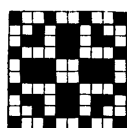


**WEAVING
FOR BEGINNERS**

WEAVING FOR BEGINNERS

WITH PLAIN DIRECTIONS
FOR MAKING A HAND
LOOM, MOUNTING IT AND
STARTING THE WORK

WRITTEN & ILLUSTRATED
BY
LUTHER HOOPER



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EXPLANATION

THIS small book appears to me a most excellent introduction to the craft and industry of weaving. Even the most developed weaving industry has grown out of the simple craft, and it is desirable the industry should keep in touch with its origin, for hand-work found out the way and set up the standard of quality. Moreover, it seems essential that the handicraft itself should be preserved as a means of keeping the ideal of sound workmanship, fine skill of hand, and inventiveness alive ; and, further, as a method of production which is interesting in itself and does not require great capital and elaborate machinery. It is one of the questions which will have to be considered by the political economy of the immediate future how far the experimental crafts can be maintained for their own sake against mere dividend hunting by high-pressure machine power. Indeed, what we most require is some appreciation of quality in wares and interest in workmanship by those who direct our industrial thinking. We need a productive economy in place of, or at least alongside of, the old economics of mere money profit.

It is absurd that those who affect to know about the 'laws' of labour and exchange should be so ignorant, as they obviously are, of the quality of 'goods,' skill

in workmanship, and appropriateness in design. This ignorance was only possible in the era of cheapening : in the time before us, quality will again become of prime importance.

A point that has to be made plain to these ' purely economical ' writers is that fine handicraft has a training value and ethical reactions—it makes men. A political economy which ignores men and life is really unscientific.

The essential human interest of craftsmanship is a point which needs to be clearly apprehended, as it is especially valuable at the present time. Such unexciting yet absorbing employment as weaving has, as the doctors have come to see, a curative value which reaches cases which would yield to no other treatment. The great need in the ' reconstruction period,' whatever the financiers and politicians force on us later, is that the returning and somewhat broken men should as soon as possible, by simple means and in pleasant situations, be set to producing for their own needs—cottage building, furniture making, cloth weaving.

The author has described the making of a simple loom in great and clear detail. This account is based on a wide and deeply interested knowledge of the looms which have been used by the great weaving peoples.

The form of loom described is developed from those in use from ancient times, and embodies the experience of many generations of skilful weavers—Italian, French, English, and even Arabian and Chinese.

W. R. LETHABY.

October 1919.

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WEAVING FOR BEGINNERS

INTRODUCTION

THE value of hand-loom weaving, whether as a pleasant domestic occupation or as an educational exercise, is far from being so generally appreciated as it deserves to be ; and the practical utility and artistic beauty of the materials it is possible to produce on the simplest hand-loom, such as can be conveniently used in an ordinary room, are far greater than can be imagined by the uninitiated.

Hand-loom
Weaving :
its Value

From an educational point of view the practice of weaving is most beneficial, as it requires dexterity of hand, watchfulness, perseverance, taste in colour, and skill in design. Educationalists, for the most part, now agree that training in all these qualities is at least as necessary in the complete education of the young as are the more intellectual theoretic or literary studies which have hitherto practically engrossed the whole attention of teachers and their pupils.

Of course it cannot be pretended that hand-work, whether textile or of any other kind, can ever again supply the multitudinous needs of the vastly increased

Hand-work
versus Ma-
chine-work

and increasing population of the modern world ; but although machine manufacture has, more or less beneficially, superseded handicraft in the production of cloth and other materials required in enormous quantities for the supply of the general market, there is still, even from a commercial point of view, plenty of room for the special productions of handicraft if they are of such quality of workmanship and distinction of design as to render them superior to the goods made by machinery.

The Loom
in the
Home and
School

It is not, however, so much from the commercial as from the domestic and educational points of view that the value of the hand-loom, and the work in which it can be advantageously employed, will be described in this treatise for beginners ; but at the same time the author will always insist on the necessity of the work produced being equal in quality, if not superior, to the stuffs made on power-looms, not only for their artistic but for their technical and useful character.

Importance
of Good
Workman-
ship

This point cannot be too much emphasised, for at the numerous exhibitions of handicraft, held in different districts during recent years, it has been pitiable to observe that, although in many other departments good workmanship is—as it always should be—as much in evidence as artistic merit, the specimens of woven fabrics shown, for the most part, compare very unfavourably in the matter of technical excellence with those of a similar kind, even of the lowest grade, made on machine-looms driven by power.

No Excuse
for Bad
Workman-
ship

There is no excuse for bad weaving on a properly constructed hand-loom, for the close personal super-

vision of the web in progress by the weaver, in comparison with the automatism of the power-loom, should result in the production of a far more perfect material than the competitive prices and the commercial exigencies of manufacture, simply for profit, will admit of. The general use of better yarns for hand-weaving than are generally used for machine work also tends towards a better result.

The hand-loom weaver should aim at the achievement of absolute perfection in the webs he weaves. The finished work would then, at any rate, equal in appearance the stuffs made on machine looms, but, when made up into garments or furniture for use, would wear much better and continue to give satisfaction as long as the threads of the fabrics would hang together : this all, of course, providing only good raw materials were used, the loom and its fittings properly constructed, the work correctly set up and kept in good order during its progress, and the character of the web suitable in design for the capacity of the loom and the experience and skill of the weaver.

Perfection
the Aim of
the Hand-
loom
Weaver

To the above end, the purpose of this work is to describe practically the art of simple weaving for elementary students ; to describe the loom and its construction according to traditional plan and method as well as that of the few necessary appliances for the work ; to state and illustrate the universal principles on which various textures are woven and the faults to be avoided by beginners ; also to furnish some simple typical designs such as can be woven without adding to the structure of the most manageable form of loom,

Scope of
this Hand-
book

Free Use of
Diagrams and to give clear directions for getting them ready and weaving them.

Advice to
Students Throughout the book diagrams are freely used, and are carefully dimensioned, lettered, and figured in such a way as should be readily understood by any skilful mechanic or intelligent student. Advice is also given on the choice of yarns, and the characteristics of the various raw materials available are described.

Before starting to make any appliance or attempting to weave, the student should read carefully right through the book, referring to all the letters and figures of the diagrams, so as to make sure that every detail is clearly understood. It is recommended that the first attempts at weaving should be made on the simplest kind of webs, and with the least expensive kinds of yarn.

Many of the illustrations used in this book are from the author's larger work 'Hand-Loom Weaving,' published at 8s. 6d. net in the 'Artistic Crafts Series of Technical Handbooks,' by the same Publishers.

PART I

THE LOOM AND ITS FITTINGS

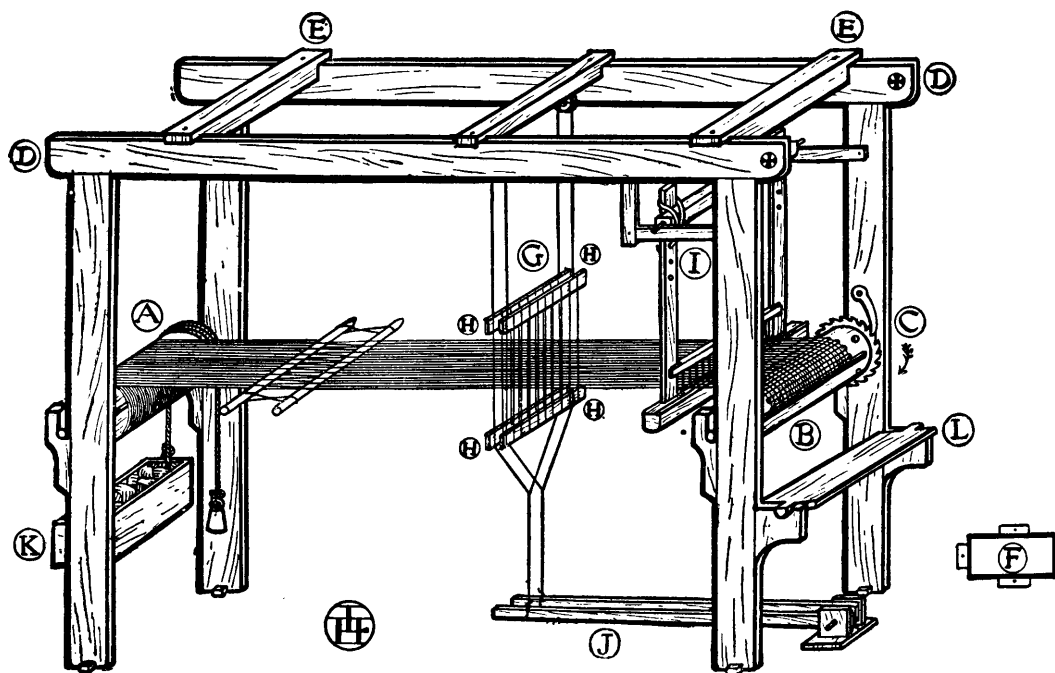


FIG. 1:

THE OLD ENGLISH LOOM FROM 'HAND-LOOM WEAVING.'

- A. The back roller or *cane beam* on which the warp is first wound.
- B. The front or *breast roller* on to which the woven cloth is wound.
This is sometimes called the *cloth beam*.
- C. The ratchet and wheel, which prevents the breast roller turning back, but allows it to turn forward to receive the woven cloth.
- DD. The loom frame with its four strong posts.
- EE. The tie pieces, which hold the sides of the frame together.
- F. Plan of one of the loom posts, showing method of fixing the posts to the ground.
- G. The harness. This is used for lifting warp threads in order to make successive openings for the passage of the weft.
- HH. The headles of the harness, through the loops of which the warp is threaded in the order required for the particular cloth to be woven.
- I. The batten or *sleigh* fitted with the comb or reed for beating the weft together.
- J. The treadles for working the harness.
- K. The weight box for regulating the tension of the warp.
- L. The weaver's seat.

CHAPTER I

BRIEF BUT VERY IMPORTANT

THE essential operations of weaving are invariably three, and they always follow each other in the same succession. It does not matter however simple or however complicated the interlacements of a piece of cloth may be, these three operations are always necessary, and have to be repeated over and over again till the whole web is woven. The three operations are (1) opening the warp—that is, lifting certain threads of a set called a warp, which has been previously stretched on some kind of frame, and depressing others, so that a thread, called the weft, can be passed between them; (2) passing the weft, either by the fingers or wound on some kind of spool or shuttle, through the opening thus made; and (3) beating successive lines of weft together with some kind of tool, generally formed like a comb. It must be understood that a different set of threads is raised each time the weft is passed through an opening, and by this means the interlacement of warp and weft is effected.

The Essen-
tials of
Weaving

It is obvious that some kind of appliance must be made in order to keep the warp threads stretched and to hold them spread out equally to a certain width, the width of the cloth intended to be woven. If the work is to be done at all quickly, some means of lifting the threads automatically in regular succession must

Evolution
of the Loom

be devised; and in order to make good even cloth the beating of the weft together must be carefully regulated. The appliance which has been evolved during many thousands of years is that which we call a loom, and it may either be worked by hand or power.

Loom must
be Solid and
Geometri-
cally True

In order to be useful and lasting the loom must have two principal qualifications whatever material—wood or iron—it may be made of, and whatever traditional or original model its designer may follow. These two qualifications are (1) rigid strength, and (2) geometrical exactness of construction. Without the first of these qualities the loom will be unfitted to bear the accumulating strain of the incessant, more or less heavy blows required to beat the solid cloth together, and, without the second quality, the material can never be made true and even in texture, whether it be close and solid cloth or open filmy gauze.

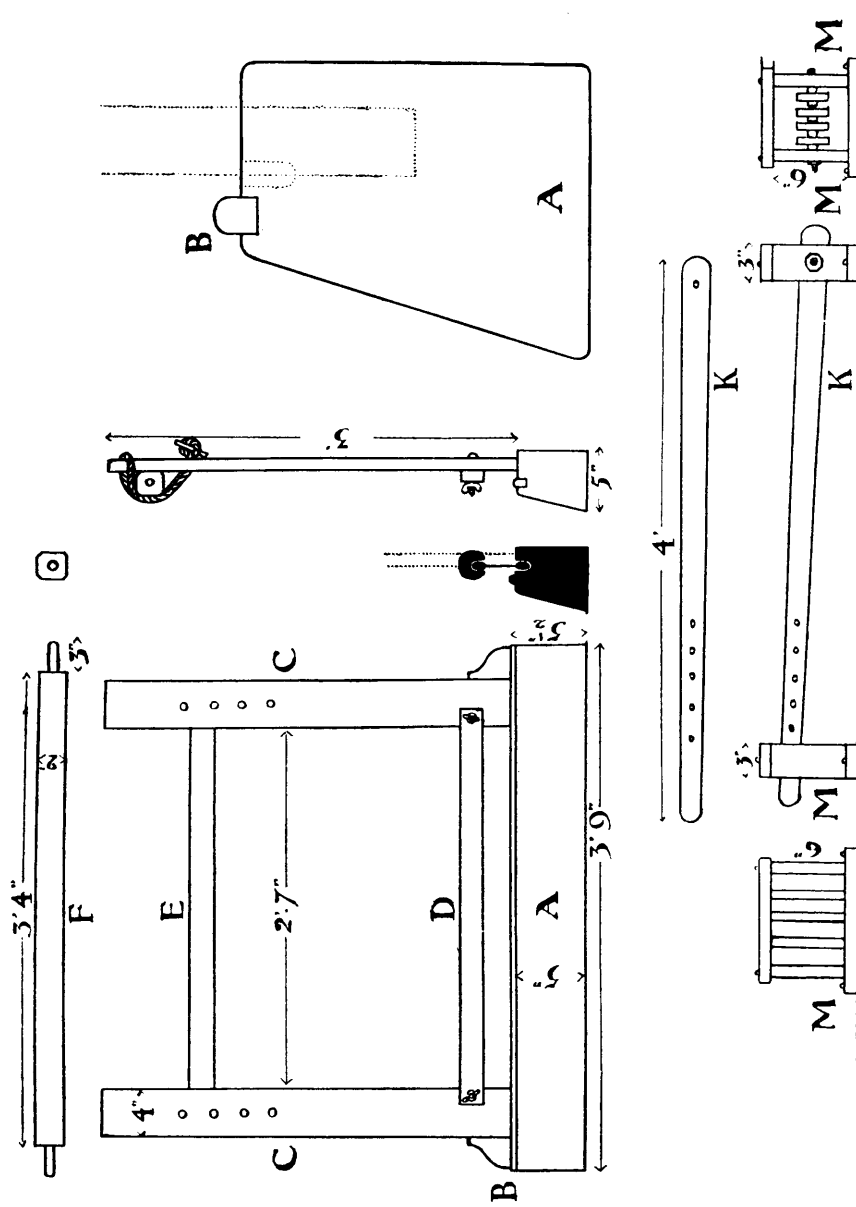
Whatever form of loom frame may be designed, for various shapes have been and are in use, the above two qualities must be possessed. In purchasing a ready-made loom, therefore, it should be tested particularly for these qualities, and if it will not bear the most severe test, should be rejected. The form of loom frame most practical, simple of construction, and serviceable for all kinds of weaving—although perhaps not the most ornamental—is that to be described in exact detail in the following chapters. It is the traditionally developed form of frame which the hand-loom weavers of France and England have invariably used ever since the seventeenth century, when the art of weaving reached the highest pitch of perfection it ever attained to.

THE LOOM

WORKING DRAWINGS
FOR THE CARPENTER

[illegible]

PLATE II.



CHAPTER II

THE WOODWORK OF THE LOOM

IN setting out to make a loom, whether for commercial, domestic, or school use, we must make sure that the wood provided for the framework is sufficiently sound, solid and dry to prevent any tendency to bend, spring or shake when the loom is in use ; and in cutting out the various parts and fitting them together, great care must be taken that all the dimensions are correct, and the joints, mortises and tenons are so perfectly adjusted that when complete the loom will stand exactly four square and true in all its members.

The Kind of
Wood Re-
quired for
the Loom
Frame and
Fittings

Careful
Carpentry
Required

THE LOOM FRAME

The best wood to use for the loom frame is good, clean deal or pine, free from knots and shakes. An examination of the working drawing No. 1 will show that a length of 70 feet will be required, and that it must be, when planed, $4\frac{1}{2}$ inches wide by $2\frac{1}{2}$ inches thick. This will be sufficient to make the frame 8 feet 6 inches long by 4 feet wide and 6 feet high.

Plate I.
A, B, C, D,
E, F and G

Four lengths of 6 feet each must first be cut off : these are for the four corner posts. At one end of each post a tenon must be cut.

Plate I.
B, B, C

Two lengths of 10 feet each will next be required

Plate I.
DD

for the top pieces of each pair of posts. These are to be shaped at the ends and must have mortises cut in them to fit the tenons on the top ends of the posts. The spaces between the front and back posts must be 7 feet, as shown in the drawing.

Plate I.
E, E, E

Three cross pieces, each 4 feet 6 inches long, will be required for ties to hold the sides of the loom frame together at a distance of 3 feet 6 inches apart: that is if the loom is intended for weaving cloth up to 30 inches wide. These will be fixed at the top of the loom, as shown in the drawing.¹

Plate I. F

Two lengths of 2 feet 9 inches will be wanted for the two front brackets F, and two lengths of 1 foot 6 inches for the smaller brackets G. These have all to be firmly fixed by bolts to the loom posts to hold the two rollers HH in their places, as shown in the diagram.

Plate I. G, G
and H, H

The combined lengths of these various parts of the loom frame added together will be found to equal exactly 66 feet—practically 70 feet, as aforementioned, in order to allow for waste in cutting, and they are all made of the same sized wood, viz., $4\frac{1}{2}$ inches by $2\frac{1}{2}$ inches when planed.

Plate I.
H, H

The rollers in the loom are two in number, though for some thick stuffs and for very long lengths three may be required.² One roller is placed at the back of the loom, the second on a bracket of the same height on the front post in the position shown in the drawing. One or two spare rollers should also be provided. These rollers must be made of well-seasoned, hard wood, each must be turned perfectly true on its axis and must

¹ and ² See notes at end of Chapter IV., p. 23.

be of exactly the same diameter throughout its length. It must also have a groove cut in it (see drawing) about an inch and a quarter deep, half an inch wide and not less than 31 inches long.

