed the ends indicated by the solid marks are cut because they are the ends which are raised to form the open shed and, therefore, the leno part of the design, the ends indicated by the blanks being left down. The simplified design A corresponds to the interlacing diagram I in which the manipulations described above can be easily traced. It will be appreciated that the blank or uncut card inserted on crossed shed picks is 'blank' only in respect of the figuring harness–it will contain appropriately cut holes in the spare rows for the operation of the lifting heald frames of the doup assembly and the standard heald frames. As in the previously described system, in which the crossing sheds also occurred regularly on alternate picks, the easing operation can be cam controlled.

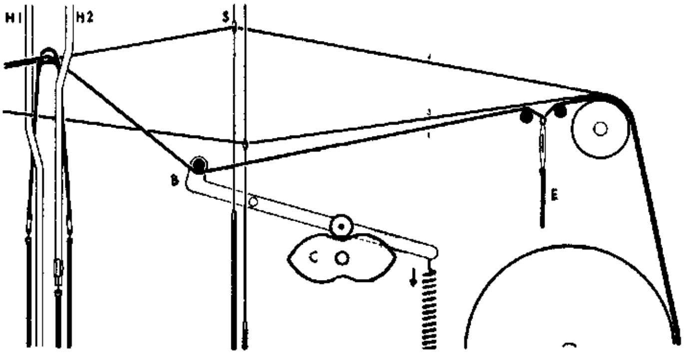


Figure 12.34

A different mounting used in 1-crossing-2 styles is represented in *Figure 12.34* which also shows the form of easing action suitable for such mountings. In this method no heald frames are involved and each doup assembly consisting of eyed doups is an individual unit in which the lifting healds H1 and H2 are controlled by separate jacquard hooks. In this way each crossing end can be made to operate in a different sequence from its neighbour. Some may be raised on the crossed shed side and some on the open shed side for several picks in succession, others may be left down to produce a warp float on the underside. The standard ends are also individually controlled by the jacquard harness which means that in this mounting full structural variety can be introduced with warp and weft float brocaded figure, areas of three-ended plain weave as in the previous mounting, and areas of leno weave which in themselves can vary considerably.

One system of control is represented by the comber-board diagram at A in *Figure 12.35* which represents one short row of harness. It will be noted that one short row consists of six ends but requires eight hooks and needles as the crossing end lifts must be controlled separately on the crossed and on the open shed side. At B a small portion of design is shown which contains an area of warp and weft float figure bordered by the plain weave and an area of leno weave. The design corresponds exactly to the interlacing diagram at I. In the design each leno group of three ends occupies four vertical rows of design paper which correspond with the needle numbers as given at A. All marks in the design indicate warp up—the solid marks show the lifts of the standard ends, the crosses refer to the lifts of the crossing ends on the crossed shed side and the circles to lifts of the crossing ends on the open shed side—and all the marks are cut in a straightforward manner. Simplification of the design may be carried out by colour coding the different structural areas in the usual way. In view, however, of the comparatively small size of the repeats in leno weaving—small in terms of the number of ends and picks involved—simplification in this instance frequently causes more trouble than it is worth resulting in a large number of detailed weaves of varying repeat size which for the purpose of automatised cutting must be brought into the common size denominator. Very often, to curtail the preparatory processes, simplification results in the reduction of the variety of effect produced.

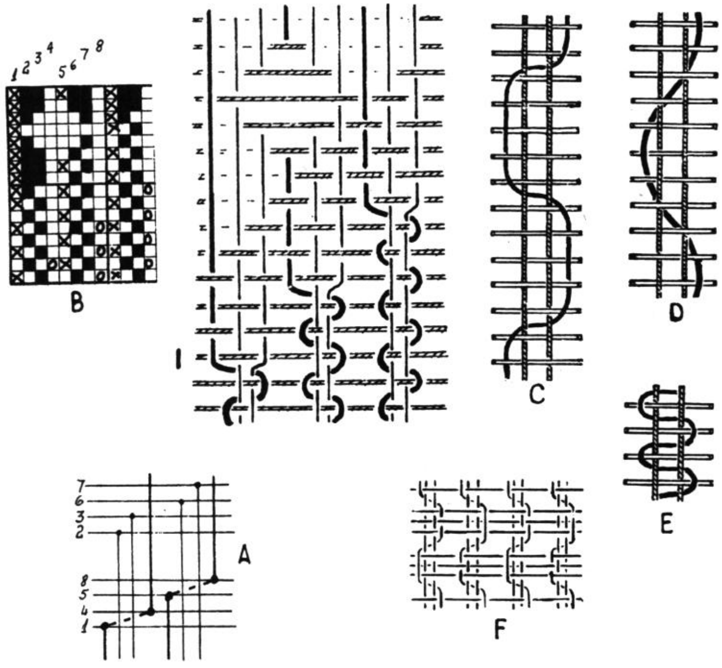


Figure 12.35

The system of control described permits full flexibility of operation in the ordinary and in the leno portions of the design. A rich variety of leno effects can be used and, if desired, all of them could be contained within one repeat. Diagrams C, D, E and F in *Figure 12.35* show four frequently employed effects in 1-crossing-2 leno styles some of which will clearly differ from others in the amount of crimping introduced and the designer's skill must be employed to the full to ensure that within a repeat the amount of take up between the different ends will be eventually equalised. If it is not, then considerable distortion of the cloth may occur. Periodic and temporary differences between neighbouring groups are permissible because the compensating system used is sufficiently flexible to allow for that. It may be observed from the illustration in *Figure 12.34* that tension variations which occur regularly in the crossing ends are controlled by the double-winged cam, C, mounted on the bottom shaft and the compensator bar, B. In the diagram the bar is shown at its highest point during the formation of the open shed; it will be at the same point on a crossed shed but between the sheds the major diameter of the cam will force the bar down taking up the slack which develops on those occasions. It must be appreciated, however, that the major function of the bar is to keep the crossing ends clear of the standard ends during crossed shed formation and that the real compensation for temporary yarn length differences, such as may occur between the crossed and the open shed or as are occasioned by structural differences within a repeat, is performed by the negative easing harness E. Each crossing end is threaded through an eye which is attached by a yarn loop to a lingo which depresses the end between two bars near the back rest of the loom thus creating a reserve length of yarn.

