

*Draw-loom* is the most complicated and extensive machine, in its operation, used in the weaving of ornamented cloth. There is no diversity of pattern, or figure, however extensive, which can be brought within the whole range of cloth of the largest dimensions, but may be produced by this useful, although expensive, machine. Draw-loom, in Britain, are used for three purposes, *viz.* for weaving damask, carpets, and the most extensive patterns of spotted muslins. The general principle of all these machines is pretty similar, but modifications in their construction take place, according to the particular purposes for which they are intended. When patterns become so extensive, that the number of heddles necessary for moving the warp in its numerous combinations, could neither be included within any moderate bounds, nor worked by any moderate power, it becomes necessary to have recourse to the draw-loom. Of all the draw-loom, that for weaving fine damask is the most extensive; some of those in common use containing upwards of 120 designs, of 10 spaces each, which renders them equal to 1200 leaves of the diaper harness, or 6000 of the leaves used for dornock, dimity, or common tweeling. The general principle of the draw-loom harness, and the mode by which the flushing is reversed, is in every respect the same with that of the diaper, the difference consisting solely in the superior extent of the former, and the method of mounting and working it. *Fig. 3. Plate XIV. Miscellany,* is a perspective view of the harness part of a draw-loom, and

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the apparatus for working it. The number of harness-cords of a draw-loom is so great, and they are of necessity so closely crowded together, that any representation of the whole, even if drawn upon a very large scale, must convey a very inadequate idea of their construction and operation. A few, therefore, only are represented at intervals to illustrate the way of constructing them, and this being once well understood, may be extended to any length that convenience will admit. The harness of the draw-loom is not confined by leaves, but every cord carrying a mail for the warp is kept stretched by a weight. The mails are the same as those of the diaper, *fig. 2. Plate XIV.* The weights attached to the harness are represented at L. A horizontal board, or frame C, is fixed across the loom, and is either perforated with a number of small holes, or divided by wires, or pins, to serve as guides to the cords of the harness passing through them. When the range, or extent of the design, has been ascertained, by counting on the paper the greatest number of squares contained in it from right to left, the harness must be made to correspond with this range. Let the range be supposed to extend to 500 squares, and the whole breadth of the warp to contain 10,000 threads. If five threads are to be drawn through each mail, the number of mails composing the harness will be 2000, and four ranges of the pattern will include the whole breadth. The divisions in the board C, and the number of pulleys in the box, or case H, being adapted to this, the operator may proceed to put up his harness, which is done as follows: the 1st, 501st, 1001st, and 1501st harness twines, after being passed through their respective intervals in the board, or frame C, are to be knotted together at M. A cord being attached to these is carried over the first pulley in the case H, and is made fast to the piece of wood G, which is generally called the *table*. The 2d, 502d, 1002d, and 1502d, are connected in the same way, and the cord attached to them, passing over the second pulley, is fastened to the table as before. The same operation is successively repeated, until the whole 500 connections are completed. The cords at B, passing over the pulleys and fastened to the table, are called the *tail* of the harness. From each cord in the tail a vertical cord descends, and is made fast to a piece of wood K, which is lashed to a fixture in the floor. These cords, represented at D, are called *simples*. The draught of the warp through the mails of the harness is regularly progressive from right to left, as in common tweeling, and the draught, cording, and mounting of the front leaves are exactly the same as in diaper. A stout perpendicular cord is now stretched from the roof to the floor, and made fast at both ends. This cord is represented at I, and the loom is then ready to be adapted to work any pattern, of the range of 500 squares, or mails.

The next operation, therefore, is to apply a certain number of small cords, called *lashes*, and represented at E, so as to form the particular pattern required. This is called reading on the design, and from the complexity of the operation, and the necessity of its being accurately done, is performed by two persons. The first of these persons selects from the design paper the simples, to which lashes are to be successively applied; and it is the business of the second to apply those lashes according to the instructions which he receives from the first. To read or select the lashes in their proper rotation, it is proper to observe, that the whole range of squares, from right to left, between the extreme points of the pattern, is equal to the whole number of simples, and the whole range from top to bottom, to the number of operations which those simples are to undergo. The person who is to select, therefore, taking the design paper, begins

Ff at

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at the lowest square, and counting from the right hand, instructs the other to pass as many simples as there are blank squares upon the paper, to put lashes to as many as are coloured, again to pass the blanks, take the coloured squares, and so on until he has reached the left side of the pattern. When these lashes have been applied, which is done by passing each loosely round the simples which it is to work, they are knotted together, and attached to the cord I by a loop, so that they may slide up and down freely, both upon the cord and the simples. Proceeding to the second square from the bottom, the selection is made in the same way, and thus they continue until they have reached the top. The lashes being now in clusters upon the cord I, these clusters are connected at convenient distances from each other, by small cords represented at F, the first applied cluster being lowest upon the cord I.

The draw-loom being ready for work, the operators may begin to weave. Two persons are required to work the loom. One of these pulls down the first set of lashes, the whole being placed high upon the cord I, and by pulling them tight, draws the simples with which they are connected clear of all the rest. Then by grasping these simples firmly in his hand, and pulling them down, he tightens the tail cords at B, by making them diverge more from a straight line, and of course raises the mails which are attached to them by the harness twines at M. The weaver then works over his front, mounting, as in common tweeling, once, or oftener, if more squares than one, upon the design, are included between the same parallel straight lines from top to bottom. When a change of the harness becomes necessary, the connecting cord F pulls down the second cluster of lashes, upon which the same operation is performed as before. By these means, the simples, however numerous, (and in the case we have supposed they would amount to 500,) are selected from each other with the utmost accuracy and facility. The successive repetition of the same operation compleats the pattern, and then it is only necessary to push the lashes up again, and begin a new one.