The weight box I, the treadles K, the shafts or swords of the sleigh L, and the frame brackets from which the sleigh hangs as well as the treadle racks M, also the lever frame O, must all be made of deal an inch thick when planed.

The weight box I must be very strongly made, as, for some kinds of weaving, it has to hold very heavy weights. The sides must be 3 feet long by 1 foot high, the ends 10 inches wide by 1 foot 6 inches high, and the bottom board 9 inches wide, which will allow, when it is grooved into the sides, an inside space of 8 inches in width. The two holes indicated at the top of the ends must be 1 inch in diameter.

The amount of 1-inch deal required for the box I, the treadles K, the treadle racks M, and the sleigh L and its bracket will be about 30 feet by 1 foot. The details of the sleigh and treadle are given fully in Plate II.

The headle laths N, which are made of $\frac{1}{4}$ -inch deal, need not be considered until the loom frame is finished.

THE BATTEN OR SLEIGH

Equal in importance to the loom frame is the batten or sleigh, as it is often called, by means of which the actual weaving is done. It swings freely, from its brackets behind the front posts of the loom frame,

and holds the comb or reed through which the warp threads pass on to the breast roller. Immediately in front of it the shuttle is driven from side to side in order to intersect the warp and weft threads in the manner necessary for the weaving of cloth. Any fault or inaccuracy in this part of the mechanism of the loom will make it difficult, if not impossible, for the weaver to weave perfect cloth.

Wood
Required
for Making
the Batten

Good, clean, well-seasoned deal is the best sort of wood of which to construct the batten. The different parts should be cut out and left for some days before being finished and fitted together, in order to make sure that they will not warp or twist. If any piece shows the least tendency of the kind it must be rejected.

The Several
Parts of the
Batten.
Plate II.

The several parts of the batten are called as follows : The letters refer to the diagram, Plate II. A, the race block ; B, the shuttle race ; C, C, the swords ; D, the cap of the reed ; E, the sword tie ; and F, the rocker. The position of the batten in the loom is shown at L in Plate I.

The shapes and dimensions of all this woodwork can be easily made out by a careful study of the diagrams ; it is only necessary, therefore, to add that, in constructing the batten or sleigh, the grooves in the cap D and the race block A, into which the reed has to be fitted, must be so placed that the dented surface of the reed itself may be exactly flush with the front side of the swords, for if it is not so, the shuttle cannot be thrown so as to reach the opposite side without flying out.

CHAPTER III

THE IRONWORK OF THE LOOM

THERE is very little ironwork necessary in the construction of the hand-loom, but what little there is requires to be exactly fitted for its purpose and must be carefully made.

THE REED

The most important fitting of the loom, now invariably made of fine steel, is the reed or comb. It is an appliance which fits into the groove of the block A, Plate II., and is kept in its place in the batten by the cap D. Its position is clearly shown at O, in the section of the batten drawn at the right-hand side of the front elevation.

The Reed :
its Importance
and
Position in
the Batten

See Plate II

The reed, as its name suggests, was originally made of strips of cane or reed fixed more or less closely together between two pairs of half-round rods (Fig. 2). Since the middle of the eighteenth century, however, strips of steel have been used instead of strips of cane, and greater strength and exactness in the implement has resulted from the change.

The spaces between the strips of metal are called *dents*, and a reed is technically described as having *so many dents to the inch*. Thus a reed of ten dents to the inch for a batten of 30 inches reed space would contain

The Dents

300 dents; the number of dents to the inch being determined by the fineness or coarseness of the cloth to be woven. Although the spaces between the strips of metal

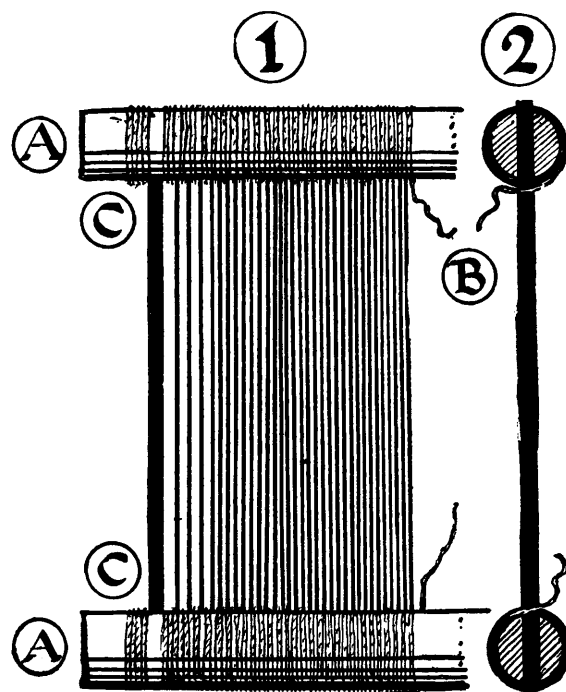


FIG. 2. THE REED-END AND SECTION.

thus vary in different reeds, the distance between the top and bottom laths into which they are fixed is always from $3\frac{1}{2}$ to 4 inches. Reed making is one of the separate trades dependent on the textile industry and requiring the use of special machinery. It will be necessary, therefore,

to purchase a reed for the loom as soon as the kind and width of cloth to be first made is determined on.¹

The choice of a reed will be treated of in the section on 'Getting to Work.'

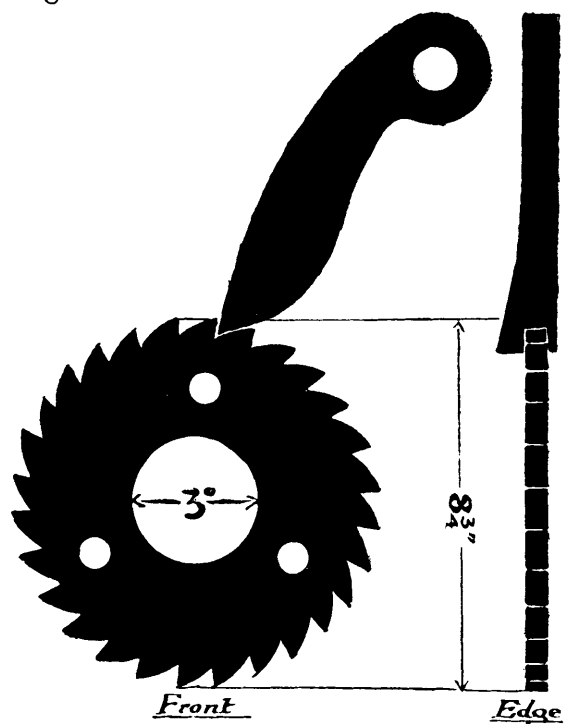


FIG. 3. RATCHET AND WHEEL.

THE RATCHET AND WHEEL

The front roller of the loom, on to which the woven cloth is wound, has to be fitted with a cast iron toothed The Ratchet and Wheel

¹ For the addresses of reed makers see advertisements at end of book.

wheel in order to fix it, by means of a ratchet attached to the inside of the right-hand post, in such a manner as to prevent its moving backwards, but allowing it to move forwards, at the will of the weaver, as the cloth is made. The wheel is made of cast iron, but the ratchet should be of wrought iron, as sometimes it has to bear a great strain.

The wheel must be firmly fixed to the roller by four screws, at the right-hand end, and the ratchet so attached, by a strong screw, to the inside of the right-hand post as to allow of its falling into the spaces

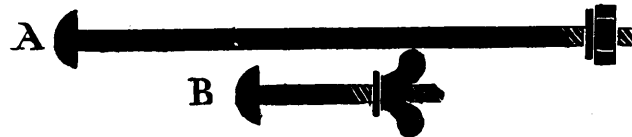


FIG. 4.

between the teeth of the wheel and so preventing its running back, as it would otherwise do owing to the tension on the warp. In order to allow for the half-inch wheel being fixed to the breast roller, the latter must either be made half an inch shorter than the back roller or half an inch must be cut off when it is attached, as both rollers must occupy exactly the same space between the loom posts.

The rest of the ironwork of the loom consists only of bolts of various lengths, about $\frac{3}{8}$ of an inch thick, and nuts to fit them. Sixteen of these will be required, and in addition to these, two small bolts, with wing nuts to fix the cap of the reed to the batten, will be wanted.

Bolts and
Nuts. Fig. 4

CHAPTER IV

ERECTING THE LOOM FRAME

POSITION OF THE LOOM

PLENTY of light is essential to good weaving, especially if fine work is to be done. The loom, therefore, must be placed near a window and be in such a position that the light comes from the left side of the weaver when he is at work. A ground plan of the loom is given in Fig. 5. This must be marked out on the floor in such a manner as to allow the weaver,

Position of
the Loom

Ground
Plan of the
Loom

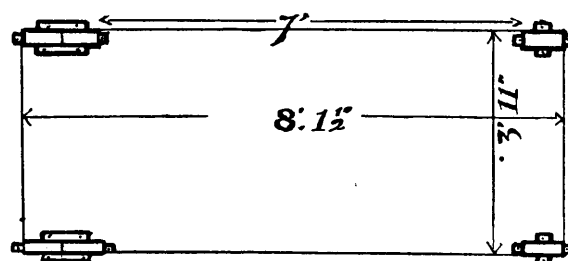


FIG. 5.

when the loom is erected, space to sit at one end—preferably with his back to a wall—and to be able to move all round the loom and reach to all its parts.

In order to get the ground plan perfectly true it is necessary to set out on the floor a parallelogram, in the four angles of which the posts A, B, C, D are to stand. Great care must be taken to get the four right angles

exact. This can be tested by measuring the diagonal lines from opposite corners—shown in Fig. 6.

Providing the lines AB and CD are the same length and the lines AC and BD are also the same length, the diagonal dotted lines CB and AD will also be of equal length if the angles A, B, C, and D are true right angles.

Within this oblong parallelogram the loom frame, fitted together, may now be stood, and each of its four posts fixed accurately in the angles by four small blocks

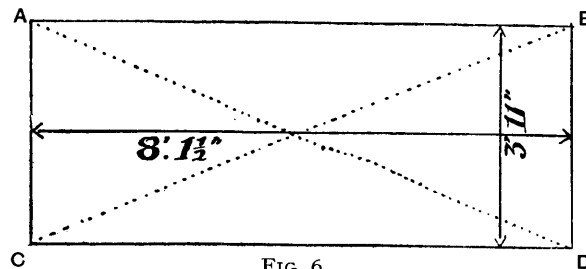


FIG. 6.

being nailed or screwed to the floor, one at each of its four sides, as in the plan A, Plate I., and Fig. 1, F. This is the best way of fixing the loom, because it does away with the necessity of side rails in the lower part of the loom, which are always apt to get in the way of the weaver when regulating or attending to the harness or other mountings that may be required for different sorts of work. If, however, the loom is to be fixed in a room having a stone, cement or tiled floor, side rails will be necessary; but, if used, they should be fixed as near the ground as possible. The ties EEE may then be fixed in their places by screws, and will complete the frame.

POSITIONS OF THE ROLLERS, WEIGHT BOX, BATTEN, PULLEY RACK AND TREADLES

The two rollers HH may now be placed in their positions on the front and back brackets, and the ratchet screwed to the loom post as shown in the drawing of the old English loom (Fig. 1, C). The weight box may also be placed on the ground underneath the back roller and parallel with it, ready to be connected with it by ropes and weights. The batten (L, Plate I., and A, Plate II.) with its rocker attached to it by a loop of strong cord, as shown in the end view, Plate II., may be hung on its corner racks (O, Plate I.). The pulley rack E (A, Plate I.) is next to be mounted on the top of the frame and fixed temporarily about midway between the front and back posts—its exact position being regulated afterwards. The treadles M, K (Plate I.), with their racks may also temporarily be put in their places between the front posts, so as to be worked by the weaver's feet ; and thus, the carpenter's and smith's work being finished, the loom will be ready for *gating*, as the mounting and preparation for actual weaving is technically called.

Getting the
Various
Parts in
Position

NOTES

1. If very thick cloth is to be woven and there are a great many yards to go on the breast roller, it will soon become inconveniently large and necessitate much regulating of other parts of the loom. In such a case a third roller is required for the cloth to run over as it is made, the cloth roller being fitted up underneath

where its alteration of size will not interfere with the work. The beginner need not trouble about this however.

2. The loom will require bracing or staying up to steady it and prevent vibration. This may be done most effectively by elongating the top pieces of the loom frame

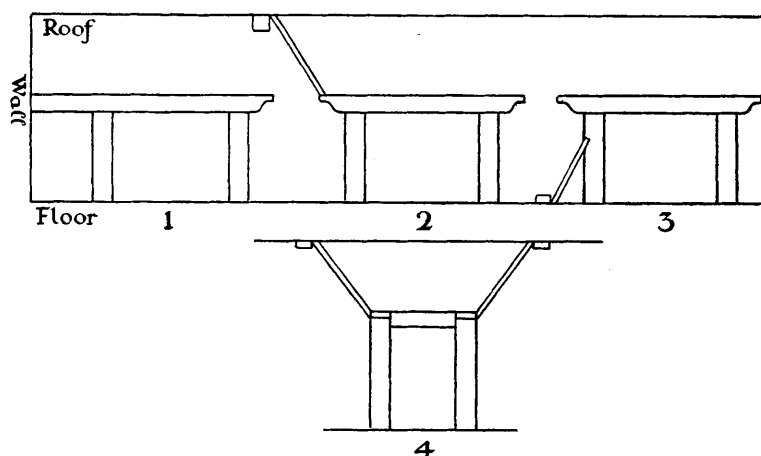


FIG. 6A. SIDE AND END VIEWS OF LOOM WITH STAYS.

sufficiently to reach to the wall behind the weaver's seat ; or, if there is no convenient wall, strong stays can be carried from the loom to a beam or floor which will do almost as well. All the strain is toward the weaver, so that slighter stays only are required for the sides of the loom in order to keep it perfectly steady.

CHAPTER V

THE HARNESS OF THE LOOM

THE purpose of the harness, as the most essential part of the mounting of the loom (shown at G, Fig. 1) is called, is to enable the weaver, by means of the treadles, to lift certain threads of the warp and depress others in such a manner as to make a succession of openings in front of the reed for passing the weft from side to side, and thus interlace it with the warp threads. At Fig. 1, G, a very simple harness is shown. It is composed of two *headles*, as they are called, HH, HH. Each headle is made of two laths, one above and one below the warp. Each pair of laths is joined together by a number of compound loops, as will be presently described. The warp threads are passed separately through eyes in the centre of the loops, so that if the headle is raised all the threads passing through its eyes will be raised together with it. Thus an opening between the threads lifted by the headle and those remaining below will be made in front of the batten I, Fig. 1. The harness shown in the drawing is one of *two* headles only, in order to keep the drawing clear and simple, but any reasonable number may be required according to the design of the web to be woven, and any number of loops may be mounted on each headle according to the number of threads it is intended to lift.

The
Harness,
Fig. 1, G

A Four-Headle Harness

Plate I., N

The Leashes



FIG. 7.

The Leash Gauge

A great variety of useful, plain and even ornamental work can be done on a harness of four headles; it will be best, therefore, to make a harness of that capacity for our elementary experiments.

In order to make a harness of four headles we shall require eight laths like N, Plate I. Each headle must consist of two laths suspended one above the other at a distance of 14 inches apart. The two laths of each pair must be connected together by compound loops of strong thread called *leashes*, and these leashes must each consist of three loops, two long ones and a short one—called the *eye*—in the middle (see Fig. 7).

Of course, as every warp thread has to pass through a separate leash, a very large number are required in a harness, and they have to be very accurately measured and tied. The first web it will be proposed to weave will consist of 40 threads to an inch of warp, and the width of stuff 21 inches, which works out at 840 threads of warp, 840 leashes in the harness, and 210 leashes on each headle.

The appliance for making the leashes is called a gauge (see Fig. 8).

A, A is a smooth board 19 inches by 6 inches by 1½ inches, and B, B are two strong smooth metal pegs firmly fixed in the board, one at each end, 17 inches apart and projecting from the board from 1½ to 2 inches; C, C are two similar pegs, but instead of being fixed they are fitted tightly into holes drilled in the board and are

movable. The board has holes in the top edge, into any of which the pegs C, C can be fitted, so that the space between the pegs C, C can be altered at will. Fig. 9, which is a top view of the gauge, will explain this point.

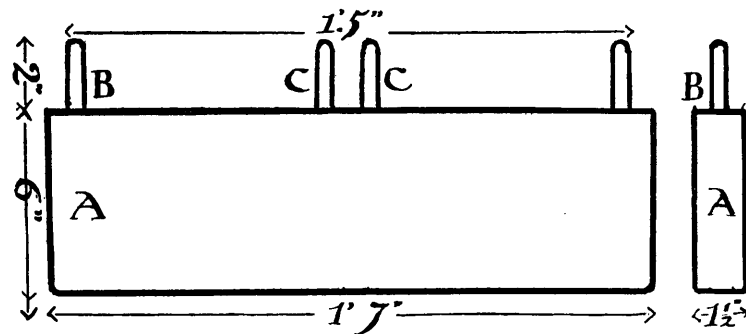


FIG. 8.

From Fig. 9 it will be seen that the position of the centre pegs can be altered so as to enclose a space of from $\frac{1}{2}$ inch to 3 inches.

The dotted lines in Fig. 9 show the manner in which Making Leashes

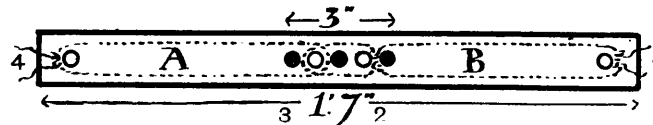


FIG. 9.

the leash is formed. The loop A is made first, tied at peg 4 with a double knot, and encloses pegs 3 and 4. The board is then turned and a thread is passed through the loop already made and tied, after enclosing pegs 2 and 3, also with a double knot: the ends of the thread

are left long enough to tie outside peg 1 also in a double knot, and so one leash is finished. Leashes made in the same way are added until ten, or it may be twenty, are finished, when they should be taken off and neatly tied up by passing cords through the loops A and B. Being tied up in bundles of tens or twenties they will be easy to count. It is best to tie the leashes together before taking them off the board. The removal of the centre pegs will sufficiently loosen the leashes to allow of their being removed from pegs 1 and 4. For these leashes strong thread, made for the purpose and called harness thread, must be



FIG. 10.