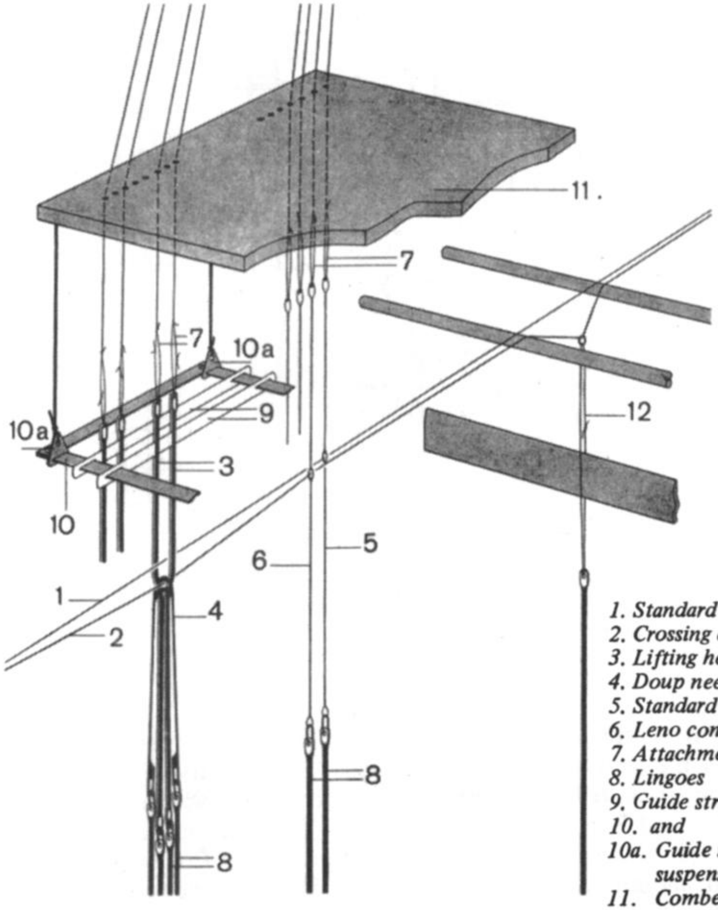


Figure 12.36

1. Standard end
2. Crossing end
3. Lifting healds
4. Doup needle
5. Standard harness
6. Leno control harness
7. Attachment loops
8. Lingoes
9. Guide strips
10. and
10a. Guide strip frame and suspension brackets
11. Comber-board
12. Negative easing harness

When the crossing end tightens up the reserve diminishes as the lingo is pulled up; when this end slackens off the reserve is restored again, the lingoes vibrating up and down in accordance with the variation in the demand for compensation by the ends to which they are attached.

The method of suspension of the individual jacquard doup assemblies is illustrated in *Figure 12.36* which shows a slightly different arrangement to the one described above. In this mounting the cam-controlled compensator bar is not used–instead the crossing ends are drawn additionally upon control harness which ensures that upon the formation of the crossed shed they are kept clear of the standard ends by lowering them behind the doup. To preserve the clarity of the diagram only one standard end is shown. As the key to the numbered parts is provided in *Figure 12.36* the arrangement is self explanatory, but attention is directed to the doup assemblies whose mounting involves special features not encountered in other jacquards. Each unit is controlled by two harness cords and two hooks and the lifting arms of the unit are individually weighted by separate lingoes. The return movement of the doup needle is ensured by two additional lingoes so that each assembly requires a total of four lingoes. To prevent the assemblies from turning sideways or twisting around during weaving each one is threaded through guide strips which fit between the double strips of the lifting arms without obstructing their shed forming movements. The guide strips themselves are held in a frame which is suspended from the comber-board. The positioning of the frame is such that the douping harness is kept the prescribed distance of 10 cm in front of the control and standard harness. The diagram in *Figure 12.36* also illustrates clearly the method of suspension of the negatively operating easing or compensating harness.

Two-crossing-two styles

The cloth usually produced in this style is less open than the previous ones with denser warp and weft settings. Consequently, to achieve a sufficient contrast in apparent density between the leno ground and the solid figure areas the ground is frequently produced as a 4-pick structure, i.e. the crossing is carried out over groups of four picks which being confined within the twists of the standard and crossing ends separate themselves from the neighbouring groups of picks thus creating open spaces. A number of ground weaves suitable for this purpose are given at A to E in *Figure 12.37.* A feature of all these structures is that on the crossed shed side the two crossing ends which form a leno row or group together with the two standard ends, must lift in pairs. On the open shed side, however, they can be operated individually. This is due to the type of mounting used which is basically similar to the one given in *Figure 12.36* and consists of individual leno assemblies but the doup is of the slotted type with two crossing ends per slot. Comber-board diagram A in *Figure 12.38* shows that all the ends are drawn through the figuring harness by which they can be operated individually. The crossing ends are additionally drawn through the slotted doup units in pairs the units being arranged in two rows in front of the figuring harness. The lifting arms of the leno assemblies are marked H1 and H2, as in all the previous examples, H1 being responsible for the crossed shed lifts and H2 for the open ones. When the crossed sheds are formed the figuring harness through which the corresponding crossing ends are drawn must remain down to permit the formation of a clear shed at the front but on open sheds the corresponding figuring harness may be operated in any way desired.