When the mounting of the draw-loom is very extensive, it would be inconvenient to use only one case of pulleys; for the tail-cords and the frame of this case must be extended to very inconvenient dimensions. Besides this, when so many pulleys are employed, the tail-cords must deviate so much from the perpendicular line, that there would be much danger of throwing the cords off the pulleys, and setting the machine fast until each cord was replaced. Indeed, to prevent the danger of this, which materially impedes the operation, it is customary to place guides of wire under the pulleys, to confine the cords. But when the mounting is very extensive, two, and sometimes three, cases of pulleys are very generally used. These are placed parallel to each other, that represented at H being the middle one, and an equal number of tail cords are conducted over each. It is also usual to construct more than one set of simples, that which is to be used being lashed to the floor, while the others are loose and hung near the roof, until it becomes necessary to use them in their turns. This, indeed, is very useful in working bordered table-cloths, where the whole is frequently the continuation of one design, extending sometimes three yards, or more, in breadth, and five or six yards in length.

In an age like the present, when simplification of process and saving of labour have become objects of such general attention, it is not wonderful that plans, which have these for their object, should have been adapted to the draw-loom as well as to other machinery. One of these, lately introduced at Dunfermline, has been pretty generally adopted,

and appears, upon the whole, to have given very considerable satisfaction. Whether properly or not, it is there known by the name of the patent draw-loom.

The object of the patent draw-loom is, to enable the weaver to change his harness, as well as to perform the other necessary operations of weaving, and consequently to supersede the necessity of employing a second person at the loom. In this loom the tail of the harness, instead of having its direction changed, by passing over pulleys, and being carried to one side, rises perpendicularly, and is made fast to the roof. The simples are brought in a horizontal direction to the front of the loom, over the weaver's head. The direction of the simples is very similar to that of the tail cords of the diaper-loom, *fig. 1*. The lashes hang down perpendicularly, so that the weaver may pull them with his hand. Upon the tail are knots, placed at equal heights from the floor, and in front of these knots is an instrument very much resembling a coarse comb, or the teeth of a garden rake. This instrument moves upon a fulcrum, from which a lever extends over the weaver's head, by depressing the end of which he can raise the teeth at pleasure. The simples being pulled, the tail is drawn forward, and the knots engaged between the teeth of the comb. The lever being then pulled down, and secured by a cord and handle, as in the diaper-loom; the teeth rise, and carrying the knots along with them, raise the harness. When a change is required, the teeth are let down, the knots relieved, a second set pulled in, and the operation proceeds as before.

This plan has come into very general use, and seems to meet with much approbation, for those kinds of damask where the pattern is not very extensive. In the others, there is still a diversity of opinion respecting the comparative merits of the old and new plans, which, as the invention is recent, will probably be only decided by experience.

The draw-loom is also applied, in most instances, to the manufacture of carpets. Carpets are not tweeled like diaper or damask, but consist of plain or alternate weaving. A carpet consists of two webs of cloth, woven separately and independently of each other, but being woven at the same time, particular parts of them are taken through each other, so that any part of each web is sometimes above, and sometimes below the other. From this it arises that when a carpet is turned upside down, the pattern remains the same, but the colours are reversed, that which formed the ground being now the pattern, and *vice versa*.

The front mounting of a carpet draw-loom consists of four leaves, two of which raise the web which forms the ground, and the other two that which forms the figure. One shot of the woof is inserted into each web alternately. The eyes of the front mounting are long, like those of the diaper and damask, to allow the harness to rise freely. As carpets are woven generally of coarse dyed woollen yarn, and do not contain much warp, it is unnecessary, except in very complicated patterns, to use simples. The lashes, therefore, hang perpendicularly from the tail, and at the end of each set there is a small handle, or as it is called, a *bob*. These pass through a long horizontal board, perforated with holes to preserve their regularity, and are arranged in pairs, one bob raising the harness of the pattern-web, and the other that of the ground-web. To adapt the figure upon the design to the application of the lashes, the instructions for the pattern-web are the same as in the damask; those for the ground-web the same exactly reversed. In the latter, therefore, the blanks upon the design are to be taken, and the coloured squares passed. In this consists the whole difference.

The harness of the spot draw-loom is exactly the same as the

the damask, excepting that the yarn of the warp being much finer, the mails are not used, but short eyes of twine substituted in their places. In the front mounting, also, the end is attained by means which, although in effect the same, are better adapted to the particular nature of the work. Four leaves of heddles are used; but they are mounted, so that two leaves will either go together up or down, or in opposite directions. The heddles are constructed like those for weaving plain cloth, and every thread is drawn through two heddles, being taken through the upper cleft or link of the one, and through the under link of the other. When the two leaves move in the same direction, the threads of warp are confined as in the clasp of a common heddle; but when they move in a contrary direction, they present all the facility of the long eye in allowing the harness to rise without interruption.

As the time, labour, and materials, necessary to mount a draw-loom involve a very considerable expence, before any productive return can be attained, it is of the utmost importance that the quality of the materials should be good, and that every part should be square, level, and equally stretched. Draw-looms will only gradually remunerate those who expend money or labour in fitting them up; and the better they are executed, the quicker and more certain will be the return. A trifling additional trouble or expence to attain those ends will therefore always be found consistent with the soundest judgment, and truest economy.