FIG. 11.

used. Ordinary thread would very soon wear out with the unavoidable friction of weaving, and give endless trouble to the weaver, who would have to renew the leashes very frequently.

Preparation
of the
Headle.
Laths

The eight laths N, Plate I., must be prepared to receive the leashes by being notched at both ends in the manner shown at Fig. 10. In the notches at the ends cords will have to be tied, as shown in Fig. 11, in order to attach them to the cords which pass over the pulleys or are tied to the treadles (see Fig. 1).

To Hang
the Leashes
to the
Laths

The best way to put the leashes on the laths is to hang the laths, one at a time, by loops to a couple of nails, as shown in Fig. 12, A and B.

Loop B should be made a little longer than loop A, so as to allow it being wound once round the lath, to prevent it slipping off while the leashes are being put on at the other end (A).

As soon as the sufficient number of leashes are on the lath the cords, shown at Fig. 11, must be firmly tied to the notches and the four ends tied together temporarily in order to prevent the leashes slipping off. The leashes can remain tied up in the bundles

See A,
Fig. 13

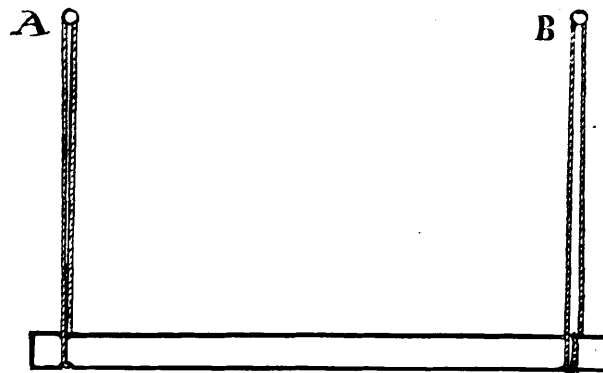


FIG. 12.

of ten for the present, as so they are less likely to get entangled. Twenty-one bundles of ten will have to be hung on each lath.

When one lath is full and the end cords tied on and secured, a second lath must be slipped into the lower loops of the leashes, particular care being taken to prevent any bundle of leashes being twisted. As soon as this has been done and the end cords tied on, the headle will be so far finished and should appear like Fig. 13.

See A and B,
Fig. 13

The Finished
Headle

The ties A and B must be such as can be easily undone
but will not come undone of themselves.

The four headles of the harness being so far finished,

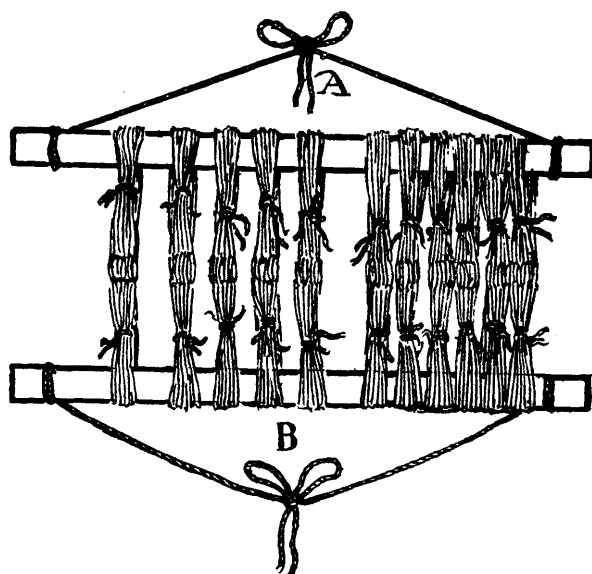


FIG. 13.

they may be temporarily hung in the loom from a bar fixed at the top of the loom in the position shown at Fig. 1. They cannot be finally regulated till the warp is prepared and drawn through the eyes of the leashes. The next thing, therefore, is to prepare the warp.

PART II

WARPING, BEAMING AND ENTERING

CHAPTER VI

PREPARING THE WARP

THE *warp*, as the whole number of threads running the length of the piece of any kind of woven material is called, must be very carefully and exactly prepared. It may be made of any material—linen, cotton, wool or silk—but, whatever it is, it must be good and strong in order to bear the strain of weaving and to look and wear well when made into cloth. It will be best to make our first warp of mercerised cotton of not too fine a size. Mercerised cotton is generally kept in stock by dealers in two sizes, fine and coarse, No. 60 and No. 30. The coarser of the two sizes is the better to begin with. It should also be purchased wound on reels or spools ready for warping.

Warps of
Different
Kinds and
Sizes

The warper has to cut off equal lengths of any number of threads required for a stuff of a certain count and width, to lay them parallel to one another, and to provide a simple method for keeping them, even if there are several thousands, in perfect order, not only till they are transferred to the back roller of the loom, but till they are all woven up into cloth. This appears, at first sight, a very difficult thing to do ; but the experience of hundreds of generations of weavers proves that a very simple appliance, if carefully used, will enable the weaver to do this preliminary work perfectly and with ease. This appliance is the warping board.

The
Problem for
the Warper

The Warping Board

The warping board is a stout board of any convenient size, not less than 6 feet 6 inches long, 1 foot broad, and $1\frac{1}{2}$ inches thick. It can hang at a convenient height either on a wall or on the side of the loom. The board is fitted up with a number of pegs, two of which

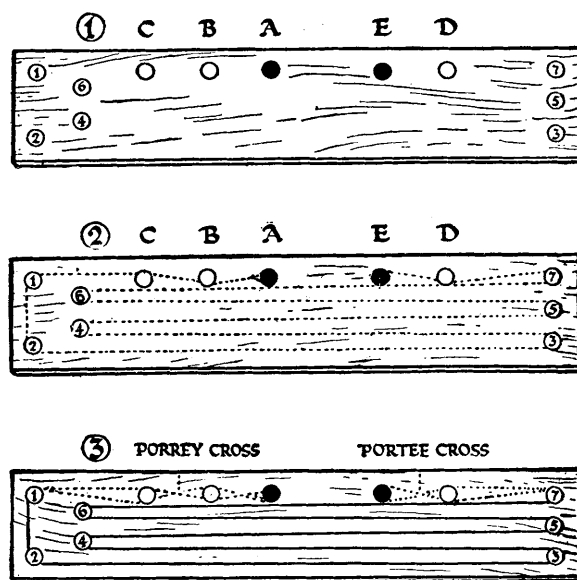


FIG. 14. THE WARPING BOARD.

must be movable; all the others are fixed firmly in the board. The pegs must be made of hard wood, be perfectly round and smooth, not less than 1 inch in diameter, and must project from the board from 6 to 8 inches (see Fig. 14, 1, 2 and 3).

No. 1, Fig. 14, shows the board with its pegs A, B, C, D,

E, and 1, 2, 3, 4, 5, 6 and 7. The pegs A and E, marked in solid black, are movable ; all the others are fixed in the board. Although movable, the pegs A and E must fit quite firmly into their places in the board. The top row of pegs, 1, A, B, C, D, E and 7, should be about a foot apart, but there must be a foot at least between B and A and E and D.

Before attempting to make a warp of many threads, the beginner should start by making a very small warp, in order to learn the principles of the work. A warp of twenty threads, 10 yards long, will be sufficient to begin with. The student must take a single reel of thread and place it on a short rod of thick wire about 10 inches long. If held upright, the reel will then be able to turn and unwind freely. The operation is begun by tying the end of thread to peg A, No. 2, Fig. 14. Now, keeping the wire and reel upright in the left hand, with the right hand he must guide the thread under peg B and over peg C. Then, following the dotted line, he will carefully guide the thread *outside* pegs 1, 2 and 3 *back* to peg 4, then to pegs 5, 6 and 7 in succession. Then it must go *under* peg D and over peg E. This finishes the course of the first single thread as shown at No. 2, Fig. 14. Now turning to No. 3, Fig. 14, in which single threads are indicated by dotted lines and double threads by clear lines, the thread must be carried under E, over D, round 7, 6, 5, 4, 3, outside 2 and 1, then *under* C, over B, and under and round A. This will complete the course of two threads, and they will be seen to cross each other between A and B, B and C at one end and between D and E at the other end. The first cross

Making an
Experimental
Warp

Names of
the Warp's
Crosses

at the beginning is called the *porrey* cross, and the one at the end is called the *portee* cross, as in Fig. 14, No. 3. It will also be seen that between the two crosses two threads have been warped of about ten yards each. Of course the length of warp must be reckoned from peg 1 to peg 7, represented on the diagram by the continuous line.

The second thread being carried round and over peg A, goes under B, follows the exact course of the first thread, duly arrives at E, then, following the second thread back, it reaches A, goes *under* and over it, and *four* threads out of the twenty are warped.

After ten forward and ten backward journeys are made, our sample warp of twenty threads will be finished, and, when the porrey and portee crosses have been secured, it may be removed from the board. It is very easy to secure the crosses, but it must never be forgotten, for unless it is done the warp will be irretrievably spoiled, and if it consists of a large number of very fine threads, the whole will be tangled and wasted.

Securing
the Crosses

Fig. 15 will help to explain the method of securing the crosses before the warp is removed from the board. The letters A, B, C, D and E indicate the pegs of the warping board, and between the letters B and C and D and E are the two important crossing places of the thread. Two pieces of strong, pliable cord, about 2 yards long, must be inserted in the same openings as the pegs and tied securely at the ends, as shown in the drawing. It is obvious that these cords will preserve the crosses after the warp is loosened and removed, and

that, as long as the cords remain tied, the warp cannot get out of order.

It will be noticed that there is another cross between the pegs B and A, but this is not so important. It will be found convenient, however, to pass a short cord round this cross also, and to tie the threads close together so as to preserve the loop formed at peg A. The movable peg A may now be loosened and the warp carefully wound on to a smooth stick ready for the back roller of the loom.

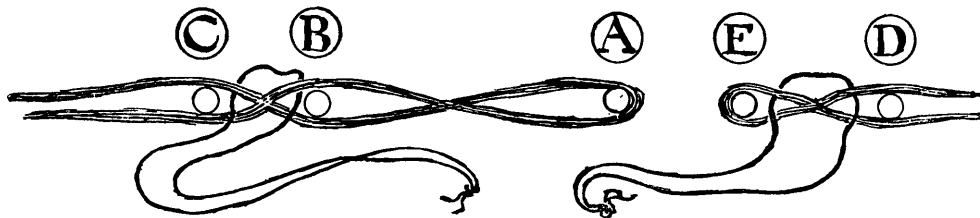


FIG. 15. METHOD OF SECURING THE CROSSES IN THE WARP.

If this experimental warp of twenty threads has been made correctly, the principles of warping will have been mastered by the student, and it will also have been discovered that to warp a large number of threads, one at a time, would be a very tedious process. Eight threads can quite easily be warped at one time, so that when the warper has carried them *once* from peg A to peg E and back again, *sixteen* threads will have been laid instead of only *two*. It is possible to lay as many as a hundred threads together in every *portee*, as the single round of thread is called, if a machine called a warping mill is used; but for our present purpose the

Warping
with Several
Threads at
a Time

simple appliance described for laying sixteen threads at a time will be quite sufficient: indeed, the simple warping board can be used for much larger warps than the one of 840 threads we are proposing to deal with.

The Bobbin
Carrier

To effect this saving of time we must use a *bobbin* or spool carrier, shown at Fig. 16. The bobbin carrier is an oblong frame in which there is room for eight bobbins to stand upright just far enough apart to stand when full and turn as the thread is unwound from

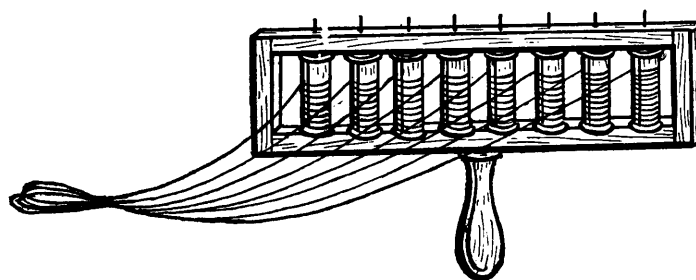


FIG. 16. THE BOBBIN CARRIER.

them. The bobbins are kept in position by wires which pass through holes in the top of the frame, through the centre holes of the bobbins or spools, and into a set of holes drilled only half through the lower part of the frame. A convenient handle may be attached to the frame in order to carry it backward and forward, or it may be fixed on a table or stand parallel to the warping board, but about two feet to the left of the peg C. In arranging the bobbins, care must be taken that all the threads unwind from the same side and the bobbins all turn in one direction.

The carrier being held by an assistant, or being fixed in a convenient position on its stand, the warper must gather the ends of the eight threads together and tie them into a small loop, which must be attached to peg A of the warping board (Fig. 14). If this is carefully done, the weight of the bobbins standing on end will be sufficient to keep the threads taut, and all will be ready for the operator to 'take the cross' between

To Use the Carrier

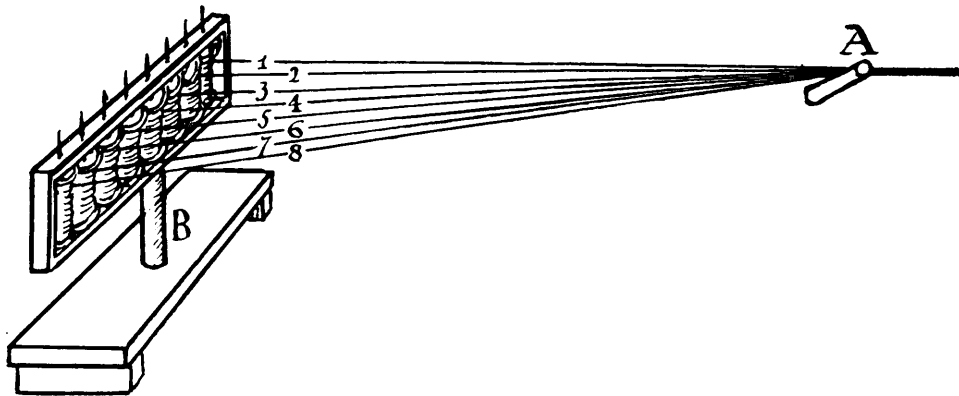


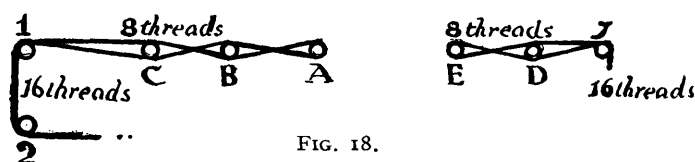
FIG. 17. THE BOBBIN FRAME.

alternate threads of the eight. The position now reached is shown at Fig. 17.

In order to *take the cross*, which of course is the essential part of the warp, the threads 1, 3, 5 and 7, Fig. 17, must be gathered between the thumb and first finger of the warper's left hand and raised sufficiently to allow the flat, open right hand to be inserted between them and the threads 2, 4, 6 and 8. Holding the odd and even threads thus separate, the hands must be moved towards the peg A, and when opposite peg B

Taking the Cross

Warping (continued) the odd threads must be placed above and the even ones below it. Then, the threads being well pressed home to the board, so as not to slip off, the threads numbered 2, 4, 6 and 8 must be lifted, and threads 1, 3, 5 and 7 left below. The right hand must then be inserted in the opening as before, and the opening transferred to peg C. It will then be seen that alternate threads from 1 to 8 cross each other between pegs B and C. The eight threads must now be taken in the right hand altogether over pegs 1, 2, 3, 4, 5, 6 and 7, in the same course as the single thread of the experimental warp. We have now arrived at peg D, *over* which all the eight



threads must be taken and carried *under* and *round* peg E, *under* peg D, *over* peg 7, and back on the same course to peg 1. Having reached peg 1, the even threads 2, 4, 6 and 8 must be raised as before from the odd ones, 1, 3, 5 and 7, and thus slipped on to peg C, the even threads this time being at the top. The threads 1, 3, 5 and 7 must finally be raised, and the threads 2, 4, 6, and 8 left below and so placed on peg B, the odd threads being at the top, as at the beginning. The eight threads altogether must now be carried over peg A, and so the first collection or *portee* of sixteen threads is warped.

If now examined sixteen threads all exactly 10 yards long will be found on the board between pegs 1 and 7.

Between the pegs B and C the odd and even threads will cross each other in exact order. On pegs A and E there will be loops of eight unseparated threads, and between pegs D and E there will be one *portee* cross of eight also unseparated threads (see Fig. 18).

Description
of First
Portee of
Sixteen
Threads

Great care must be taken to press the portee of threads close to the board at each round, and to lay the succeeding portees as neatly and closely as possible on the pegs.



FIG. 19.

Beginning in the same way by separating the threads and keeping the odd ones at the top of pegs B and C, the second portee must follow, and as many as are necessary to complete the warp must be added in exactly the same way.

The number of portees consisting of 16 threads necessary to complete the warp of 840 threads will be $52\frac{1}{2}$. This is arrived at by dividing the 840 by 16 = 52, and 8 threads over. The best way to keep account of the number of portees warped, as the work proceeds, is to make a mark on a slip of paper as each portee is finished, and at every tenth mark to cross the marks out, as in Fig. 19.

Number of
Portees in a
Warp of 840
Threads

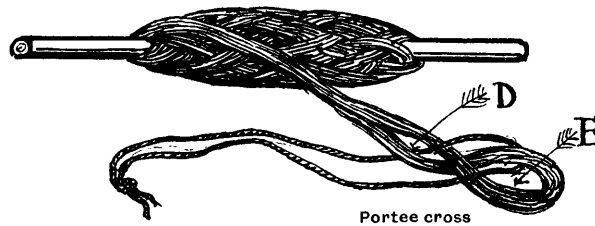


FIG. 20. WARP ON HAND-STICK.