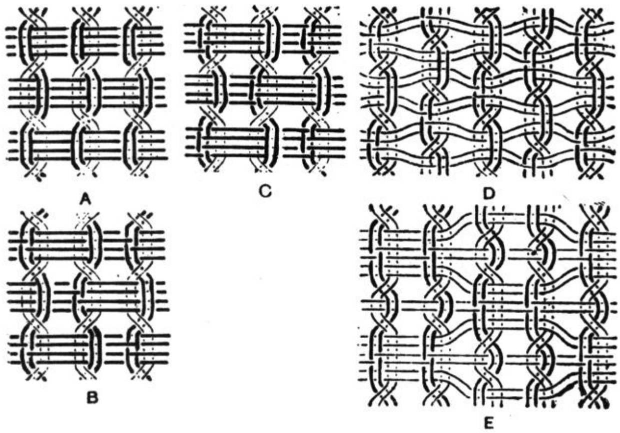


Figure 12.37

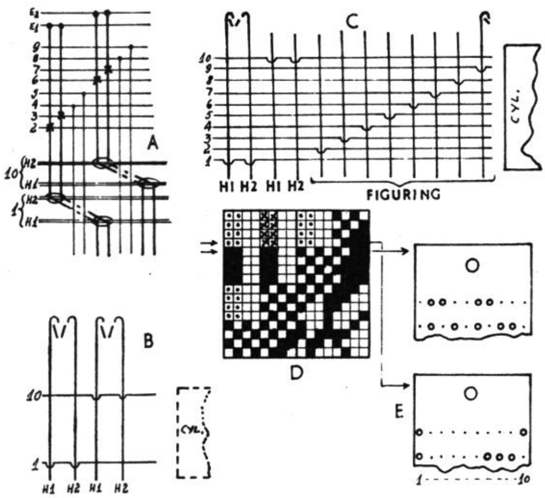


Figure 12.38

The lifting healds H1 and H2 are operated by separate hooks but each pair of hooks, if arranged on an inverted hook principle, can be controlled by a single needle because the two healds are never up or down together, i.e. when H1 is up, H2 is down and *vice versa*. The principle of inverted hook operation is shown at B in *Figure 12.38* in which the odd hook, controlling H1, is in the normal position facing the cylinder and over the knife when at rest; the even hook, controlling H2, is in the reversed position facing away from the cylinder and clear of the knife when at rest. A hole in the card opposite the needle will, therefore, cause a lift of the odd hook when the knives rise but will leave the even hook down as in the position indicated it cannot be engaged by the ascending knife. A blank in the card, on the other hand, pushes the odd hook clear and the even hook over the knife thus causing the lift of heald H2. Thus, unless the needles controlling the leno harness are cut, which results in the crossed sheds, it is the healds H2 which are lifted permitting the figuring harness to determine how the two crossing ends in the free slot are to be operated. The hook/needle connections in a full short row of the type of mounting described are given at C in *Figure 12.38.*

A small portion of design is shown at D and consists of a weft and warp float figure surrounded by plain weave the function of the latter being to spread the ends out after they have been pulled together by the leno weave in the ground areas. The solid marks used indicate warp up. The leno ground is represented in a conventional form in which the open sheds are indicated by solid marks and the crossed sheds by the dots and crosses and it will be noted that the ground weave selected corresponds to the structure A in *Figure 12.37.* From the diagram C in *Figure 12.38* it is seen that the figuring harness is operated by needles 2 to 9 and the douping harness by the needles 1 and 10. In order, therefore, to produce the structure depicted at D the following card-cutting instructions are formulated:

Solid marks–cut for needles 2 to 9
Dots–cut for needle 1
Crosses–cut for needle 10

The result of the above cutting is indicated at E where the first two rows are shown in two cards which correspond with the horizontal rows of the design D marked by the arrows. To comprehend the above cutting fully is must be borne in mind that the hooks controlling lifting arms H2 of the leno assemblies are up on every pick unless their automatic lifts are cancelled by the cutting of holes for needles 1 or 10 which, of course, is equivalent to forming a crossed shed.

Figure 12.39

The edge of the figure is developed in steps of four to fit with the leno weave, but if it is considered that the outline so produced is too coarse then it can be modified together with the leno weave in the boundary areas. The easing or compensation is most conveniently carried out by the negative system as shown in *Figure 12.36.* A leno brocade constructed according to the method given above is illustrated in *Figure 12.39.*

MADRAS MUSLIN STRUCTURES

Structure of the cloth

In the Madras muslin texture a plain gauze foundation, which is formed continuously throughout the cloth, is ornamented with extra weft. *Figure 12.40* shows the appearance of a typical fabric, as viewed from opposite sides, while the diagram 1 in *Figure 12.41* illustrates the interlacing of the threads. The warp consists of crossing ends and standard ends arranged 1-crossing-1, and in the gauze structure, which is very light and open, there is one ground pick in each shed. The extra weft is softer spun and usually much thicker than the ground

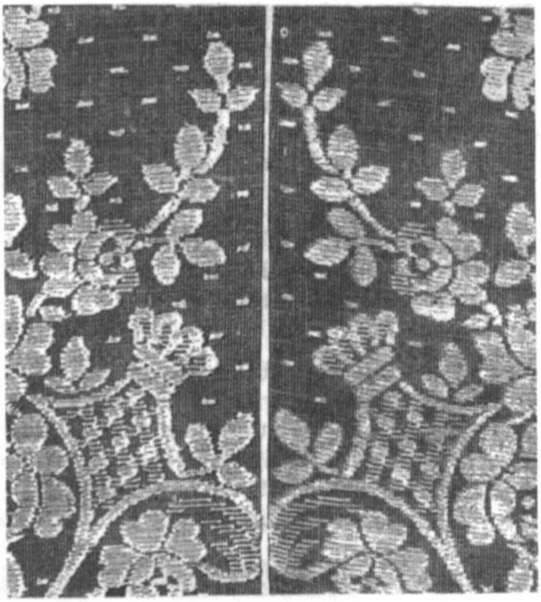


Figure 12.40

weft; it is interwoven with the warp where required, and floats loosely in the remaining parts of the design. The loose floats are afterwards cut away and a texture with an opaque figure on a transparent gauze ground, or *vice versa,* results, which is particularly serviceable for use as window curtains. The appearance of the cloth after the cutting operation is represented in *Figure 12.40,* which shows, on the left, the fabric as viewed from the cut side—i.e., the side on which the extra picks float loosely during the weaving of the cloth, and on the right, as viewed from the uncut side. The cloths are normally woven with the cut side uppermost. When used as window curtains either side of the cloth may be taken as the right side, but as shown in *Figure 12.40* the ornament has a bolder outline on the cut than on the uncut surface, hence for certain purposes the cut side is taken as the right side. The uncut surface, however, is neater, and for such cloths as dress fabrics, for which the structure is to some extent adapted, this is mostly taken as the right side.

