WEAVING.—No. IX.

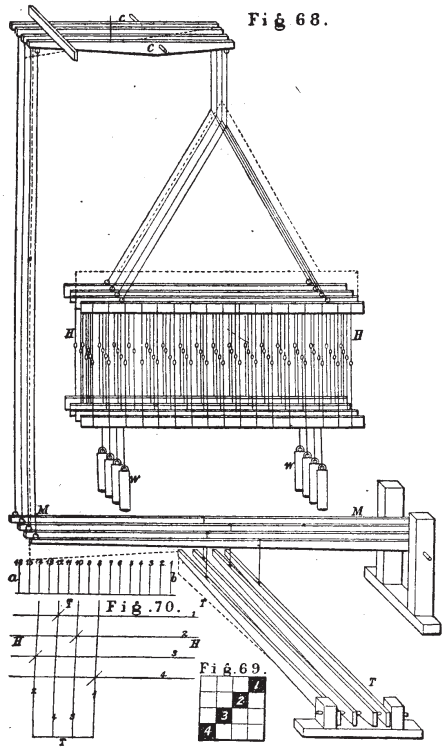
SHEDDING.

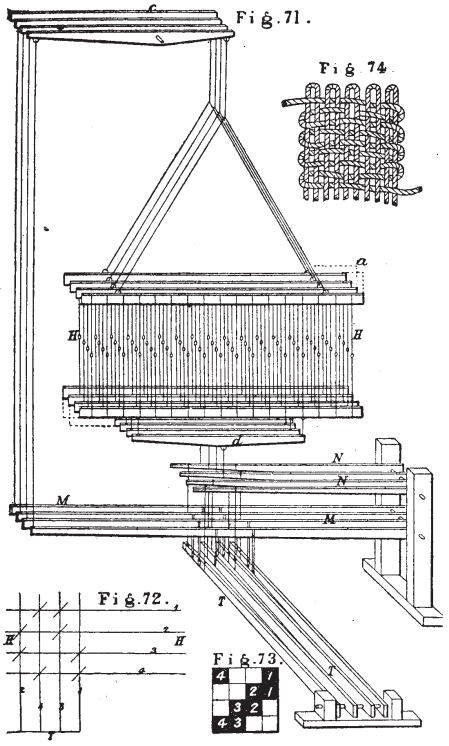
As the principles upon which twills, satins, &c., are formed have been shown, it now remains to describe the methods adopted by the weaver in arranging his loom for weaving them. We confined our attention to the uses that four leaves of headles only could be applied to, in order to avoid the complication which a greater number would necessarily cause in the figures. In the present case we shall adopt the same course, for it is only by limiting the number sets of the working parts that we are enabled to avoid complication and apparent confusion in our diagrams.

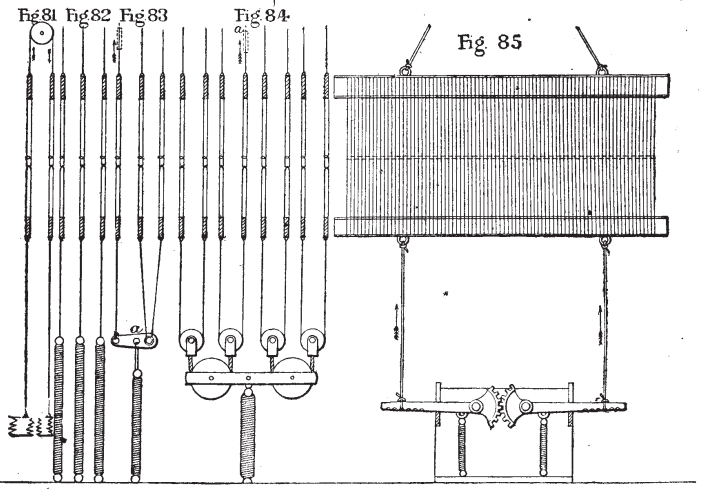
In Fig. 41, on page 461 of our last volume, was shown a common hand loom mounted with four headles, the manner in which these headles were connected to the loom being represented. Fig. 68, subjoined, represents the four headles as seen from the front of the loom, but all the other parts of the latter are omitted. As before described, the headles H H are each connected to a separate couper or tumbler C C, and thence by the long cords to the ends of the marches M M, and finally to the treadles T T. Each headle is held down by two spiral springs or two weights—or sometimes one weight only in the form of a lath or plate—but in this case by the weights W W. In this instance the loom is arranged to weave a single thread twill, as shown at Fig. 49, on page 111 *ante*, and at Fig. 69. annexed. For this purpose it is only necessary to connect one of the marches by a cord to one of the treadles, as shown; consequently only one of the headles can be raised at each movement of a treadle, and the operation of weaving the twill, shown, is simply to raise the headles in consecutive order as represented in Fig. 69. But it will be observed, on tracing the connexion of the treadles to the marches, and thence to the headles, that they are not placed in consecutive order, as shown in Fig. 69, but they are corded in a different order. The reason for this is, that, in working the treadles with his feet, the weaver could not conveniently press upon the treadles in consecutive order without crossing one leg over the other. The weaver, therefore, adopts some other arrangement, to devise which he constructs a plan which will not only represent the draughting or entering of the warp threads through the headles, but show also the cording or the attachment of the treadles to the headles.