How to Use
the Hand-
stick

When the warp is finished the end of the half portee must be securely looped on to the peg E (not tied), and the complete warp may then be wound on to a stick, as at Fig. 20.

The warp is shown on a *hand-stick* at Fig. 20. In preparing to remove it from the warping board the peg A must be removed; this will relax the whole warp, and will allow of its being easily slipped off all the other pegs. An assistant will be required for this operation, in order to keep the warp from too easily slipping off each peg in succession. The winding on to

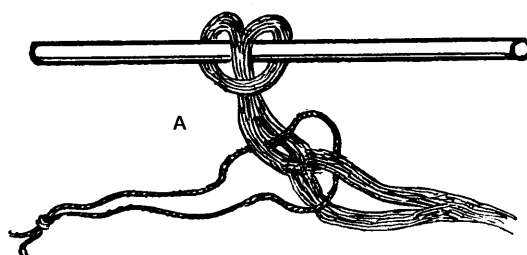


FIG. 21.

the stick must not be direct as in the winding of a bobbin, but must be as indicated in Fig. 20. It must be, when finished, compact and solid and without any tendency to sink into itself and get entangled.

In starting to wind the warp on to the stick the straight loop from A must be taken in hand and made into a double loop on the stick, as shown in Fig. 21, A. The method of forming this most useful loop is shown in Figs. 22 and 23. The winding on must be started in the direction of the arrow drawn in the bottom compartment of Fig. 23.

When the winding is finished the portee cross will be left on the outside of the compact ball of warp (see Fig. 20).



FIG 22. MAKING THE WEAVER'S MOST USEFUL LOOP.

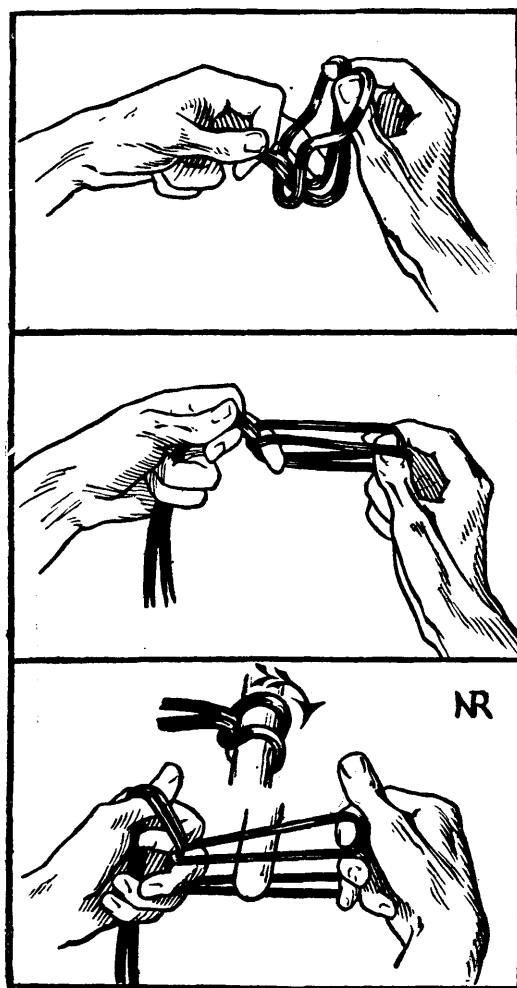


FIG. 23.

CHAPTER VII

TURNING ON, OR BEAMING

THE next operation is to transfer the warp from the hand-stick to the back roller of the loom, and to spread the warp out to the required width of the material to be woven. Like warping, *turning on* has to be done very carefully and methodically,

Turning on,
Beaming, or
Spreading
the Warp

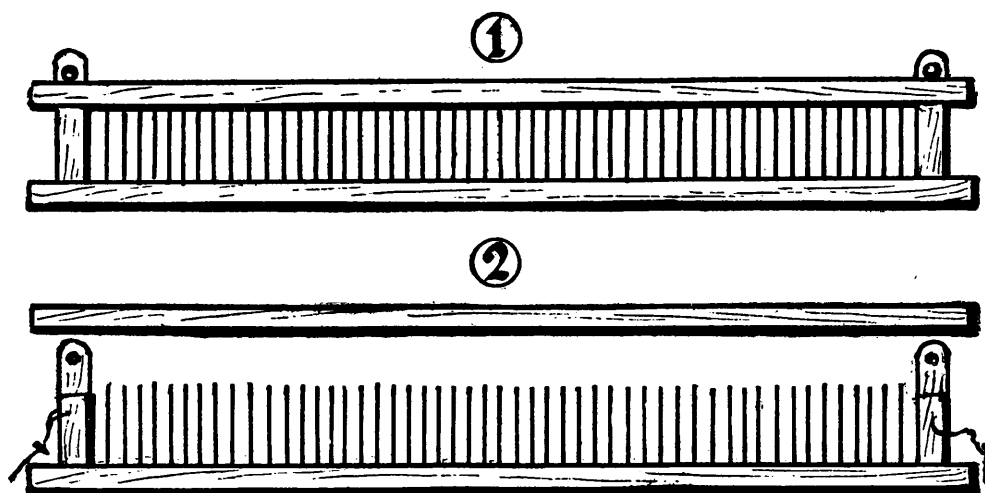


FIG. 24. THE RADDLE.

as the comfort and success of weaving depends very much on this preliminary work.

Spreading the warp out is done by means of an appliance called a *raddle* or *vateau*, Fig. 24, 1 and 2.

Description
of the
Raddle

The raddle is simply a long comb with a movable cap to cover the ends of the teeth (Fig. 23, No. 1). The frame is made of hard wood, but the teeth are best made of hard brass wire. The cap has a mortise in it near each end, through which a tenon, cut on the top of the side, passes (see No. 2). There is a hole in the rounded end of each tenon, into which metal pins or small wooden wedges are put in order to fix the cap in its place. The cap is deeply grooved on its under

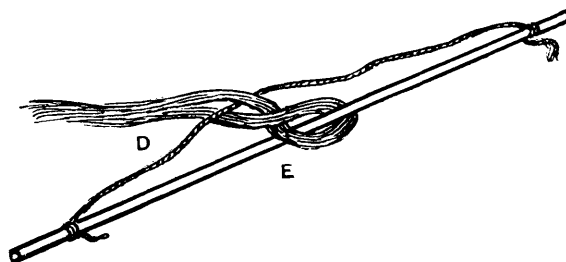


FIG. 25.

edge, above the range of teeth, so that when fixed in its place the divisions between the teeth are effectually separated.

The size of the raddle required for a warp of 21 inches, forty threads to the inch, will be 25 inches teeth space, and there must be not less than 110 teeth equally distributed in that space.

The Back
Roller and
Cane Rod

It will be remembered that the back roller of the loom has a groove cut in it $\frac{1}{2}$ an inch wide and $1\frac{1}{4}$ inch deep. A smooth rod will now be required made of hard wood, such as will drop easily into the groove. Several

of these rods will be wanted, so half a dozen may as well be provided at once. The rod must now be put through the loop E (Fig. 20); and one end of the cord, which passes through the opening D, must be firmly tied to one end of the rod, and the cord passing through E must

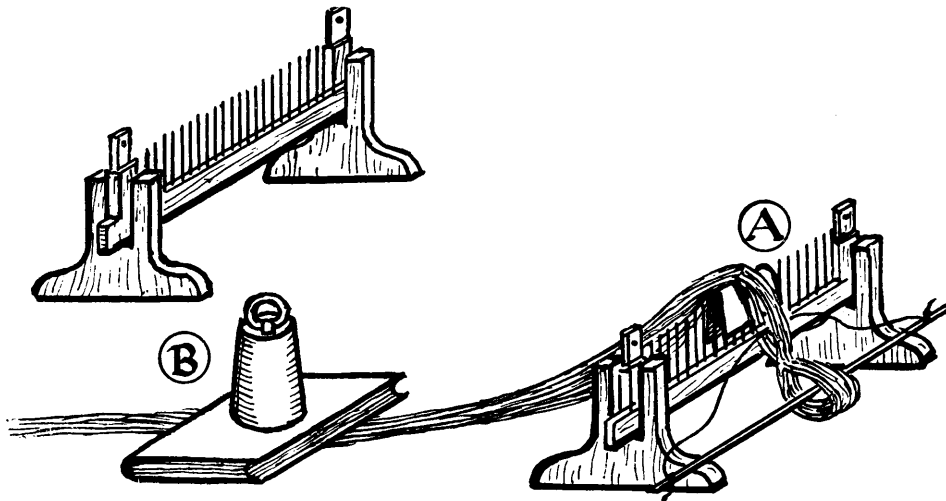


FIG. 26. WARP READY FOR DISTRIBUTING IN RADDLE.

be removed from its loop and tied to the other end of the rod. This is illustrated in Fig. 25.

Thus the portee cross is kept between the cane rod inserted in loop E and the cord remaining in loop D.

Fig. 26 shows the next step to be taken. At A the raddle, without its cap, is drawn, placed in an upright position on two little stands, which may rest on a table near and parallel to its edge, and near this edge the warper

must place himself. Just beneath A a bent card rests on the teeth of the raddle and supports the warp, whilst the portee cross with the string and cane in it hangs between the raddle and the warper. Sufficient of the warp is

unwound to allow a heavy book or board being stood on it to keep it from moving (see B, Fig. 26).

The warper must now take the rod in his left hand, allowing the warp to rest on the bent card, and separate the first half portee from the others, placing it in the space between second and third teeth of the raddle. It will be found that the half portees come off in regular sequence, as they are all kept separate by the cross between the string and rod. The next half portee must be placed in the next compartment of the raddle. In the same way each of the 105 spaces must be filled. As soon as all the portees are in their places the cap of the raddle must be fixed, and the warp will be ready for turning on.

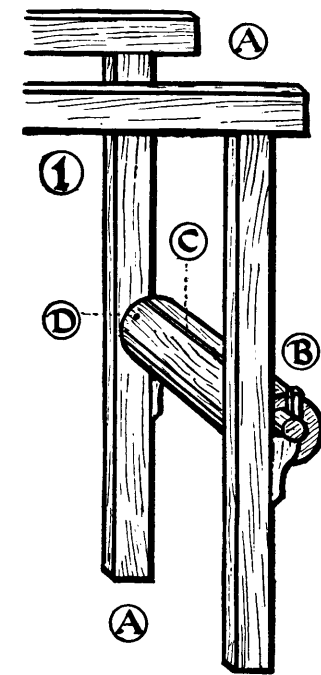


FIG. 27. THE LOOM POSTS WITH ROLLER.

The next business is to turn the warp on to the roller. As the beginner is not likely to have to deal with either very full or very long warps, this operation can be done on the roller as it stands on its brackets in the loom frame (see Fig. 27).

Two assistants will be required, one to turn the roller at the back of the loom, and the other to hold on to the hand-stick in front of the loom while the warp is being turned on. Before we can begin turning on, however, a means of turning the roller must be described. Into the roller, at the place marked D, Fig. 27, a very strong, short screw must be driven deeply enough to take firm hold, but at the same time to leave

Preparing
the Back
Roller
for Turning
on

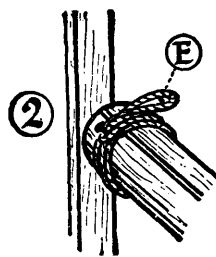


FIG. 28.

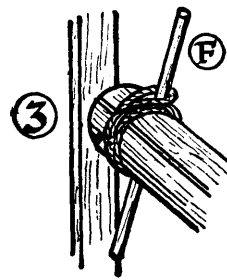


FIG. 29.

LOOP AND STICK FOR TURNING ROLLER.

the head about an inch out of the wood. About 6 feet of strong cord will also be required; this must be tied together at the ends so as to form a long loop. One end of the loop must be caught on to the screw head, and the double cord wound round the roller two or three times, crossing itself as it winds. It must be wound in the direction shown at E, Fig. 28, leaving the loop E for the insertion of a strong stick, as at F, Fig. 29. By means of this stick and cord the assistant will be enabled to turn the roller, hand over hand, and wind the warp upon it quite easily, although a good deal

The
Beamer's
Assistants

of strength must be exerted at the other end in order to pull the warp tight as it is spread on the roller.

The actual process of turning on, for which the warp is now ready, will be understood from a study of Figs. 30 and 31.

At Fig. 30, No. 1, the warp is shown with the raddle, GG, and the cane stick, HH, in their proper places in the warp. One assistant, we will suppose, is holding

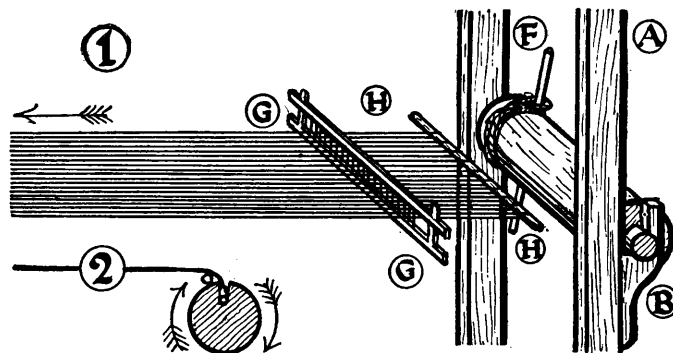


FIG. 30. WARP READY FOR FIXING IN CANE ROLLER.

the hand-stick, with the bulk of the warp upon it, at some little distance off in the direction of the arrow. The other assistant is holding the raddle, GG, and the cane stick, HH, in the relative position, with regard to the loom posts, shown in the drawing. The beamer must now stand behind the loom posts, and, reaching between them, take the cane stick, to which the warp is attached by the portee loops, and slip it into the groove in the cane roller. To fix the cane stick in the groove another stick must be passed, underneath the roller

50

and the warp, into the groove, as shown at No. 2, Fig. 30. The raddle must now be brought close to the roller, and the roller itself must be turned once round. This will fix the warp securely in its place and, at the same time, spread it evenly upon the roller. When placing the cane stick in the groove care must be taken to put it in the centre of the roller. The warper and the assistant holding the raddle will now have to change

The First
Turn

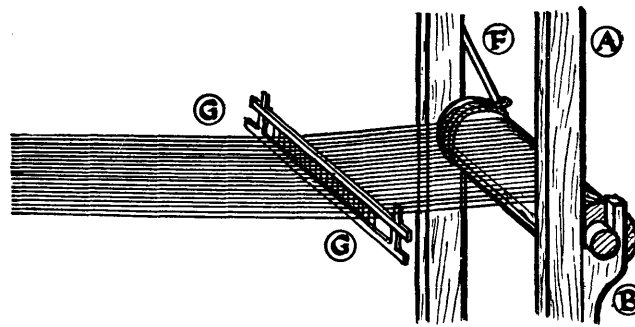


FIG. 31. WARP READY FOR WINDING ON THE ROLLER.

places, but before doing so the roller must be fixed so that it will not turn back, although the tension of the warp is sustained. This may be done at any moment by placing the turning stick F in the position shown at F, Fig. 31, which represents the stage of the operation now reached.

The beamer must now examine the raddle to see that all the half portees are in their separate divisions and that there are no crossing threads, also that the raddle can be moved easily along without obstruction.

Handling
the Raddle

Guiding the Warp on to the Roller	All being found in order, the turning on may proceed. The beamer must guide the warp, as it is turned on, by means of the raddle ; gently shifting it about so as to lay the threads as flatly and evenly as possible. All the time of turning he must look out for broken or tangled threads, being careful to place any that have to be mended in the portee to which they belong. If all goes well and the warp is turned on easily, it will prove that the warping has been correctly done. All this time, from the first turning of the roller, the assistant holding the hand-stick must have been steadily pulling with all his force against the turning. If indeed the warp is of any considerable size, the combined strength of two or three people will be required in order to give sufficient tension to it. When a few turns have been given it may be necessary to place a sheet of very thick strong paper underneath the warp and let it wind on to the roller. This will only be wanted if the warp on the roller begins to feel soft and flabby. The paper must be a little wider than the whole warp, and a little longer than the circumference of the roller. In a very long warp several of these papers may be required to keep it hard and to prevent threads sinking in.
Great and Steady Tension Required	
The Cross Rods	As soon as the porrey cross is exposed, the warper must call a halt, leave the raddle near the roller, and spread the threads out on the securing cords (see Fig. 15, p. 37, C, B). This will not be difficult to do if the tension is kept on. When the cross is spread out clearly, two smooth, round, wooden rods, pointed at one end, about an inch thick and six inches longer than the width of warp, must be put into the openings, together

with the securing cords. When the rods are safely in place the turning must proceed as before, and continue till the rods are close up to the raddle. As soon as they are in this position the cap must be taken off, the raddle itself removed, and one or two turns of the roller will temporarily bind the rods to it, and the hand-stick being released from the warp the turning on will be finished. The next operation, that of entering the warp in the harness, must now be prepared for.

Finishing
off

CHAPTER VIII

ENTERING THE WARP IN THE HARNESS AND REED

Meaning of
the Term
'Entering'

FIG. 32 represents a loom with a warp and harness fixed up in a convenient manner for *entering*, as threading the warp in the eyes of the leashes and through the dents of the reed is called.