The Madras loom

Special types of looms have been built for weaving the cloth. The following illustrations and description correspond with a system in use at present. In the diagram 1 in *Figure 12.41* the structure is represented from the same side as the cloth on the left of *Figure 12.40,* i.e. as viewed from the cut side. When the texture is woven with this side uppermost the crossing ends are raised and the standard ends are left down on every ground pick. On the figuring picks all the crossing ends are left down, but the standard ends are raised where the extra weft has to be interwoven, and the latter is, therefore, firmly bound in between the standard and crossing ends. The plan given at Y corresponds with the effect shown in the diagram 1; the full squares indicate the lifts of the standard ends and the crosses of the crossing ends. The crossing ends, however, are operated independently of the jacquard harness, while no standard ends are raised on the ground picks; therefore in constructing a card-cutting plan it is only necessary to indicate the lifts of the standard ends on the figuring picks, as shown at Z, which illustrates the usual method of designing a figure.

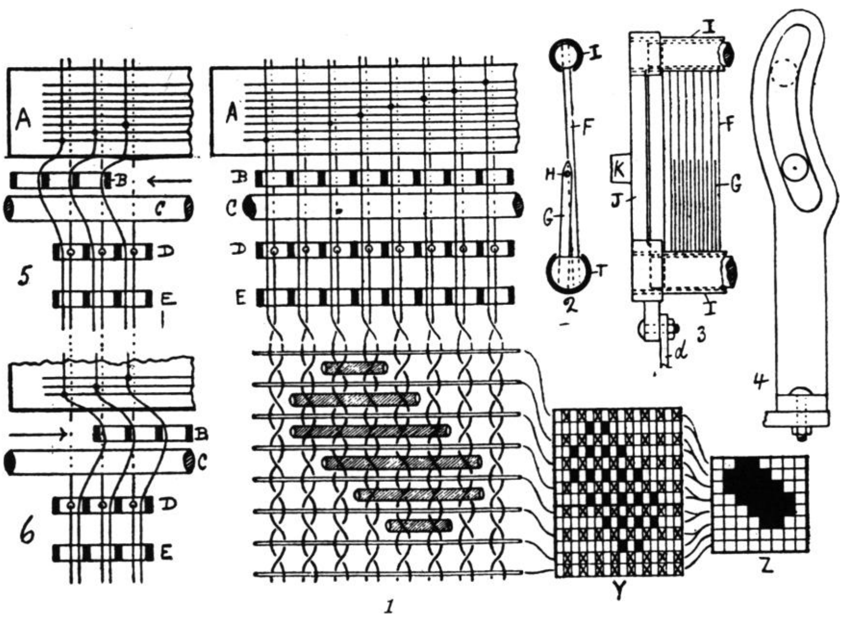


Figure 12.41

An ordinary form of double-lift jacquard and harness is generally employed, but in front of the harness A there are, in the following order, a tug reed B, and easing bar C, a gauze reed D, and an ordinary weaving reed E. These are represented in the diagrams given in *Figures 12.41* and *12.42,* while the draft of the ends is indicated in the upper portion of 1 in *Figure 12.41.* The standard ends are drawn through the harness mails, and then are passed through the reed B, above the bar C, and through the reeds D and E. The crossing ends are passed between the harness cords, under the tug reed B and the bar C, then through the eyes in half-dents in the gauze reed D, and afterwards each end is passed along with its accompanying standard end through a split in the weaving reed E.

The crossing of the ends is effected by means of the tug reed B and the gauze reed D. The tug reed is suspended in front of the harness and is moved a small distance to left and to right on succeeding ground picks. The form of the gauze reed is shown separately in the diagrams 2 and 3 in *Figure 12.41.* Between each pair of full dent wires F there is a short, pointed dent G which is slightly inclined, and is provided near the top with an eye H through which a crossing end is drawn. The baulks of the reed fit within metal cases I, and this arrangement makes the reed very strong and rigid. Each end piece J is provided with a stud K, which fits within a curved shot formed in a guide, as shown in diagram 4. The gauze reed is raised and lowered on each ground pick, during which the studs K slide within the curved slots in an arcuate movement. When the reed is down the points of the short dents G are below the lower line of the shed, as shown in diagram 7 in *Figure 12.42.* When it is raised all the crossing ends are lifted sufficiently high to form a shed for the shuttle to pass through in front of the weaving reed E, as shown in 8. Each time the gauze reed is lowered the tug reed is moved laterally, and the standard ends, which pass through the latter reed, are pressed by the wires and traversed to left or to right. This is illustrated in the diagrams 5 and 6 in *Figure 12.41,* in which small circles represent where the crossing ends pass through eyes in the short wires of the gauze reed. Diagram 5 shows the tug reed moved to the left and diagram 6 to the right, so that each standard end is moved above the point of a short wire of the gauze reed from one side to the other. Hence on succeeding ground picks, as the gauze reed rises it lifts the crossing ends first on the right and then on the left of the standard ends, in which positions they are bound in by the ground weft. The movement illustrated in the diagram 5, will take place previous to the insertion of the odd ground picks of the structure represented in diagram 1, and in the diagram 6, previous to the insertion of the even ground picks.

The easing bar C has an important function, as will be seen from a comparison of its position in the diagrams 7 and 8 in *Figure 12.42.* The bar rises and falls on each ground pick in coincidence with the movement of the gauze reed, and maintains a uniform tension on the crossing ends.

The Madras loom is usually made with four boxes at each side, but the two series of boxes are connected so that they rise and fall together. Not more than three figuring shuttles, as well as the ground shuttle, can, therefore, be employed at the same time, but in different parts of a design it is possible to employ the ground shuttle or to insert one, two, or three extra picks to each ground pick according to requirements. The box motion is governed by the jacquard cards through four needles and hooks that are set aside for the purpose. The ground weft shuttle is placed in the fourth or bottom box. The figuring wefts may be inserted in almost any sequence, but one figuring colour—usually that which is inserted most frequently and most regularly throughout the design—is taken as the leading colour, and is placed in the third box (the next box to the ground shuttle). An important feature is that when the gauze ground shuttle (the bottom box) is brought into operation the special motions of the loom are automatically put into action.