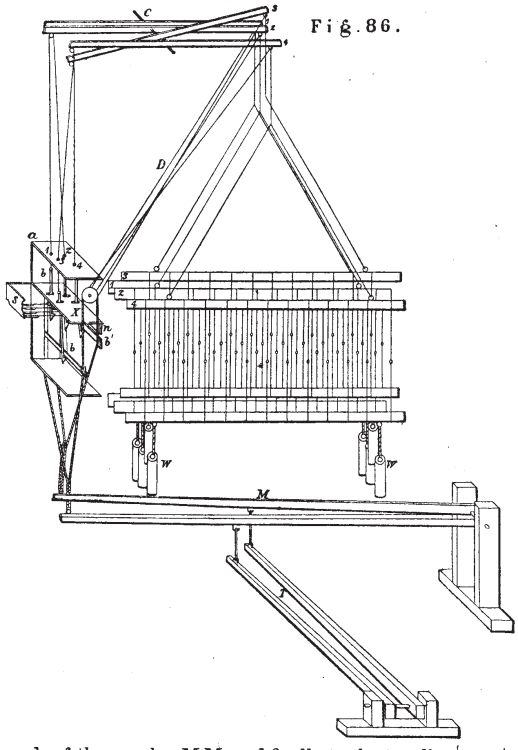
This he does in a very simple and effectual way, and in the present instance Fig. 70 shows the draught and tie-up, as it is called, for weaving the twill, Fig. 69. It is simply a rough plan of the headles and the treadles, in which the single lines H H¹ represent the four headles, and the lines T T represent the treadles. Near H¹ four numbers, 1, 2, 3, 4, are placed in a diagonal position. These numbers represent the first four warp threads (exclusive of the selvage), and show the order in which they are entered. At *a b* we have added a few lines, representing an extension of the plan, and a portion of the warp threads, in order to show that the diagonal position of the numbers, placed by the weaver, corresponds to them; but it is not necessary for the weaver to place the lines *a b*, as the four figures are quite sufficient in this case, and they represent the order in which the warp threads are entered. On the lines T will be seen the figures 2, 4, 3, 1. These numbers represent the order in which the weaver can use his feet upon the treadles in the most convenient and rapid manner. Thus he treads the right foot first on the right outside treadle. This is, therefore, marked No. 1. The next treadle he can best use is the outside left one, and upon this he places his left foot. Consequently this is No. 2 treadle in the order of treading, and so on with Nos. 3 and 4, as shown on the plan, the odd numbers representing the right foot, and the even numbers the left.

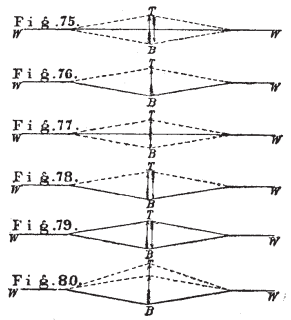
Now, in Fig. 69 the first thread, or series of threads, are those in No. 4 headle; consequently the weaver puts a mark upon his plan at the intersection of No. 1 treadle with No. 4 headle. The next is No. 3 thread to be raised; therefore he marks the intersection No. 3 with No. 2 headle, and these marks represent the tie-up or connexions to be made. In like manner No. 2 thread or headle is attached to No. 3 treadle, and No. 1 to No. 4 treadle. At first sight the order of the intersections gives little appearance of any consecutive arrangement; but it will be admitted that the arrangement











and the plan are all that can be desired for the purpose. Any number of headles can be shown in this way, and one, two, or more of them may be shown attached to the treadles, according to the patterns to be woven.

It may be here mentioned that there are some cases which exact from the weaver no little amount of ingenuity for arranging the tying up. If there are five headles to be used, instead of four, it is evident that with one foot he must work two treadles, and with the other foot he must work three, in passing over the treadle for each course. In doing this he slides upon the next treadle, say, from 4 to 5, whilst the other foot is moving to No. 1. This process is called hopping. It can be avoided by using ten treadles, making the odd number even, for by so doing the five headles are worked twice over by working over the treadles once. This, however, increases the number of treadles. But there are cases where the weaver can diminish the number of treadles, *i.e.*, where the same headle or headles are repeated in the compass of one design. These are matters that, although they may not exactly come within the limit of our notice, still could not be omitted, for it is by explaining their seeming complication that we can alone render the process of weaving clear and simple.