Side Cords
for Enter-
ing

Two strong side cords, AC, CC, must be firmly tied to the front posts of the loom at the same height as the top of the breast roll, the latter having been temporarily removed. The ends of the cords must be then carried over the top of the back roller, wound once round it, and terminated with a rather heavy weight. This will allow the back roller to be moved round, but will prevent it moving round of itself. The warp must then be gently unwound, and the ends of the cross rods be allowed to rest on the side cords at B. The side cords are then to be twisted once round the ends of the rods, as shown in the drawing, and by this means the latter will be securely fixed at that point, but, at the same time, can be readily moved backward or forward if the side cord weights are lifted. The warp can now be regulated so that the loops hanging below B will reach to the front of the loom, the cross rods, of course, being moved back to allow of this being done. Perhaps it is as well to say here that the cross rods must never be taken out of the warp until the

Importance
of the Cross
Rods

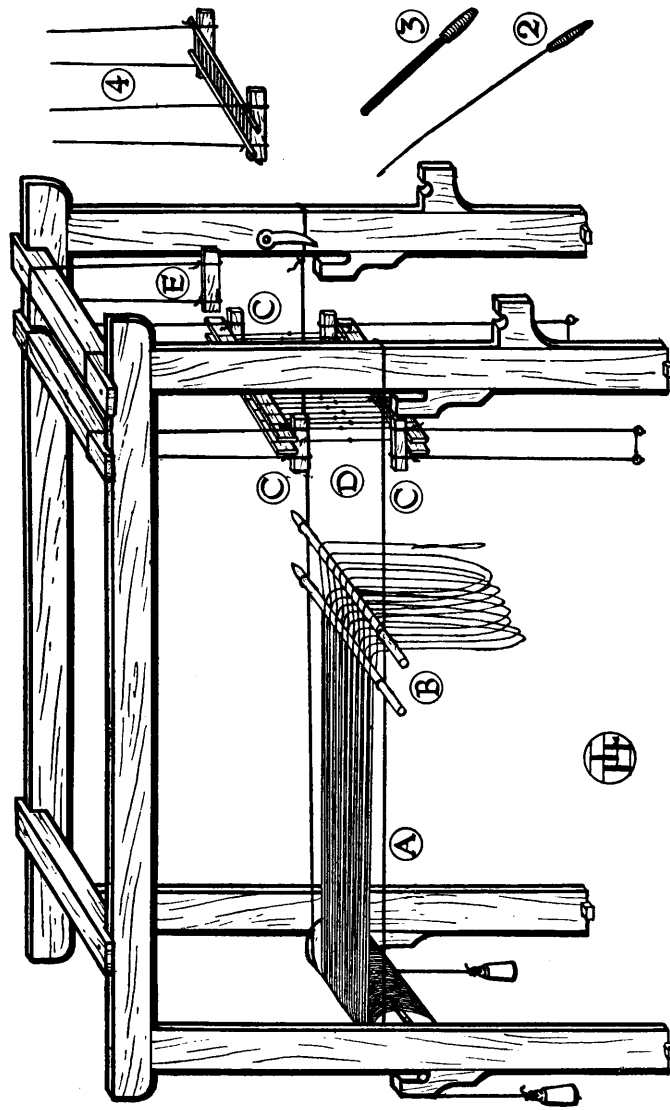


FIG. 32. LOOM PREPARED FOR ENTERING.

Fixing the
Headles for
Entering

piece of weaving is finished, as it is by their means that the threads are prevented from getting hopelessly entangled.

The four headles of the harness must next be conveniently fixed up for entering, and for this short pieces of wood (D) are provided. The pieces of wood must be long enough to allow spaces of not less than 1 inch between the headles. They should be shaped as shown in Fig. 33, so that the headles can rest in the square cuts, which should be about $1\frac{1}{2}$ inches deep. Two of these notched rests must now be hung on the movable

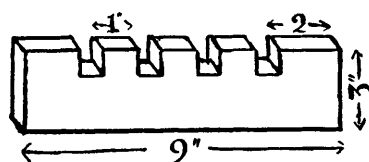


FIG. 33.

cross piece, as shown in Fig. 32, near the front of the loom and at such a height as to allow the eyes of the leashes to be just on a level with the warp. The headles having the leashes—210 on each, still tied up in bundles of ten—on them can now be suspended on the notched rests, and the bundles may be distributed about one to an inch. The ends of the four headle laths should now be tied together by a cord fastened round them outside the rests. The four lower laths must next be fixed in a similar manner, but now the notched holders must be placed on the ends of the laths with the notches downwards, and the pair of holders must be held tight by cords attached to eyes or staples screwed into the floor.

Nos. 2 and 3, Fig. 32, are the hooks necessary for Hooks for
Entering entering. No. 2 must be slender enough to pass easily through the eyes of the leashes, and the flat hook, No. 3, must be thin enough to go through the fine dents of the reed.

It may be observed that entering only needs to be Note done when a harness is new. After a length of cloth has been woven, sufficient of the old warp is left in the loom with the cross rods in it ; this will allow of the new warp being tied in thread by thread. When the threads are all joined, the old piece of warp is drawn forward, and of course the new threads follow the old ones through the headle eyes and the reed.

The preparations being all complete, the entering Entering can begin. The *enterer's assistant* sits in the space D, between the warp and the harness, facing the left side of the loom. Beginning at one edge, he takes up a small bunch of looped threads and first cuts the looped end so as to separate the threads ; he gives the bunch two or three sharp, firm pulls, which clear the cross between the rods and make it quite easy to find and separate the first thread. When this is done the thread is held ready to be hitched on to the enterer's hook as soon as it is pushed through the first eye of the harness.

The *enterer* himself sits on the weaver's seat in front of the harness, with the slender hook, No. 2, Fig. 32, ready for use. After having untied the first bundle of leashes on each headle he selects the first leash on the back headle,¹ and pushes the hook well through the eye,

¹ In England the first leash is on the back headle ; generally, on the Continent, it is on the front one.

so that the assistant can loop the first thread of the warp to it. The hook is then drawn through the eye and brings the thread with it, which is immediately taken by the left hand of the enterer and firmly held. The operation with the hook is repeated, only that the first leash on the second headle is selected and the second thread in the warp drawn through it. Next, the first leash on the third headle will be dealt with, and then the first on the fourth headle will complete a *course*, as it is called. Returning to the first headle, the *second* leash must be entered with the *fifth* thread of the warp, the *second* of the second headle with the *sixth* of the warp, the *second* of the third headle with the *seventh* of the warp, the *second* of the fourth headle with the *eighth* of the warp, and the second course will be complete. This regular order must go on until ten courses are complete, when it will be found that *one* bundle of *ten leashes* on each headle will be filled up and *forty* threads of the warp disposed of; these, being arranged pretty close together, will occupy the space of *one* inch of reed when, after the whole of the harness is entered, they are entered therein.¹ The forty entered threads can now be loosely tied together so as to prevent them slipping back through the leashes. The next forty threads must be entered and tied up in exactly the same order, as must also the following nineteen forties ;

¹ The harness of movable leashes is suggested for use at first, as they can be more easily adapted for different counts of work, and a greater variety of work can be arranged for than with a harness of ordinary fixed leashes, although the latter are better for quick work and large quantities of the same kind of work. Another advantage of loose leashes is that they can be more readily mended if broken or corrected if a mistake is made.

and, as soon as this is done, the reed can be fixed up for the same purpose.

Reeds are made of different numbers of dents or openings to the inch, according to the fineness of the work required. The reed suitable for the warp and harness just described would be one of twenty dents to the inch, and it had better be 24 inches in width, so that there will be in all 480 dents.

Selection of
a Reed

For entering, the reed must be mounted on a pair of slings (E) similar to those for the harness, except that no notches have to be cut in them, as the reed simply rests flat on them, as shown in the drawing, No. 4, Fig. 32. The reed must be firmly tied to the slings to prevent slipping. The assistant now sits in front of the harness and the enterer stands over him. Beginning at the left-hand side, the enterer must count thirty dents, which, as our stuff is to weave 21 inches wide, must be left vacant for the present, and through the thirty-first dent he must thrust downward the flat hook No. 3, Fig. 32, the front of the hook being towards the enterer. The assistant, having first untied the first bundle of forty threads, selects the first thread coming from the first and second headles; he places them, *both together*, on the notch of the hook, which the enterer immediately draws up through the dent, and takes them in his left hand. The assistant must next take the first thread in the third headle, together with the first of the fourth headle, and place them in like manner on the hook which the enterer has thrust through the thirty-second dent. This regular picking out and drawing up continues till the forty threads of the first bundle are drawn through

Entering
the Reed

twenty dents of the reed, two being in each dent. After the threads have been examined to see that no dents are missed and they come in regular succession from the first and second and third and fourth headles, the next bundle of forty threads may be dealt with ; and so on, till all the warp is entered and secured in the reed. This will leave a space of thirty dents at the end of the reed as at the beginning.¹

When the harness and reed are all entered and the bunches of threads safely knotted, at the front of the latter, the loom will be ready for the weaver to *gate*, as the adjustment of the loom for actual weaving is called.

¹ Too much care cannot be taken to make sure that each bundle of threads is correctly entered both in the harness and reed, as mistakes cannot be rectified afterwards without great trouble.

PART III
GATING THE LOOM

CHAPTER IX

MOUNTING THE HARNESS

THE first thing to do in gating the loom is to hang up the harness and connect it with the treadles in such a way that the weaver may have it under perfect control, being able to lift and depress the headles with his feet at will, in order to make an opening in the warp for the passing of the weft. There are different methods of doing this, as will be explained later, but the simplest and most practical for the beginner is that technically called the *pulley shedding motion*: the *shed* being the weaver's term for the opening made between alternate threads of the warp,¹ and motion being a term used in engineering to signify any part of a machine governing some special operation: in this case *opening the shed*.

The
Simplest
Shedding
Motion

The pulley motion is shown at Fig. 34, Nos. 1 and 2. It consists of two or more rollers or pulleys attached to a narrow board, which is fixed across the top of the loom in such a way that cords passing over the pulleys, after being tied to each separate pair of headles, which in their turn are tied to the treadles below, will cause certain headles to be raised and others depressed when the treadles are worked, consequently making a shed in the warp.

It is necessary to tie up the headles very neatly and evenly in order to make a good shed; the cords, therefore, with which they are tied up, must be so knotted

Tying up
the Headles

¹ See Chapter I.

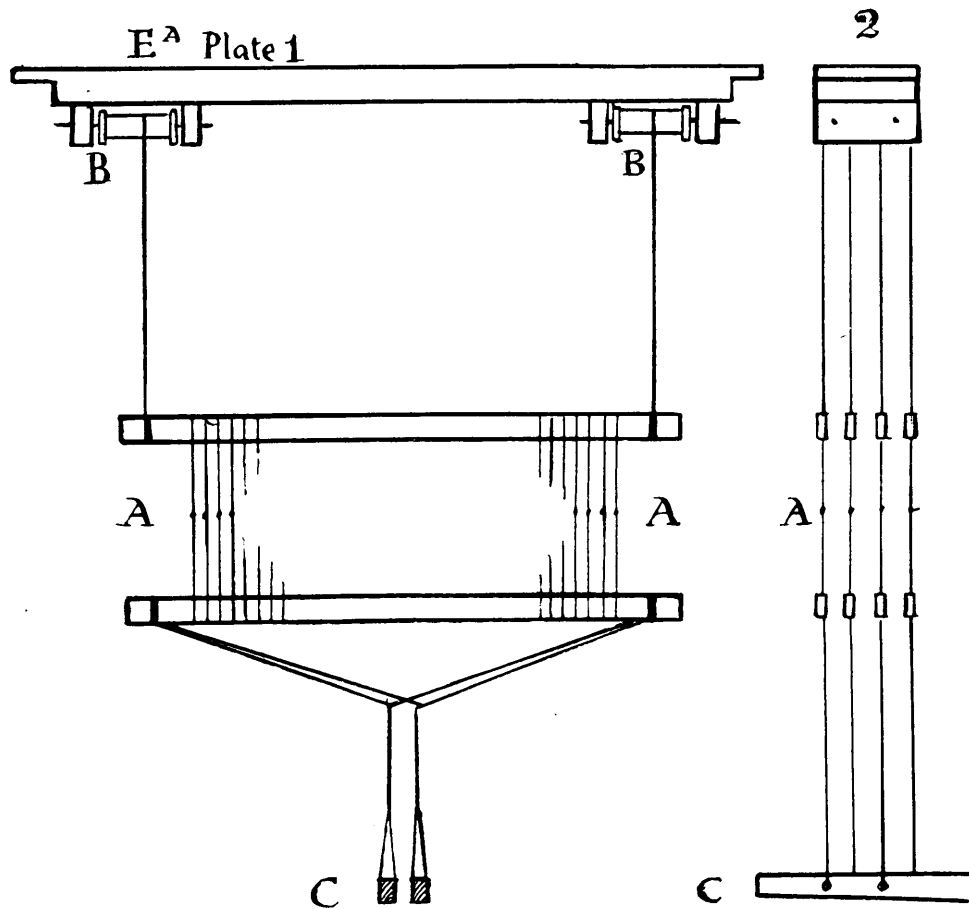


FIG. 34. THE PULLEY BOARD.

as to be easily lengthened or shortened. Fig. 35 shows clearly the best kind of knot for this purpose. A, B, C, D show the knot at different stages. A shows the cords ready to be joined; at B a slip loop (see also Figs. 22 and 23, pp. 43 and 44) has been formed at the end of the long loop of the first headle cord, and the two ends of the second headle cord have been drawn through it. At C the two ends are loosely tied in a single knot, which at D is drawn close so that both cords are straight and taut. The cord so secured will not slip unless the single knot is loosened; but to shorten the cords all that is necessary is to pull the two loose ends, while to lengthen it the single knot must be loosened and the double cord pulled through the loop. Goodstrong, smooth, thin cord must be used for thus tying up the harness, and great care must be taken to make the headles hang exactly even, so that the centre eyes of the leashes may be perfectly in line and at the same general level as the warp.

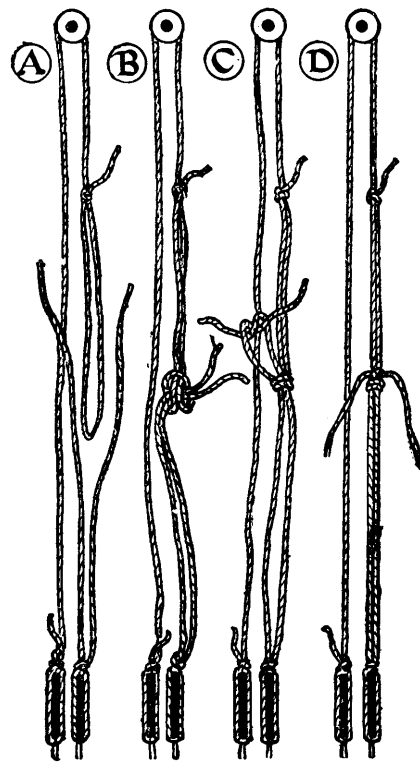


FIG. 35. KNOTS.

Tying up
the Treadles

The treadles must next be put in their place under the weaver's seat in such a position that the holes in the treadles (see Plate I.) are immediately below the headles. Fig. 36 shows the method of attaching the lower laths of the headles to the treadles.

The first and third headles must be tied to the right-hand treadle, and the second and fourth to the left-hand one. Only two treadles will be required for the first work to be started.

The tying up of the harness and treadles being

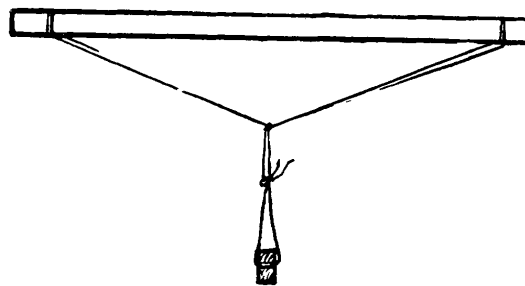


FIG. 36. SLIP KNOT.

properly done, the slings and rests can be removed, and the headles should be found to hang straight and even, especially if the batten is hung in its place, as in Plate I., and the reed fitted in and fixed by its cap.

Attaching
the Warp
to the Front
Roller

The next thing is to attach the warp to the front roller, which must now be rested in its brackets at exactly the same height from the ground as the back roller. The toothed wheel must be next to the right-hand post and the ratchet so placed on the post as to drop between the teeth of the wheel, and, when required, to be easily lifted out. If this is properly adjusted,

the roller will turn forward easily, but will be prevented by the ratchet from turning backwards, unless the latter is lifted.

The front roller being in its place, it must be turned until the groove is at the top. Another pair of rods, small enough to drop quite easily into the groove, will be wanted to fix the warp to the roller. The bundles of forty threads, which are lightly tied in front of the

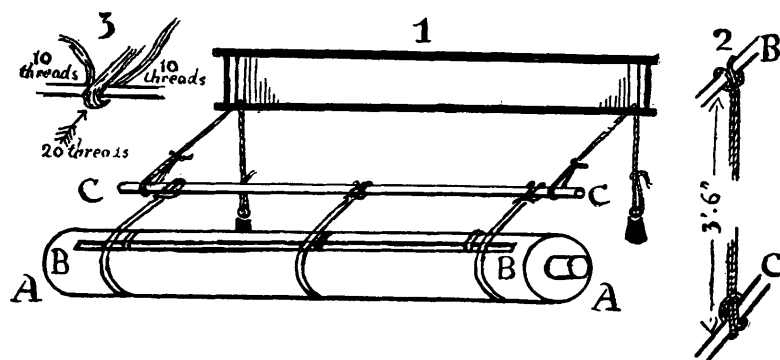


FIG. 37.

reed, must now be divided up into smaller groups, one at a time, say of ten each, and each group must be securely tied at its end.

The small group of ten threads must next be tied to one of the rods by which it will be fixed in the groove. Like all the other operations, this requires great care. The rod must be so tied in as to keep all the threads at an equal tension ; this can only be done in the manner which will be readily understood by a study of Fig. 37, Nos. 1, 2 and 3.

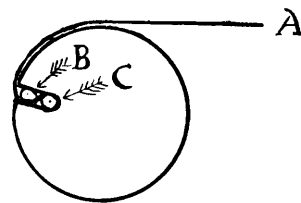
No. 1, Fig. 37, shows the front roller AA with the

groove on top. A rod BB has been placed in the groove. Three long loops of strong cord, exactly the same length, have been hitched to it and have connected it with another rod CC, as shown at No. 2, BC. As soon as the rod B was placed in the groove the roller was turned twice round, thus fixing the rod in the groove as shown in the drawing. Two cords with weights at their ends were then brought through the vacant dents of the reed, one at each end, and tied to the ends of the rod C, thus fixing it between the reed and the rollers.