The rising and falling motion of the gauze reed on each ground pick is imparted by the backward and forward movement of the slay. The position of the parts, at the extremities of the movement, is represented in the diagrams 7 and 8 in *Figure 12.42.* The lower end of a rod L passes loosely through a slot in a bracket M which is bolted to the inner side of the box lever N, while the upper end passes loosely through the slot of a projection that is connected to a horizontal lever P. Two collars are set-screwed on the rod L, the lower one of which, according to the position of the box lever N, is either just above or rests on the bracket M, while the higher one retains a spring O with its upper end against the underside of the projection on the lever P.

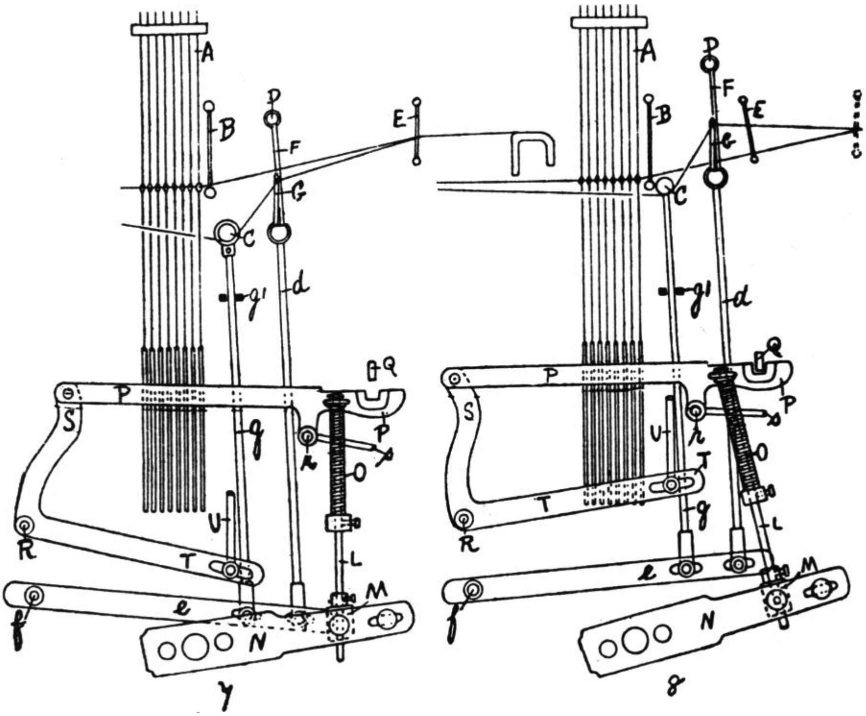


Figure 12.42

When the boxes are raised to their highest position so that the bottom box—which contains the ground weft shuttle—is brought into line with the race board, the upward movement of the box lever N lifts the rod L just high enough to cause the pressure of the spring O to raise the lever P at its forward extremity. This takes place at the time of beating up, when a bar Q, which is bolted to the back of a sword, is immediately above a recess formed in the upper side of the lever P, as shown in diagram 7, *Figure 12.42.* The lever P, when raised is brought into engagement with the bar Q, as shown in diagram 8, and as the latter moves backward and forward with the sword, a similar movement is imparted to the lever P. A bell-crank lever, which is fulcrumed on a stud R, has its upper arm S pivotally connected to the rear of the lever P, hence the movement of the latter causes the forward end of the lower arm T to rise and fall. This movement, by means of a rod U, and a series of levers causes the gauze reed and the easer, C, attached to e to rise and fall; and this takes place with each backward and forward movement of the sword so long as the gauze ground weft only is inserted.

On the insertion of a figuring pick, however, the lowering of the box lever N releases the pressure of the spring O against the projection on the lever P, the forward end of which then falls out of engagement with the bar Q, as shown in the diagram 7. The gauze reed then remains in its lowered position while the required number of figuring picks is inserted.

The lateral movement of the tug reed is obtained from the same source as the vertical movement of the gauze reed so that the two actions are fully synchronised. The movement transfers the standard end from one to the other side of the crossing end and the direction of the movement is the same as that of the preceding ground pick.

The picking motion is of the pick-at-will type and the direction of the pick is governed by the action of the shuttle box swell. At the side of the loom on which a shuttle is in line with the race, the pressing back of the swell, by suitable connections, causes the picking mechanism at the opposite side to be made inoperative, while the absence of a shuttle at one side brings into action the picking mechanism at the other side. In the event of anything occurring to bring a shuttle at each side in line with the race, the picking mechanism at both sides of the loom is put out of action.

The take-up motion. In different parts of a design the number of extra picks to each ground may vary from none to three, but it is very necessary for the foundation texture to be uniform. For this reason the up-take motion is operated from the lever P so that the cloth is drawn forward only when a ground pick is inserted. A projection on the lower side of the lever P (see *Figure 12.42*) carries a stud *r* which is connected by a rod *s* to the lever that operates the take-up pawl. Each time the lever P is drawn forward the ratchet wheel of the up-take motion is turned one tooth. The arrangement ensures that the same number of ground picks per unit space will be put in however irregularly the figuring weft is inserted.

Madras designing

Very little variation can be made in the Madras structure on account of the special means employed in weaving the cloth, and because the shearing operation makes it necessary to avoid the formation of long figuring floats on the cut side of the texture. As viewed from the uncut side, all the crossing ends (which are operated simultaneously by the gauze reed) are above the figuring picks, so that on this side the floats cannot be longer than the space between two consecutive crossing ends. On the cut side the standard ends are above the figuring picks where the latter are interwoven, and so far as the weaving of the cloth is concerned these ends may be operated by the harness as desired. It is, however, generally recognised that in the figure the weft should pass over not more than one standard end at a place, otherwise the floats are liable to be cut away in the shearing process. Only the very simplest weave development is, therefore, possible, and the ornamentation of the texture is chiefly dependent upon the formation of different degrees of density, and upon colour. A large number of ends per cm cannot be employed because the fineness of the gauze reed is limited, and the setts usually vary from 12 to 18 ends per cm, the latter number being seldom exceeded. The ground picks range from 10 to 14 per cm, but the total picks vary according to the proportion of extra picks to each ground pick, and whether the extra weft is introduced regularly or intermittently. The ground yarns are mostly of very good quality and fine in counts–ranging from 7 tex to 11 tex cotton or polyester filament yarn–while the soft spun figuring weft varies from 60 tex to 32 tex cotton. The following are typical weaving particulars: Warp 84 dtex filament yarn, 18 ends per cm; figuring weft, 60 tex cotton; ground weft 84 dtex filament yarn; 12 ground picks per cm.

The most common modifications of the Madras structure, as viewed from the cut side of the cloth, are illustrated at A, E, H, L, O and R in *Figure 12.43*, in which the crossing ends are those which are over all the ground picks. The corresponding condensed plans on the right of the examples show how the effects are indicated on design paper for the card-cutting, while on the left the complete plans are given, in which the crosses represent the lifts of the crossing ends by the gauze reed, and the full squares and dots the lifts of the standard ends by the harness. A in *Figure 12.43* shows the ordinary opaque structure, and a modification in which only the alternate figuring picks are interwoven. The

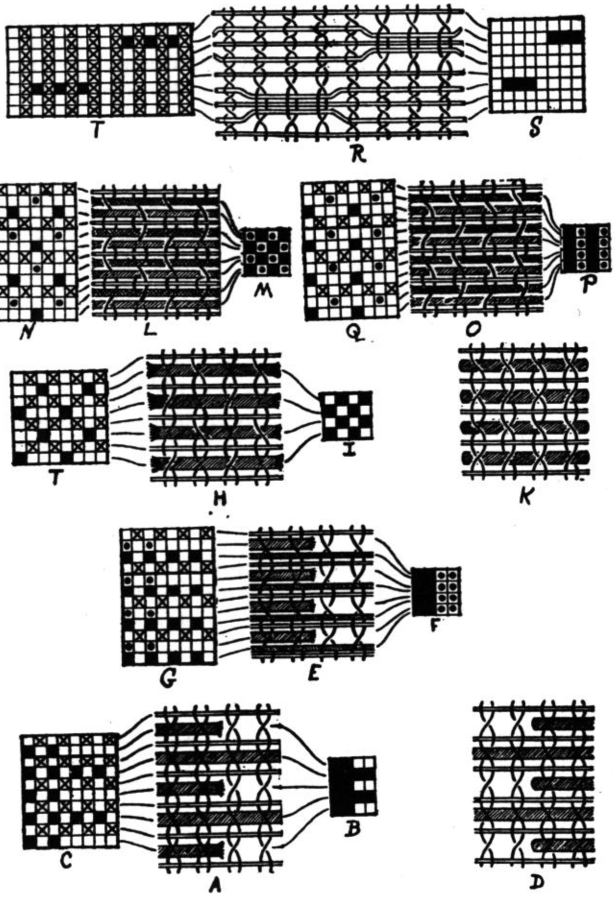


Figure 12.43

latter produces a semi-opaque effect which forms a pleasing contrast between the transparent ground and the opaque portions of a design, and may be used effectively in shading a figure. The marks in the plan B indicate where the standard ends are raised on the figuring picks when the cloth is woven with the cut side up. The appearance of A when turned over from left to right is represented at D; the texture is the same on both sides, except that the free ends of the figuring picks show more prominently on the cut side.

E illustrates another method of producing different degrees of density. In this case two figuring picks of different thicknesses are inserted to each ground pick; both wefts are interwoven in forming the opaque structure but in the semi-opaque effect only the finer weft is interwoven. Two figuring cards are cut from each horizontal space of the condensed plan F, the full squares and dots being cut on the first card, and the full squares only on the second.

In the modification shown at H the density is the same as in the ordinary structure, but the figuring weft is brought more prominently to the surface on the cut side of the cloth. The standard ends are raised alternately on the figuring picks, as shown by the plain order of marks in the plan I. On the uncut side, a view of which is given at K, the figuring weft shows less prominently than in the ordinary structure.

The alternate system of operating the standard ends can be effectively employed in mixing two different colours of weft in the manner represented at L in *Figure 12.43.* Each horizontal space of the plan M represents two figuring cards, in one of which the full squares are cut, and in the other the dots. The mixed colour effect may be used as a subsidiary to the patterns formed separately by the two colours of weft from which it also differs in density.

O in *Figure 12.43* shows another method of mixing two colours, in which each weft is bound in a straight line by the alternate ends, so that vertical lines of colour are formed. The card-cutting particulars for the plan P are the same as for M.

It will be understood that the small floats, shown in H, L, and O, remain in the cloth as they are too short to be cut away by the shears; the latter are set close enough to engage any floats that are longer than those shown in the examples.

The diagram given at R in *Figure 12.43* shows how the gauze ground structure may be modified by lifting certain standard ends at the same time as the crossing ends are raised by the gauze reed. This prevents a crossing taking place so that at these places the ends lie straight for three picks which are grouped together. The marks in the plan S, which show where the standard ends are raised on the ground picks, will be cut on the ground cards, and in this respect the example is different from the foregoing styles. In weaving the ordinary gauze foundation, ground picks are blank except where holes are cut for the purpose of operating the boxes and the selvedges. As regards the figuring picks, sometimes these are not interwoven with the selvedges, catch ends being provided for them at each side, so that on the figuring cards, in addition to cutting the marks of the design, it is necessary to cut holes to correspond with the lifts of the selvedges or the catch ends, as well as holes for operating the boxes.

Chintzed designs. An illustration is given in *Figure 12.44* of a Madras muslin texture which is termed a 'single cover', i.e. there is only one figuring pick to each ground pick. Three different figuring wefts are, however, employed, but these are chintzed, one following another in succeeding sections of the design. The ground is transparent, and in the figure, in addition to the ordinary opaque structure, effects are formed which correspond with those represented at A and

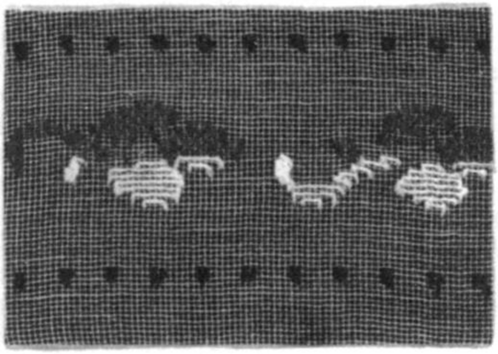


Figure 12.44

H in *Figure 12.43*. Where the ordinary opaque structure is formed the figure is simply painted in solid, but in producing the semi-opaque effect the alternate horizontal spaces only are filled, while in bringing the weft more prominently on to the cut side a plain order of marking is employed, as at A and H in *Figure 12.43* respectively. It is important to note that if the transparent gauze ground is required to show distinctly between two detached portions of figure formed by the same weft, the two portions must be separated horizontally by at least two blank spaces of the design paper. Otherwise the weft floats between the parts of the figure will not be long enough to be engaged by the shears, and the two portions of figure will appear to join up.