The bundles of warp threads having been all divided as before described, have now to be tied in pairs to the rod CC, and the best way to tie them is in the manner shown at No. 3, Fig. 37. Two bundles of ten are brought together over the rod, carried under it, and then separately brought up at the back on each side of the group of twenty threads. The two ends of the ten are then tied together and all pulled taut and even, but not too tight; they can then be secured by being tied in a bow. All the other bundles of ten must be attached to the rod in the same way, care being taken to keep the rod parallel to the reed and roller, and the threads all of the same tension. No doubt at first several of them will have to be undone and retied; this can easily be effected if they are tied in bows as recommended.

As soon as the rod C is attached satisfactorily to the warp, the cords and loops connecting it with the rod B and the reed can be removed and the warp gently drawn through the harness and reed far enough to allow of the rod C being placed in the groove instead of the

rod B. The bows and ends of warp must go into the groove with the rod for the present. The rod B having been freed from the loops, must now be put underneath the warp and pressed into the groove on top of the rod C (see Fig. 38), then if the roller be turned once round, towards the front, the warp will be firmly attached to the roller so long as there is any tension on it. To make it further secure while the remaining preparations are done, it may be well to pass and tie two cords tightly round the roller, at the ends of the rods, one on each side of the warp.



Fitting up
the Weight
Box

FIG. 38.

Up to the present the warp has only been kept at a slight tension by the side cords and weights shown at A and C, Fig. 32. A much greater tension on the warp, however, and one much more automatic and easily regulated, is required for weaving. The next thing, then, is to rig up the weight box shown in position underneath the back roller of the loom, Fig. 1, in such a way as to form what is called a *friction brake*.

The Fric-
tion Brake

In Fig. 39, Nos. 1 and 2, the friction brake is shown in front and side view. A is one end of the back roller of the loom, B is the weight box, and C is a balance weight of a few pounds only. The weight box and the balance weight are connected by a strong rope, which is wound three times round the end of the roller. There is, of course, a weight and rope at each end of the weight box and roller. Tension is given to the warp by heavy weights being put into the box, which, being suspended

from the roller, pulls the latter round backwards and stretches the warp between the back roller and the front one, which is prevented by the ratchet from turning backward. The small balance weight C must be sufficiently heavy to prevent the rope slipping round the roller.

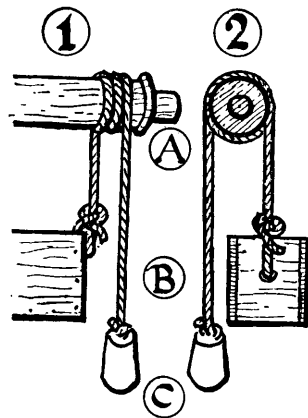


FIG. 39. CANE ROLLER AND WEIGHTING.

As the warp comes off the roller in the process of weaving, the box gradually rises, and when too near, the roller has to be let down to a convenient distance from the ground. This is effected by lifting the balance weights and easing the box gently down. Some very simple looms for coarse work are made with a ratchet and wheel for the back roller as well as the front, but the arrangement is not good, as the tension is too rigid, and, with fine warps, is liable to break a great many threads as

well as being the cause of uneven wefting.

All these different points being properly attended to, the loom should be ready for the weaver to commence weaving more or less perfectly. It will, however, probably require a little patience and a good deal of attention, especially if the weaver is a novice, before every part of the loom is so regulated as to work with exactness, ease, and speed.

CHAPTER X

TOOLS FOR WEAVING, AND THEIR USES

THE shuttle is the most important tool the weaver has to use, and on its proper manipulation depends the quality of the work he produces. All the other movements required in weaving are easily done by machinery, but the throwing of the shuttle has never yet been imitated perfectly in the automatic machine-loom.

The hand-shuttle, though a simple-looking tool, is the product of the experience of many generations of weavers, and must be exactly described. The best hand-shuttles are made of good, hard boxwood. They are about 8 inches long, 1 inch wide, and $\frac{3}{4}$ inch deep. The general shape and section are shown at Fig. 40, 1, 2 and 5; and at 3 and 4 the spool for winding the weft upon and the spring for keeping it in its place are given.

No. 1 is a view of the top of the shuttle, the straight edge being the front, which is kept towards the weaver. The back edge, which is kept towards the reed, is curved near the ends. At the ends, which are sharp and smooth, slips of metal are generally inserted in order to protect the points from damage should the shuttle fly out and fall, as it is very apt to do when thrown by a beginner or even by an experienced weaver when the loom is

newly gated. The top of the shuttle is flat throughout its length, with rounded edges ; but the bottom, No. 5, curves upward at the ends, and the flat part, about three-fifths of its entire length, has the edges slightly raised (see section No. 2), so as to present less surface for friction as it runs across the threads of the warp from one edge to the other. In the centre of the top of the shuttle an oblong hollow is carved as deep as it is wide. This hollow is for the reception of the spool or quill on which the weft is wound (No. 4). At each end

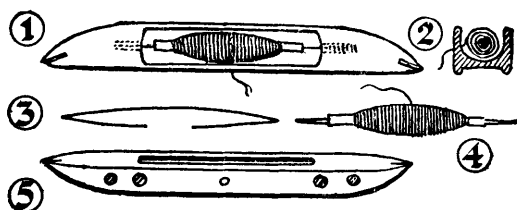


FIG. 40. THE HAND SHUTTLE.

of the hollow a small, flat hole is made, and into one of these a small spiral spring is fixed. By means of this spring a piece of hard wire, bent in the form shown at No. 3, and with the spool upon it, as at No. 4, is kept in its place, after it has been inserted by pressing one end against the spring and allowing the other end to be pushed by it into the opposite hole. This is shown at No. 1. The wire being bent in the form shown at No. 3, acts as a brake to the spool and prevents the weft coming off too easily as the shuttle is thrown. By bending or extending the ends of this wire the tension on the thread can be regulated to a nicety. There is

a small hole in the centre of the straight side of the shuttle (see No. 5), into which a porcelain or glass eye is fixed, and through this the weft is unwound as the shuttle is thrown from side to side. Small plugs of lead are generally let into the wood in order to give it more weight ; two of these are shown at each end in the front view of the shuttle, No. 5.

The above is the description of a shuttle for fine work, but for coarse work larger and less carefully made shuttles can be obtained ; no better model of a hand-shuttle, however, can be given than this traditional form.

Fig. 41 contains two views of the hand-shuttle in use. It is lightly held in the right hand of the weaver, partly within the open shed, and resting on the race board ready to be thrown by a slight, quick wrist movement. The throw causes it to glide along the beading of the block, over the lower warp threads, to the opposite edge, where it is caught by the fingers of the left hand and guided into the palm. As soon as the shuttle is out of the shed the hand, pressing back the batten, is withdrawn and the reed, fixed in the batten, falls against the weft, as the batten swings forward, and presses it home. In the meantime the right-hand thumb is prepared, as soon as the blow has been given, to push the batten away for the next throw of the shuttle from left to right. In gating the loom the batten must be so hung that when it is at rest the reed just touches the edge of the woven weft. *The quality of the weaving depends very much on the way in which the shuttle is caught and the thread drawn through the shed, or laid*

Use of the
Hand-
Shuttle

Beading
shown at
Plate II. B

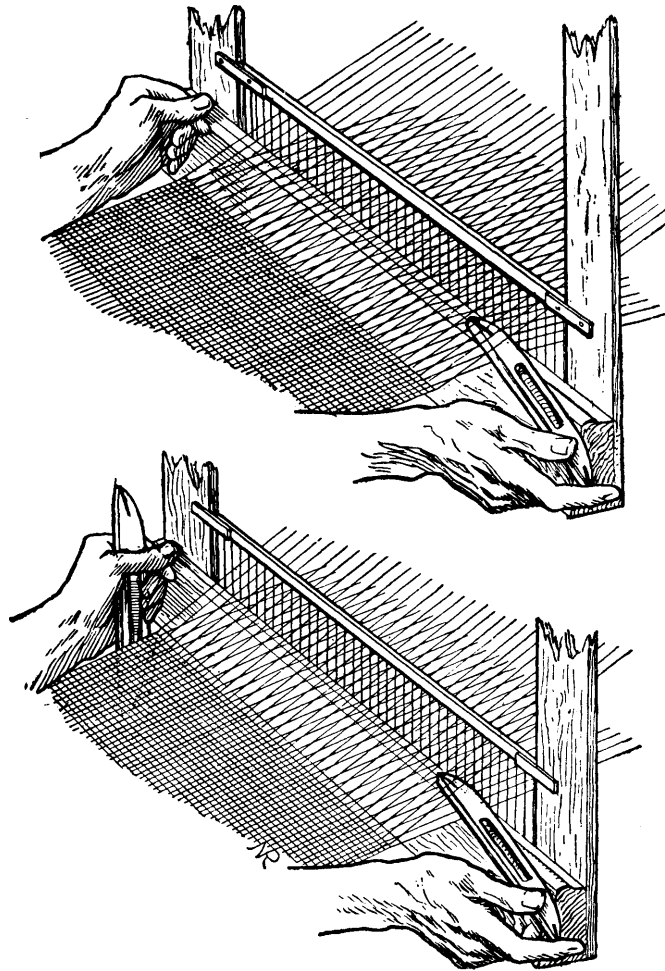


FIG. 41. METHOD OF HANDLING ONE, OR TWO SHUTTLES.
If more than two shuttles are used they are laid in order on the web.

as the weaver calls it. In fact, it is the delicate manner in which this can be done which makes good hand-shuttle weaving superior to all other kinds whatever.

Winding the spools for the shuttle must be properly done. If care is not taken to wind them evenly, so that the thread runs off with regularity, good weaving is impossible. Fig. 42 shows the best sort of spool winder. It consists of a small table about 2 feet

Winding
the Spools

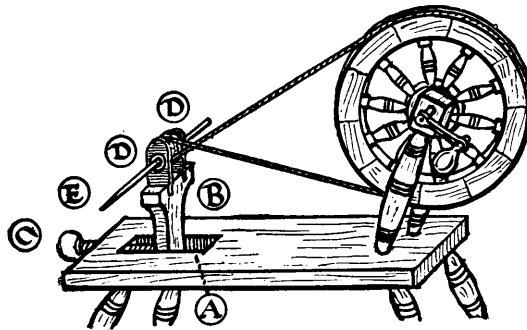


FIG. 42. QUILL- OR PLUG-WINDER.

long and about the height of an ordinary chair. Two firm uprights are fixed near the right-hand end. Between the uprights a small, heavy wheel having a broad, shallow groove on its edge is truly poised on an axle, which terminates in a small handle. By means of this handle, the wheel can be made to revolve, and easily be kept revolving, with great rapidity. At the opposite end of the table a slot, A, is cut, and into this a shaped block, B, is made to fit. The large screw, C, after passing through the edge of the stand into the

slot, runs into the block, and not only holds it firmly in position but can be made to regulate the distance between the block and the wheel. D, D are a pair of thick leather bearings in which a metal spindle, having a pulley in its centre, is carefully fitted. The pulley is connected by a cord to the large wheel, and the latter, being turned, causes the spindle to revolve with great rapidity. The elongated spindle E is tapered so that the hollow spools can be fixed on it, and on these the weft must be wound very carefully and with perfect evenness.

Fig. 43 shows how the winding should be done. A is the spool with one layer of weft wound on it, and the dotted lines give the shape it must have when filled. The thread must be held between the finger and thumb of the left hand, and guided backward and forward in layers of gradually diminishing length till the shape shown at B is piled up.

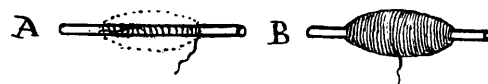


FIG. 43.

Fig. 44 is a skein winder, which is only required if the weft is supplied to the weaver in skeins. The upright stand has a long slot cut in it. The reels revolve on elongated axles, which pass through the slot and can be fixed at any distance apart by means of the washers and wing nuts, so as to adjust them to skeins of any size.

It is often necessary to shoot two or three threads of fine weft together in each opening of the warp ; for this purpose the spools have to be wound two or three

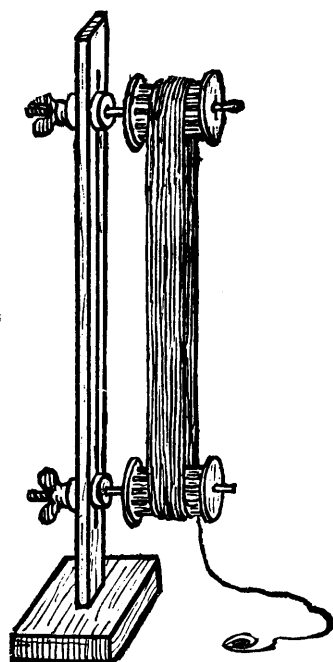


FIG. 44.
SKEIN-WINDER.

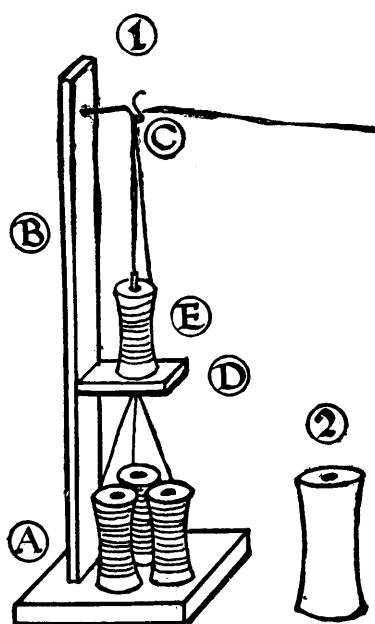


FIG. 45.
DOUBLING STAND.

threads at a time. The best contrivance for doing this is shown in Fig. 45.

The doubling stand, as it is called (No. 1), has a solid base A and upright B, from the top of which a short arm extends, terminating in a smooth hook C. About a foot above the base A there is a shelf D, in the centre of

which is fixed a thin tube of glass or metal small enough to go through the centre hole of the reel E when it is standing on the shelf. The reels on which weft is wound should be rimless, as drawn at No. 2.

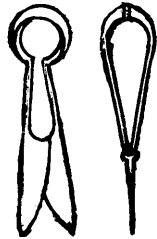


FIG. 46. SHEARS
AND PICKER.

In the drawing four threads are represented as being wound together. Threads from the reels beneath the shelf pass through the tube to the hook C, and the thread from the reel E twists lightly round them as it passes over the hook and binds them together.

The shears and picker, Fig. 46, complete the list of tools and appliances required by the weaver before he can get to work.

PART IV

GETTING TO WORK

CHAPTER XI

GETTING TO WORK

FIG. 1, at the beginning of the book, fairly represents a gated loom, except in respect to the harness, which is placed too far from the batten. This was purposely done in order to show the headles quite clearly. The warp and headles, too, are only represented as having very few threads and leashes, also for the sake of clearness.

The harness must be placed only a few inches behind the batten as it hangs upright on its racks (I, Fig. 1). It should not be permanently fixed till its best position is exactly determined by experiment. If it is fixed too far from the batten the *shed* in front of the reed will be too shallow for the shuttle to pass through, and if it is too near it will interfere with the action of the batten and be injured by friction with the latter.

All being prepared to the best of the weaver's knowledge, he takes his seat in the loom, his feet lightly resting on the two treadles which are tied to the harness, the right-hand treadle being tied to headle No. 1 (the most backward one) and to No. 3, while the left-hand treadle is tied to headles 2 and 4. He begins by pressing firmly with his right foot on the right treadle and holding it down. If the gating has been properly done, the 1st and 3rd headles will be pulled downward with the treadle, and

the 2nd and 4th headles will rise. The effect of this will be a more or less clear opening between all the *odd* and *even* threads of the warp in front of the reed between the breast roller and the batten. This must be carefully examined, and if found defective, too shallow, or unnecessarily wide or irregular and uneven, the cause must be found and the fault corrected. It may be helpful, not only at first but during the weaving, to fix a strong lath on the warp just about midway between

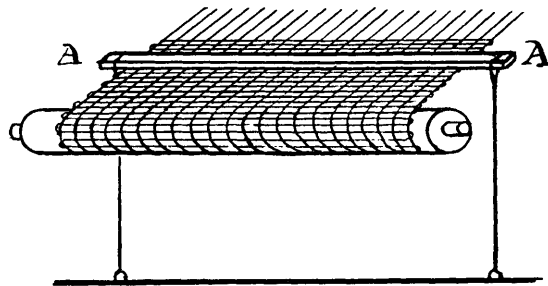


FIG. 47.

the breast roller and the batten, as shown in Fig. 47, AA. This will keep the threads and cloth at an even level.

Careful
Revision of
the Gating
Necessary

The reasons for a defective shed as described above may be manifold. Some of the threads of warp may be looser than others and will presently want tightening. This can only be done after a few shoots of weft have been laid, and they can be drawn tight and tied or fixed with pins. The leashes may not be evenly made and the eyes may not be exactly level. The headles may not have been tied up exactly true, or the tying-up cords

may have stretched or shrunk and require regulating. Even experienced weavers often need patience at this stage of the preparations, so the novice must not be surprised if he has to take a great deal of care, and must not easily be discouraged. While the first shed is being thus examined, it will be convenient to fix the first treadle down ; this can be arranged for by a button or hook on the ground or by a weight being placed on the treadle, or it can be held down by an assistant sitting in the weaver's place.

It must be noted that the clear shed only appears in front of the reed after the batten has been pushed back a few inches by the thumb of the weaver's left hand (see Fig. 41, p. 74).

The weaver must now draw the end of the weft out of the hole in the front side of the shuttle far enough to reach right across the warp when the shuttle has passed through. The shuttle must then be gently pushed through the shed and taken out on the opposite edge, leaving the long end of weft behind it. The left-hand treadle must next be pressed down, and at the same time the batten must be allowed to swing forward and press the weft straight. The second opening being made, the shuttle is gently moved back through it, laying the second shoot. After this, alternate openings are made in the same way, and gradually a piece of more or less even and solid cloth will be made. All this must be done very gently and carefully, endeavour being made to get good clear openings for the shuttle and to break as few threads as possible. When about two inches of cloth have been thus made—it will

necessarily be very imperfect, but that need not trouble us as long as the working of the harness is gradually improving—two thin rods or laths must be inserted in two successive openings in the place of weft, pressed firmly home by the reed and batten, and against this, after another fair start has been made, good solid weaving should proceed, the shuttle being thrown with gentle pushes from hand to hand. To do this well will of course require great care and more or less practice. A careful study of Fig. 41 and intelligent, deliberate practice should soon make the operation quite easy. The chief difficulty will be experienced in *catching* the shuttle and drawing the thread of weft quite *straight* but not *tight*. If left in the shed loosely, it will be beaten up into loops and kinks, and if too tightly drawn, it will make bad edges and puckered cloth.