Chintzing is a technique resorted to very often because production of multi-coloured double and treble cover effects, i.e. designs in which there are two or three figuring picks to each ground pick, is very expensive and, therefore, rarely undertaken. The expense is due not only to the reduced rate of production but also to a very much increased amount of waste. It will be appreciated from the examination of the fabrics illustrated that even in single cover structures the percentage of the extra weft retained may be as little as·30 or 50 per cent. In treble cover cloths the extra weft float sheared off during finishing may amount to 75 per cent of the total length inserted. As the extra weft is usually dyed in fast colours it is expensive and efforts are made to reduce the waste by producing a gauze figure on opaque ground, thus retaining greater proportion of the extra weft in the cloth, or by constructing detached spot effects demanding only intermittent extra weft insertion.

Modified double cover structures

In addition to their use of lightweight window curtains Madras gauze fabrics are also made for heavier interior hangings in double or even treble cover structures. In such cases, to reduce the amount of waste, most of the extra weft is retained with very little of the gauze ground exposed. When three colours of weft are used one usually forms a foundation on which the figure is produced by the other two wefts, the gauze ground in this case being chiefly employed for outlining. It has previously been shown that very little variation can be introduced in the Madras structure, as with each figuring weft only the ordinary structure and a semi-opaque effect illustrated at A in *Figure 12.43,* and a 3-and-1 structure, shown at H in *Figure 12.43,* can be made. The use of two or more differently coloured wefts at the same time, however, enables considerable diversity of density and colour effect to be obtained. Thus, with two figuring wefts (a double-cover arrangement) six effects can be produced by using each weft separately, as described above and illustrated at A and H in *Figure 12.43,* while with the two wefts used together the seven effects may also be formed, which are represented at A to G in *Figure 12.45.* Thirteen ways are, therefore available for varying the appearance of the different parts of a double-cover design, and further emphasis may be given to a figure by suitably outlining the parts with the gauze ground.

The simplified designs A to G in *Figure 12.45* are each accompanied by an enlarged weave which indicates how the figuring picks are interwoven with the ends (the even ends are operated by the gauze reed and the odd ends by the harness). Two cards are cut from each horizontal space of the plans A to G, as follows: First card—cut the shaded squares, the solid marks, the crosses, and cut the diagonal strokes plain; second card—cut the shaded squares, the dots, the diagonal strokes, and cut the crosses plain.

In the enlarged weaves only the figuring picks are shown and the marks indicate weft on the surface of the cut side of the cloth; the solid marks represent the first weft colour and the dots the second weft colour. In the structure shown at A both wefts are bound in alike, as firmly as possible, and a finely intermingled colour effect is produced. In B and C both wefts form a 2-and-1 effect, but whereas in B the colours are intermingled, in C they form separate vertical lines. In D the first weft is firmly bound in, while the second weft forms a 2-and-1 effect, so that the second colour gives the predominating hue to the surface. In E the structure is opposite to that shown at D, the second weft

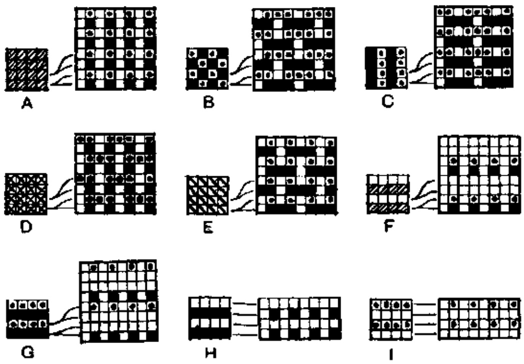


Figure 12.45

being firmly bound in while the first colour gives the predominating hue by interweaving in 3-and-1 order on the surface. In both F and G only half the picks of each colour are interwoven, but in F, which is a modification of A, the two colours are in the same shed and alternate with two gauze ground picks, whereas in G the two colours are in following sheds and are separated from each other by one gauze ground pick. F therefore has a more open structure than G, in which the figuring picks are evenly distributed.

An economical method of figuring with two colours of weft upon a gauze ground consists of arranging the weft in the order of—first colour, ground, second colour, ground, one figuring pick being inserted to each ground pick. Three effects which can be used in combination in a design are illustrated at G, H, and I in *Figure 12.45*, but only one card is cut from each horizontal space of the plans. The first colour forms the effect shown at H, and the second colour that shown at I, while a mixed colour effect and a more compact structure result from using both wefts together, as shown at G. Further variation of the structure shown at G can be obtained by interweaving one or both wefts in 3-and-1 order. Compared with a double-cover cloth the single-cloth texture should be woven with rather more ground picks per cm, and somewhat thicker figuring weft, in order to get satisfactory results.

Madras gauze with weft pile figure

Figure 12.46 illustrates a type of Madras gauze cloth which is not only suitable for use as curtains and hanging textures, but is also employed for evening dress fabrics. It has previously been shown that after the surplus weft has been sheared away from an ordinary Madras cloth the severed tips of the picks at the edges of the figure show very prominently on the cut side of the fabric. In the style under notice, where the figure is formed, the extra weft is floated in such a manner that after the cloth has been sheared the surface is covered by the severed tips of the picks, and the ornament is thus given the appearance of being composed of cut pile. The structure of the texture is illustrated in *Figure 12.47*, in which A corresponds with a portion of the design shown in *Figure 12.46*, while the weave which is indicated on the figure is shown separately at B. In order to produce the required fullness of pile two extra picks are inserted to

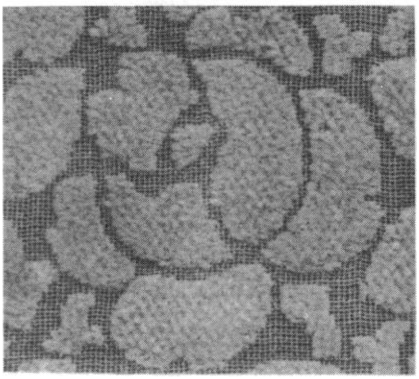


Figure 12.46

each ground pick, and two figuring cards are cut from each horizontal space, as follows: First card—cut the solid marks; second card—cut the dots. The method in which the figuring picks interlace with the ends (including the crossing ends) is shown at C, each pick interweaving in 7-and-1 order. The shearing is not done so closely as in an ordinary Madras cloth, but a portion of each float is cut away about the centre, and the severed tips of the picks then stand up from the surface, as represented at D. The two picks which are inserted to each ground pick may be alike or in different colours, a mixed colour effect being produced in the latter case.

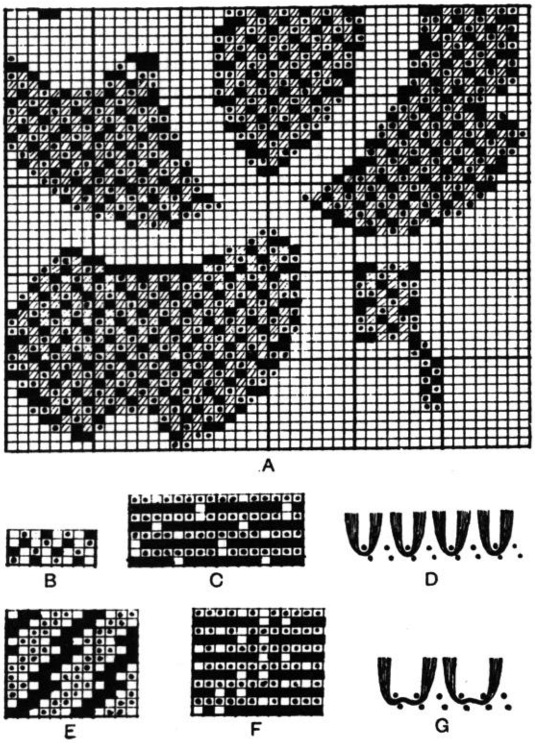


Figure 12.47

Another card-cutting plan for inserting on the figure is given at E in *Figure 12.47*, and a portion of the corresponding enlarged weave at F, while G represents how the severed tips of the picks stand up from the surface. In this case each weft floats over nine ends and is bound in by two consecutive harness ends, whereas in the plan B only one end at a place is used for binding. Binding with two consecutive harness ends makes the figuring weft less liable to fray out of the sheared cloth. (In ordinary Madras designing it is customary to bind on at least two consecutive horizontal spaces).

A further point, illustrated by the plan given at A in *Figure 12.47*, is that, in drafting a design to be developed in imitation pile, five spaces require to be left horizontally between the separate parts of the figure. This compares with a minimum of two spaces for medium sett, and three spaces for fine sett Madras cloths of the ordinary kind. Where in an ordinary cloth the severed ends of the weft increase the size of each portion of figure by about the width of half-a-split at each side, the less close shearing of the imitation pile cloth makes each detail of a design appear larger by the width of a split, or a split and a half at each side.

For this reason the ornamentation of the style requires to be on simple and massive lines.

LENO STRUCTURES PRODUCED IN A SLIDER FRAME AND NEEDLE DEVICE

Apart from the steel doup systems and the gauze and tug reed methods leno structures are also produced by a variety of devices which incorporate slider bars for the crossing action and eyed needles for the shed formation. Most of such devices together with the rotating cog-wheel mechanisms are suited mainly for the production of narrow bands of leno structure consisting of two to four rows of leno for the centre or side selvedges. One of the systems of this type, however, is also suitable for wider fabrics and can be employed for the production of very open leno fabrics in which high stability of construction is a desirable feature.

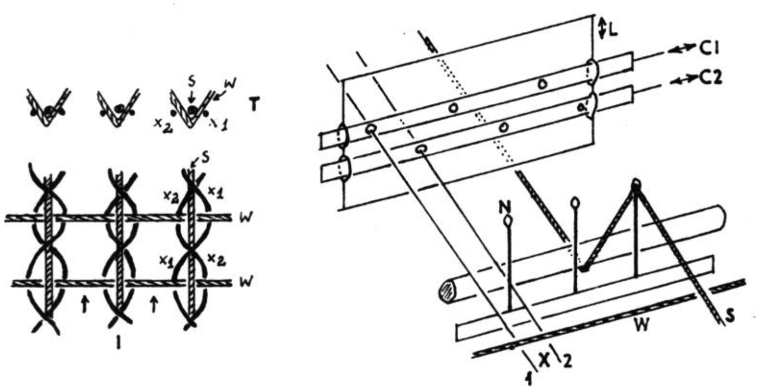


Figure 12.48

The system is illustrated by means of simple schematic diagrams in *Figure 12.48.* The standard ends, S, which are usually quite coarse, are threaded through the eyes of the needles, N, which are fixed in a stationary needle bar. Two crossing ends make a leno row in conjunction with the thick standard end and are designated X1 and X2. Each crossing end is threaded through an eye of its own slider bar, C1 and C2, which both fit into a lifting frame, L. When, between picks, the lifting frame is raised the crossing ends rise above the needles and the sliders, C1 and C2, are operated laterally, one to the left and the other to the right, so that when the frame descends X1 is on the left and X2 on the right of the standard end. After the insertion of weft, W, when the frame is raised again the sliders traverse in the opposite directions and the crossing ends assume reversed positions in respect of the standard end before the next pick is inserted.

This system has been originally developed for the weaving of chenille fur (tufted weft) for chenille Axminster carpets (see Appendix II). The tufted weft is produced by cutting the woven cloth along the lines indicated by the arrows at I and its cross-sectional appearance is represented at T in *Figure 12.48.* High tension in the crossing warp forces the severed weft picks into a 'V' formation which is particularly useful in carpets and similar one-sided pile structures. If the tension in all the warp elements, however, is about equal and the weft is not severed between the leno rows then a very stable cloth structure results in which the weft will not slide even in exceptionally open settings. The fabric construction obtained in this system is depicted at I in *Figure 12.48.*