As the weaving progresses the roller has to be turned forward so as to wind the cloth upon it. This is done by means of a short stick or iron rod, which fits into a hole in the breast roll shown at C, Fig. 1.

When a short length of cloth is made—say 10 or 12 inches, measuring from the place where the two rods are woven in—the tension of the warp must be relaxed by taking some of the weight out of the box, or by lifting the balance weight and allowing the box to rest upon the ground. The weight being off, the *first* pair of rods must be removed from the groove in the breast roll and the loose ends and knots of warp cut off close to the place where the weft begins to cross them. The two woven-in rods can then be neatly fitted into the groove, the roller turned, tension laid on the

warp again by poising the weight and balance, the cross rods, B, Fig. 31, gently pushed back against the back roller, leaving the space between them and the harness all clear, and the harness and treadles finally fixed in their places; thus, all being revised and in order, the weaving can proceed, and should go along quite merrily.

CHAPTER XII

MISTAKES AND DIFFICULTIES

The
Weavers'
Obstacles
and Hind-
rances

THE inexperienced weaver must not expect that the trouble will all be over as soon as the loom is set up and prepared for work and the first inch or two of cloth is woven. Many accidents and difficulties will occur, and mistakes be discovered before anything like perfection, in even the simplest and shortest web, can be obtained on a new loom even when used by a practised weaver: the tyro, therefore, must not be surprised or discouraged by these more or less frequent hindrances. Some of these difficulties are as follows: (1) The difficulty of getting a clear *shed* or opening in front of the reed for the passage of the shuttle. (2) The difficulty of preventing the shuttle flying out midway instead of running smoothly from one hand to the other. (3) The breaking of warp threads, and the difficulty of finding the right ends and joining them together when found. (4) The difficulty of keeping the web equal in width. (5) The difficulty of weaving good edges to the web. (6) The difficulty of beating the weft together so regularly as to keep exactly the same number of threads to the inch. (7) The difficulty of regulating the cords of the harness and *tie-up* of the treadles in such a manner as to keep the warp true and level. (8) The difficulty of keeping the warp threads

free from knots, ends, and badly spun loose places ; the latter are very apt to occur in handspun thread.

The beginner will no doubt soon experience some if not all of these difficulties, but with patience and by a careful study of the following directions will gradually be able to overcome them.

The first difficulty, (1) that of obtaining a clear open shed for the passage of the shuttle, is sure to occur as soon as the weaver attempts to work on a newly mounted loom. The cords of the new harness and treadles will have, for some time, a tendency to stretch or shrink, generally the former ; this will cause the headles to rise and fall unevenly, and consequently the opening in front of the reed, where the shuttle passes, will be imperfect and block the way of the shuttle, or, if the shuttle is forced through, the half-lifted threads will be broken. If the cords of the headles and treadles are tied with the slip-knot described at p. 65, this necessary regulation of the harness can be easily effected.

Obtaining
a Clear
Shed

The size of the opening can be regulated by moving the pulley board, from which the headles are hung, nearer to or farther from the batten. If the opening is larger than is required, the strain on the warp threads will be unnecessarily great, and many of them will probably break ; if, on the other hand, it is too small, the shuttle will be obstructed. A large opening results from the harness being near the reed of the batten, and a small opening from it being hung farther back, away from the reed. The harness must not, however, be hung so near to the batten as to allow it to rub against the front headle when the loom is being worked. If it

See Plate I.

Obtaining
a Clear
Shed

is found that the opening is still too small when the harness has been placed as near to the reed as it conveniently can be, the cords which connect the treadles with the lower laths of the harness must be shortened slightly ; this will at once increase the size of the shed. If, on the other hand, the opening is too large, lengthening the treadle cords will decrease it. Of course all these matters require very careful adjustment, as very slight alterations make most important differences.

See Plate I.

Another cause of an imperfect shed may be insufficient weight in the weight-box to give the right amount of tension to the warp threads. The amount of weight necessary, of course, varies with the quantity of threads comprising the warp, and the fineness, coarseness, or elasticity of the threads used. A good shed, whatever material is made use of, depends very much on the weight on the back roller being exactly adapted to give the right tension to the threads.

Yet another cause of a bad shed may be loose threads, occasioned by careless warping or turning on. If the trouble results from this cause, the only remedy the weaver has is to watch carefully, and when he is aware of a loose thread to tighten it without delay. He can do this by breaking it off as near as possible to the front roller, joining a piece of thread to it, and twisting it to a pin fixed in the woven cloth on the roller after drawing it to an equal tension to the other warp threads. This is illustrated by Fig. 48, A and B.

When the thread has been tightened and woven in, after a few shoots it will become fixed in its place, and the loose end may be cut off close to the web. The

pin having served its purpose will then of course be removed.

When the shed is made, as in the mounting of the loom at present described, see Fig. 34, p. 64, by some warp threads rising and the others falling the general level of the warp, when the loom is at rest, must be from a quarter to half an inch above the race-board B, Plate II., not pressing down upon it as required in another kind of mounting yet to be described. If the warp is at this level, when at rest, the pulling downward of certain threads will press them upon the race-board, so

The Level
of the
Warp at
Rest

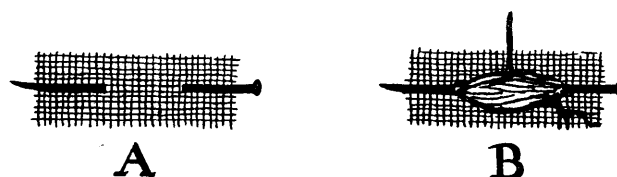


FIG. 48. METHOD OF FASTENING LOOSE THREADS.

that the shuttle will run *over* them and *under* the other threads which are raised.

The difficulty of the shuttle flying out (2) may be caused by some twist or unevenness in the race-board, Plate II., B, or by a twist in the batten itself. The batten may be found to hang the least bit out of the square or not perfectly level in the loom. The most usual cause, however, is the imperfect fitting up of the reed in the batten. This requires the greatest exactness, and extreme care must be taken to adjust the reed in its place to a nicety. It is necessary that the surface of the reed and the front of the swords of the batten

To prevent
the Shuttle
Flying Out

should be exactly on a level, as has already been described at p. 16 in the directions for making the batten and fitting the reed to it. It is well to add here, however, that when there is any considerable space between the ends of the reed and the inside edges of the swords a flat piece of wood, about the thickness of the reed, must be fixed so as to fill the space and continue an unbroken level between the outer edges of the two swords right

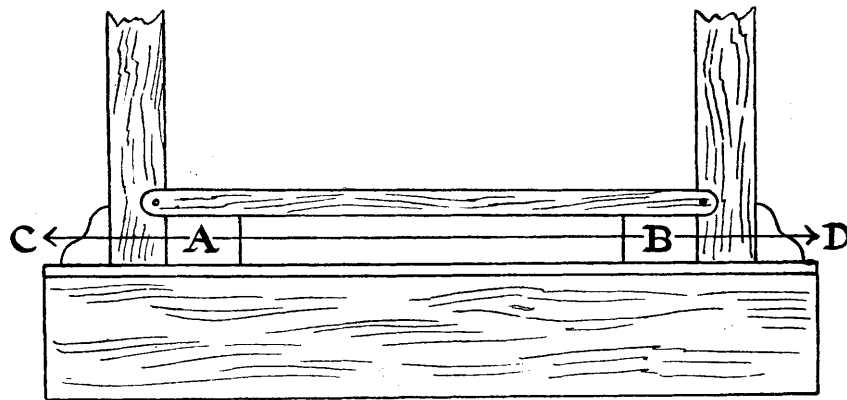


FIG. 49. LEVELLING THE REED AND BATTEN.

across the front. These fillings are shown at AB, Fig. 49, and a straight edge placed against the batten from C to D must touch at every part.

To Find
and Mend
Broken
Warp
Threads

(3) However careful the weaver may be in his work, threads of the warp will sometimes break, and it is vitally important that the right ends be found and joined together at once. If the breakage is between the harness and the cross rods, mending it will be quite easy, but it will be more difficult if the breakage is in the harness or

in front of it. In the first case, it will only be necessary to join the back end to a new piece of thread long enough to reach easily to the edge of the cloth on the front roller. Of course as small and neat a knot as possible must be made for this purpose ; after joining the new thread to the back end, its other end must be tied to the thread which has been left in the harness. As soon as these two ties have been made the latter knot can be drawn gently through the harness and reed until it reaches an inch or two beyond the woven edge of the cloth ; it must then be fastened to a pin, as described at p. 88, at exactly the right tension. This being done, the work can proceed, and the new thread will be woven in quite securely. The pin will be removed.

If the breakage is in front of the reed, the new thread must be carried in its right course between the headles, threaded through its proper eye and its proper dent in the reed, and then affixed to a pin as before described, care being taken not to twist it round or entangle it with any other thread.

(4) Difficulty No. 4 may result either from drawing the weft too tight after catching the shuttle or from a lack of proper proportion in size between the warp and weft. Constant, careful practice will soon overcome the former cause, and a little explanation will enable the beginner to avoid the latter. The weft thread should never be smaller in size or weight than the warp threads, for if it is so the cloth will inevitably draw in yet narrower as the weaving proceeds, continuing to do so until the work becomes impossible. The weft may

To Keep
the Web
Equal in
Width

be any size larger than that of the warp without causing trouble in this respect, because the weft thread in horizontal, shuttle weaving is, or should be, laid absolutely straight, and the warp adapts itself to the weft by curving half-way round it. As a general rule, if the straightness of the weft is lost, it indicates that too much tension is put upon the warp by the weighting, especially if the warp is, as is often the case, much finer than the weft.

To Avoid
Uneven
Edges

(5) Nothing is more characteristic of bad, careless weaving than uneven, loose edges to a woven material of any kind. Bad edges and tight and loose weft threads, which always go with them, are the result of irregular shuttling. If the shuttle on being caught is drawn out too suddenly, the weft will be tight, cause a pucker right across the cloth, and make a dent in the opposite edge; if left too loose, loops and kinks will result across the cloth and at the opposite edge, whilst two or three loose shoots together will cause the edge to bulge out. Great care in catching the shuttle and drawing it out alone will render the work perfect in this respect. A few of the edge threads of a warp are often doubled or trebled in order to make the shuttling easier by giving a little more resistance, but unless great care is exercised in shuttling, in this respect the weaver will fail. In very fine or complicated weaving the edges, or *leisures*, as they are called, are mounted and weighted separately at the back of the loom, so as to get rather more tension on the edge threads than on the main warp, but this will not be necessary for the simple webs with which we have to do.

(6) Beating together the weft, so as to lay it perfectly flat and even, will at first be found difficult to accomplish ; but in a loom properly built and set up a little attention directed to this point should enable the beginner soon to overcome the difficulty. The most important thing is to make sure that the batten hangs in the loom in such a manner that its weight falls against the weft with sufficient force to beat it together as required. As a general rule the batten should so hang that the swords, when seen from the side and when the reed touches the last laid weft thread, are exactly vertical. The weaver should only have to push the batten from him and let the weight of its fall back do the rest. In close, heavy weaving, of course, the hand must be used to give additional pressure to each shoot. The beginner must frequently pause and examine the work to see that the same number of shoots are laid to each inch, and must frequently wind the woven cloth on to the roller in order to keep the batten in its proper position.

To Beat
the Weft
together
evenly

The batten is made with the heavy block of wood at the lower ends of the swords for the purpose of this beating the weft together easily ; its weight can be increased, when necessary, by means of flat lead weights fixed to the lower ends of the swords at the back, or underneath, to the block itself.

(7) However well regulated the cords of the harness and treadles may be at first they will soon work loose, or may even be affected by change of weather. They must therefore be constantly watched and corrected. If the level of the warp or any part of it becomes uneven, this will probably be found to be the cause.

Regulat-
ing the
Harness and
Treadles

The method of regulating the cords has already been described.

(8) The eighth and last difficulty necessary to notice here is to keep the warp clear of knots and loose ends which, if allowed to pass into the harness and through the reed into the cloth, will cause obstruction and annoyance to the weaver and disfigure the finished web. The length of warp between the harness and the cross rods is called the *porry*, and this space has to be examined and cleared of knots, ends, &c., every time the rods are put back after they have travelled, as the cloth is woven, with the warp from their place near the back roller to a point near the harness where they begin to interfere with its proper working and have to be moved back. The time taken in thus clearing the warp must not be grudged, as it is part of the hand-loom weaver's regular work. In the case of power-looms, the warp has to be cleaned before it goes into the loom, so as to obviate the frequent stopping of the loom for the purpose.

CHAPTER XIII

VARIETY IN WOVEN MATERIALS

NOTWITHSTANDING the great variety of woven materials which have been devised by countless generations of ingenious weavers, the essential differences between them only allow of their being divided into two main branches or classes of weaving. These branches are called respectively *tabby* weaving and *twill* weaving. All other varieties hitherto achieved in textile art result either from making use of different kinds of raw material, preparing the thread used in different ways, weaving with different sized or different coloured threads, applying colour in various ways, inventing means of working out more or less elaborate designs in the texture of the material or on its surface, by combining the two classes of weaving in one web or by finishing the woven materials by different processes.

The Variety
of Woven
Materials

Two Main
Branches of
Textile Art

All the varieties of weaving in the *tabby* branch may be done on the loom fitted up as already described, except that a finer or coarser harness may be required if much finer or coarser threads than those specified are to be woven. The *twill* branch, however, requires the use of the set of levers shown in Fig. 53, p. 99; the manner of fitting these up will be described presently.

Tabby
Weaving

Twill
Weaving

Ornamental weaving often consists, as stated above,

Combined
Twill and
Tabby
Weaving

of a combination of the two branches in one elaborate web. This arrangement gives infinite scope for the invention of the most skilful designers, and results in marvellous and fascinating interlacements of warp and weft.

Tabby
Weaving

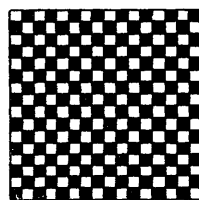
Fig. 50 represents a simple tabby web such as can most easily be woven on the loom set up in the manner described in the preceding chapters. The warp and weft are of the same material and of the same size: the material being mercerised cotton and the size No. 30. There are forty threads to the inch of warp, and there should be the same number of threads to the inch of weft. This will make an interlaced web with a mesh exactly square, such as is used for drawn thread work, and may be woven in linen, cotton, wool, or silk, which are the four materials chiefly used by weavers.

Twill
Weaving

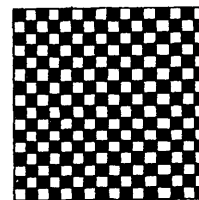
Fig. 51 represents the front and back of a simple twill weave made on the same harness as Fig. 50 and with the same material, mercerised cotton No. 30. It will be noticed at once that the front and back of the twill weave are not only different from the tabby web, which has the back and front exactly alike, but are at the same time quite different from one another. At the front the warp threads preponderate in the proportion of three to one, while at the back the weft preponderates over the warp threads in the same proportion.¹ Again, on both surfaces the interlacements of the warp and weft run diagonally across the web, but at the back the diagonal lines are in the opposite direction. Another characteristic of the twill weave is that, whichever

¹ If the twill is made on double threads, as shown in Fig. 52, the proportion of warp and weft may be the same on both back and front of the material, but the diagonal is always reversed, as stated above.

way the threads between the ties, as the intersections are called, are counted, they are always of equal number. Twills may be made on any convenient number of



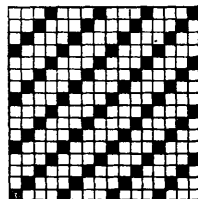
Front.



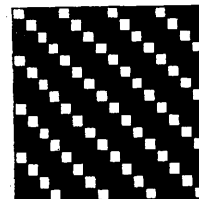
Back.

FIG. 50. TABBY ON FOUR HEADLES AND TWO TREADLES.

threads up to twenty-four, and may be broken up into what are known as *satins*, so that an infinite variety of fancy and ornamental weaving is possible by using them



Front.



Back.

FIG. 51. TWILL ON FOUR HEADLES AND FOUR TREADLES.

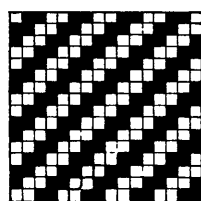
—in fact, the twill branch may be called the ornamental branch of weaving, and the tabby the plain branch.

As before stated, twill weaving requires a different arrangement for lifting the headles from that of tabby weaving: this must now be described. The various

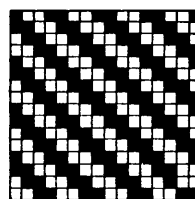
Fittings for
Twill
Weaving

levers shown in Plates I. and II. will come into use for this purpose. They must be fitted up in the positions shown in Fig. 53.

In this diagram the loom frame is omitted for the sake of clearness. The position of the harness, AA, in the loom is of course the same as described for tabby weaving. BB are lead weights attached to the lower laths of the harness for the purpose of bringing one or more of the headles down and closing the shed after the point of the lever C has raised them to open it and



Front.



Back.

FIG. 52. DOUBLE TWILL WORKED ON FOUR HEADLES AND FOUR TREADLES.

been released. DD are long levers attached by strong cords to the treadles E and connected by long cords with the levers C. The effect of this arrangement is that, when any of the treadles are depressed the ends of both the long and the short levers, which extend beyond the side of the loom frame, will be pulled down, and the end of the levers at C being raised the headles attached will be also raised and the shed be opened. As soon as the treadle is released, the lead weights, which must of course be heavier than the levers, will bring the headles down ready for the next lift.

The diagram illustrates a mechanical assembly, possibly a camera or projector, with various components labeled A through E. The assembly consists of a large frame (C) supporting a central assembly (A) which includes multiple horizontal bars and vertical supports. A base (B) is shown below the central assembly. A large horizontal bar (D) is positioned below the base, with a central support (E) and a series of vertical bars extending downwards. The diagram is a black and white line drawing.

is best for weaving twills in which, generally, fewer threads are raised than are left down ; but in the case of tabby weaving, where an equal number of threads are raised and depressed, the shed is made more quickly by the motion first described, and there is less strain on the

warp. The shed made by the simple pulley motion is shown by Fig. 54, and should be compared with Fig. 53.

It will be best, however, for the beginner, before altering the loom for the more elaborate twill weaving, to realise, by working out a variety of patterns, the

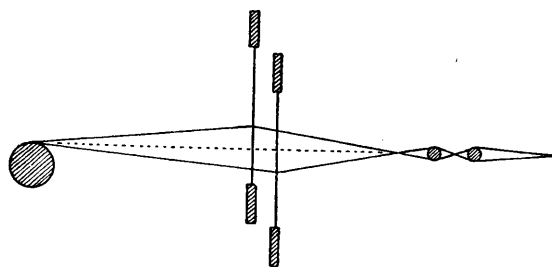


FIG. 54. RISING AND FALLING SHED.

opportunity afforded for invention, both in the texture and ornamentation of simple tabby webs. Accordingly, the next chapter will be devoted to suggestions for giving variety to tabby webs, and an explanation of the characteristics of twill webs.

CHAPTER XIV

ORNAMENTING SIMPLE WEBS

THE limits of this little book will only allow of a short final chapter for describing a few specimens of the possible varieties of weaving and ornamentation afforded by the hand-loom mounted with a harness of four headles, such as is recommended for use by the beginner. It may be, should it be asked for, that the publisher will arrange with the author to write and illustrate a second volume, or it might be a portfolio, of several of the astonishing number of more or less elaborate designs that can be worked out by the ingenious weaver on such a loom, but for the present a very few must suffice.

The simplest way of ornamenting a tabby web is by means of coloured stripes introduced at regular intervals in the warp. Warp
Stripes

This ornamentation makes no difference in the difficulty or speed of weaving, but it requires a little more care in the preparation of the warp and requires a certain amount of design in setting out a plan of the proportion of the stripes for the warper, and in the selection of the colours to be used in the different stripes if the material is to be decorated with more than one colour. The warper must have the number

of threads for the ground between the stripes and for each of the stripes in the repeat clearly set out for him, as in Fig. 55.

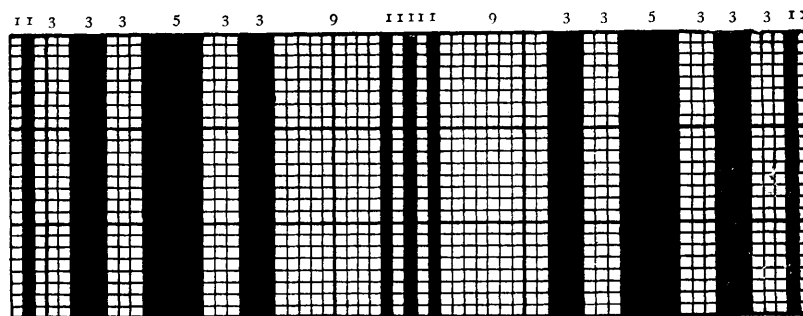


FIG. 55. WARP STRIPES.

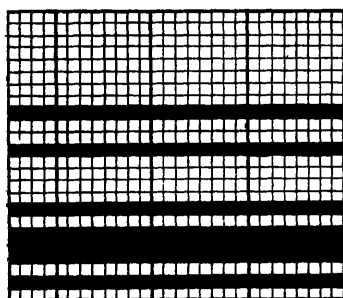


FIG. 56A. WEFT STRIPES.

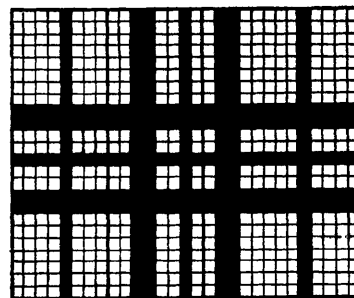


FIG. 56B. WARP AND WEFT STRIPES.

Weft
Stripes

Instead of warp stripes, weft stripes, Fig. 56A, may be used. These, however, require more care on the part of the weaver, especially if two or more breadths of the

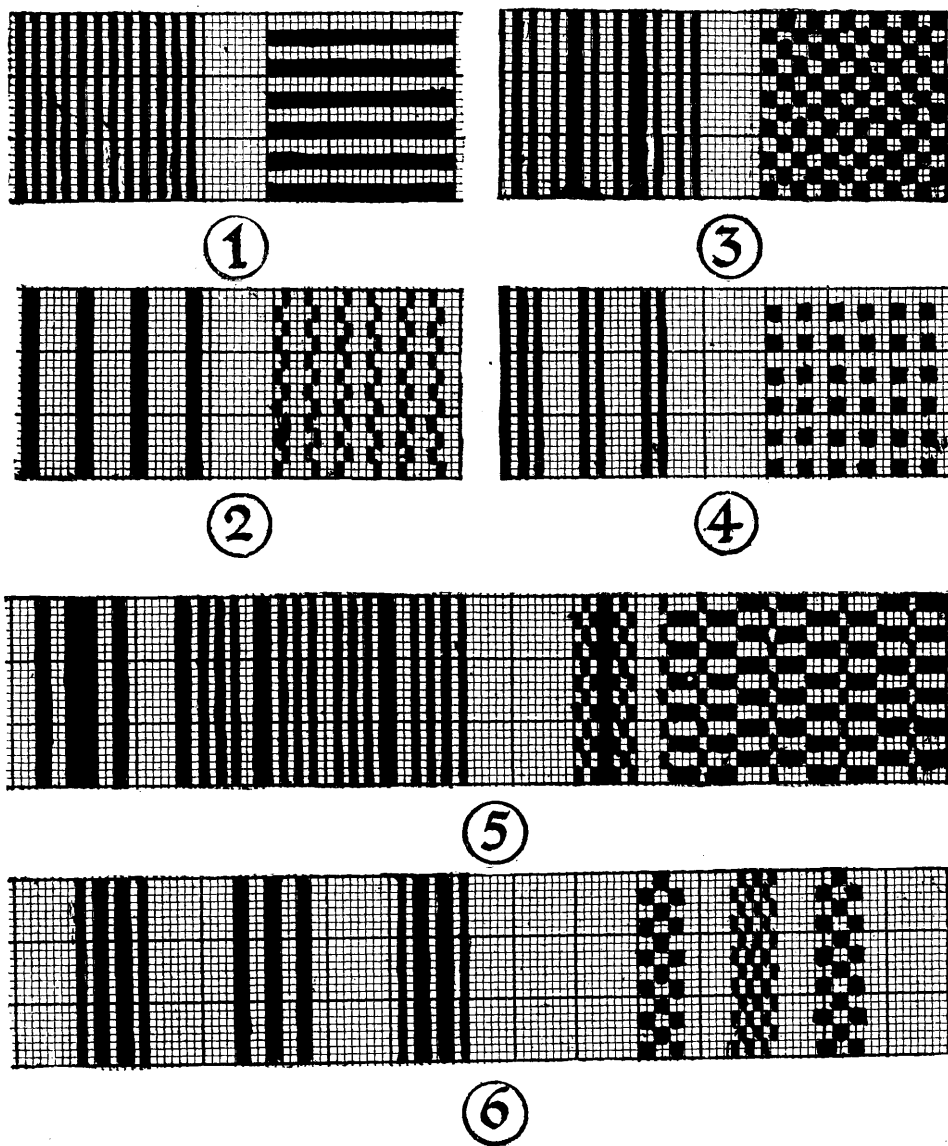
material are to be joined together. The least variation in the width of the stripes makes the matching difficult, and if the variation is considerable, matching is impossible. Weft stripes are most useful for ornamenting the ends of towels, sideboard cloths, &c., and are very effective.

Both warp and weft stripings may be used together in the same web. This gives an endless variety of form and colour effects, and may be made very beautiful, as in many of the symbolic tartans of the Scotch and other peoples (Fig. 56B).

Tartan
Stripes

A most interesting set of small designs may be made by striping the warp in certain regular sequence—see Fig. 57. In order to weave these, the warp must be finer than the weft in the proportion of two or three to one. This allows the warp to cover the weft completely and prevents it showing on the surface, as will be seen to be the case in the material called *poplin*, which is made of a warp of fine silk and is wefted with coarse wool.

A little careful study of Fig. 57 will explain the diagram, if it be borne in mind that in each of the oblongs 1 to 6 the order of warping the threads is shown to the left, and that each of the vertical lines of small squares represents a single thread of warp. The effect of the warpings after weaving is shown to the right. The explanation of all the effects is that at one shoot of weft all the odd threads are brought to the front, while at the second all the even threads come forward and the odd ones go to the back.



Warping.

Woven Effect.

FIG. 57. DESIGNS RESULTING FROM STRIPING THE WARP.

Brocading, or inlaying, as it is sometimes called, can be done on a loom fitted with the pulley motion if another independent headle be added to the harness ; but it would take up too much space to give instructions here how to fit the headle up and proceed with the work ; these must be left for a future volume. The illustration of brocading (Fig. 58) will give an idea of the advanced designs possible to the skilful weaver on this simple loom, as well as the manner in which they have to be drawn out on ruled paper. The exquisite coloured designs woven into the texture of the cashmere shawls, so highly prized in the last century, were produced on no more elaborate looms than the one which has been described.

The branch of weaving called *twill* weaving, which requires the loom to be fitted with levers and weights to actuate the headles, as described at p. 99, is peculiarly the *ornamental* branch of automatic weaving. All

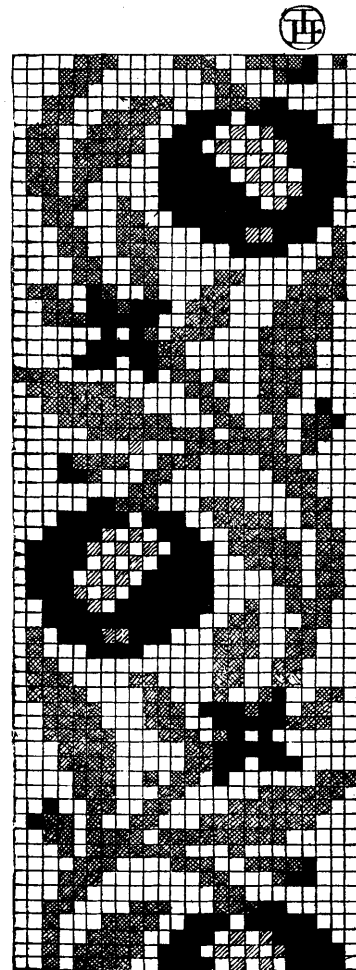


FIG. 58. DESIGN FOR BROCADE,
ON RULED PAPER.

ornamental intersections of warp and weft are made by using different kinds of twills and satins, which are only twills with the regular diagonal course of *ties*, as the intersections are called, broken up.

In order to weave a twill the headles must not only be worked by means of levers and weights, but must be actuated by four treadles instead of two. This is shown in Fig. 53, where it will be seen that each headle has its own independent treadle connected with it.

It will be readily understood that if any one of the treadles be depressed, the headle connected with it will rise, and a shed be made for the weft in which *one* thread rises and *three* remain down. This will cause a tiny spot of *weft* to show on the front of the web, which is the underside,¹ and a horizontal loop of weft to cross over three threads of *warp* at the back or reverse side.

Weavers'
Plan and
Tie-up

It is necessary now to explain the ingenious method by which weavers set down the design for even the simplest web, and indicate the order of entering the warp in the headles, the tying up of the headles to the treadles, and the order in which the treadles are to be depressed by the weaver's feet.

Plan and
Tie-up of
a Tabby

In No. 1 of Fig. 59 the tabby weave is indicated on the square of ruled paper A, in which the white squares represent *warp* and the black squares

¹ Ornamental weaving is nearly always done face downward in the loom. The reason of this is that there is generally occasion to lift a smaller proportion of threads at each ultimate shoot than are left down; this, of course, gives less strain on the threads themselves and requires less labour on the part of the weaver in a complicated design.

weft. The four horizontal lines B, to the right of the square represent the four headles, and the vertical lines C, which cross them, are the two treadles necessary for making plain tabby cloth. The circles enclosing numerals, at the lower part of the treadle lines, indicate the order in which the treadles are to be worked. The crosses where the lines intersect show which headles and treadles are tied together, and the ticks on the headle

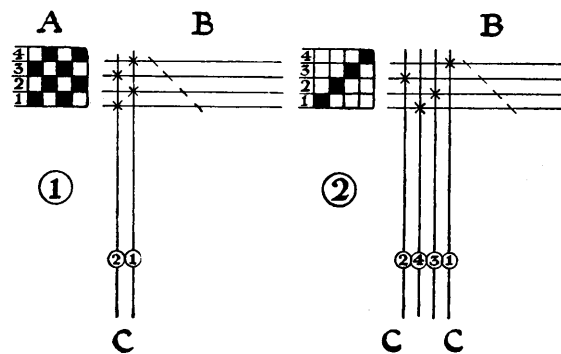


FIG. 59. PLAN AND TIE-UP OF TABBY AND TWILL.

lines show the order in which the warp is entered in the leashes of the headles. This explanation will serve for all the rest of the designs.

At No. 2, Fig. 59, the design, plan, and tie-up of a twill material is shown. Here there are the same number of headles B, and the same entering of the warp in them, but two additional treadles CC are shown, so that each treadle can be connected with each separate headle, as indicated by the crosses. The numerals on the treadles show the order in which they are to be

Plan and
Tie-up of
a Twill

trodden alternately by the right and left foot of the weaver.

Fig. 60, Nos. 1, 2, 3, show variants of the simple twill on four headles, and should explain themselves.

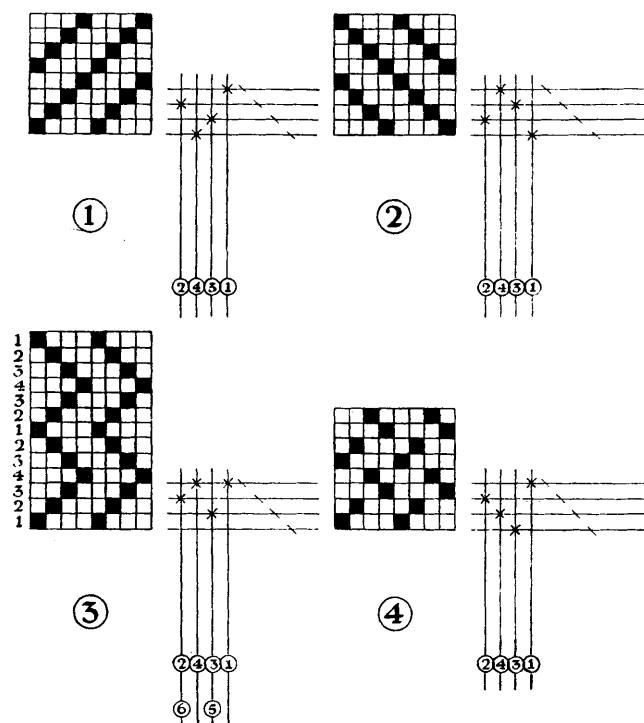


FIG. 60.

NO. 1. RIGHT-HAND TWILL.
NO. 3. ZIGZAG TWILL.

NO. 2. LEFT-HAND TWILL.
NO. 4. BROKEN TWILL.

Fig. 60, No. 4, and Fig. 61 show what is called a broken twill or satinette. This is obtained by regularly breaking the order in which the headles rise : thus in the first and second lines they rise as in ordinary twills, but here the

twill is broken and the fourth headle rises, then the third headle is left to finish the course. Broken twills can be made on any number of headles up to twenty-four,

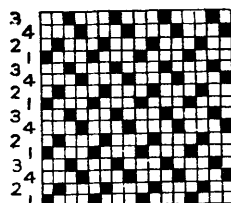


FIG. 61. BROKEN TWILL OR SATINETTE.

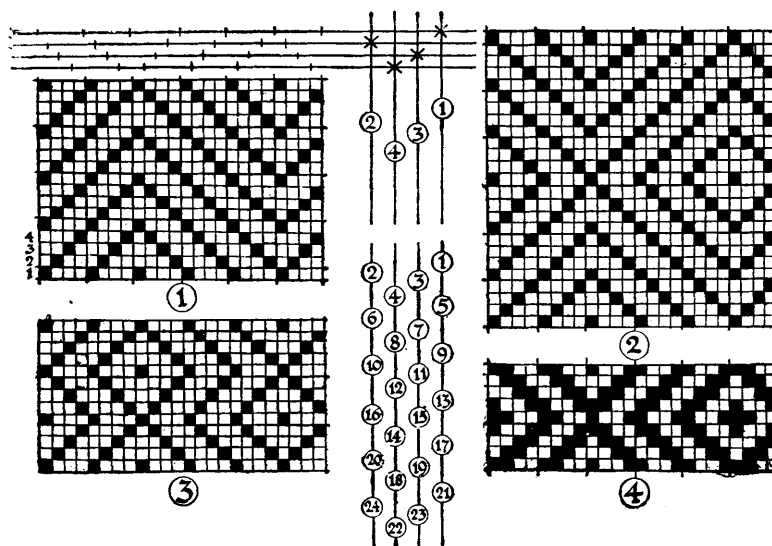


FIG. 62. EXTENDED TWILL PATTERNS.

but if more than four headles are used they are called *satins*.

Some idea of the different designs that can be woven on four headles is given by Fig. 62, but in this case

the entering of the warp in the headles, shown above No. 1, is seen to be different. An endless variety of small designs can be worked out in this way, but examples and directions for weaving them cannot be included in this volume, as the allotted space at the disposal of the author has already been exceeded.

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