Fig. 71 represents another form of connecting the headles with the treadles by means of a series of levers. In this instance the weights to hold down the headles are dispensed with, for one portion of the harness is made to balance the other portion, the effect being exactly as in plain weaving. It will be seen that, in this case, the long marches M M are connected to the headles in the same way as those in Fig. 68, and they raise the leaves exactly in the same way. Now, the only difference is, that the remainder of the headles which are not attached to the long marches, or countermarches, are all attached to the short marches N N. The effect is that by pressing upon any of the treadles part of the headles rise, and the remainder sink. The connecting cords between the treadles T T and the long marches are shown with thick lines, and the cords to the short marches with thin lines, and it will be observed that each of the treadles is connected with all of the headles, but in different arrangement. The dotted lines *a* and *b* show the extent of the rising and falling of the two front and two back headles which would be caused by pressing upon the outer right-hand treadle. Under each of the headles is attached a strong lath *d*, which is used when the headles are of extra length and require strengthening.

The draught and tie-up of Fig. 71 is represented in Fig. 72, and the design is a two-thread twill, as shown in Fig. 73, and as it would appear when woven in Fig. 74. Fig. 72 shows the connexions of the treadles with the long marches by the diagonal marks as before described, but there is no necessity for showing the other cords, for, as before stated, all the remaining cords are attached to the short marches.

The system, last described, applies best when the number of the leaves or shafts to be raised are equal in number to those which sink. Under these conditions the headles are equally balanced and work with freedom. But where only one headle at a time, or a comparatively small number is raised, the system shown in Fig. 68 is preferable. In that system not only is one headle as it rises indirectly counterbalanced by that which is falling, but the greater portion of the headles remain stationary if they are not required—hence there is no friction upon them, or upon the warp threads which they govern.

The action of all contrivances for the purposes of forming the shed can be easily understood if the principles upon which they are based are first known. Shedding motions may be classed into about six varieties, which may be represented by Figs. 75 to 80. In all the figures W W represents the normal position, and the dotted lines represent the threads in motion.

In Fig. 75, W W represents the warp as in plain weaving with two headles only. The dotted lines show the form of the shed when open, and the arrows show that some threads rise direct to the point T from the bottom B, at the same time that the other threads fall from T to B. In this instance the threads move from top to bottom and from bottom to top without any stoppage, consequently it is called a through shed. It is counterbalanced itself, and the motion is performed in the shortest possible time and with the least friction.

Fig. 76 represents the motion that would take place in working the headles as in Fig. 68, if worked with one foot only or one headle at a time. Here the line W W, showing the position of the warp, is slightly dipped by keeping the headles at a lower level, to counteract, to a certain extent, the opposite motion and tension that would be thrown upon the rising threads that would accrue if they were placed horizontally, as at Fig. 75. This motion is also similar to that performed by the common Jacquard machine, and may be called a rising shed.

But if two of the headles were used simultaneously — one rising while the other was falling — as would be the case if two of the four treadles in Fig. 68 were worked with both feet, then the motion would be the same as represented in Fig. 78, where the arrows denote a rising and falling shed with the bottom stationary or standing. Fig. 77 represents the motion of the warp that would be caused by the arrangement shown at Fig. 71. In this case it is simply a rising shed with sinking bottom. Fig. 79 shows the warp stationary at both top and bottom of the shed, and those threads which are required to rise or fall, do so simultaneously. Therefore the top and bottom are stationary with rising and falling shed. Fig. 80 shows a double shed. This is used when two tiers of shuttles are used at one time. The most perfect of these motions is the through shed, Fig. 75; whilst the most imperfect are the rising sheds, Figs. 76 and 80. Their imperfection consists in taking double the time to be formed, and they do not counterbalance themselves as in the case of Figs. 78 and 79.

As a great variety of apparatus for forming the sheds require to have the headles held down by weights or springs, various contrivances are resorted to to avoid the direct action of either weights or springs, for they operate more or less detrimentally on the action of the loom. Thus in Fig. 81 are shown the counterbalanced headles as in plain weaving; Fig. 82 shows three headles held down by three separate springs, or weights may be used instead. Fig. 83 shows how three headles may be so held, that if one only of the healds is raised at a time the effect of the weight or spring can be avoided. Whichever of three healds is raised, the other two descend to the proper level and the lever *a* with a pulley adjusts itself to the motions of any of the healds with ease and freedom. Fig. 84 is an extension of the same principle. It will be seen that any one of the healds, as *a*, can be raised, and although counteracted by all the rest, it only has its own share of the strain to overcome. This method can be extended to any number of headles. Fig. 85 shows an arrangement which requires two levers to each heald. This method has the advantage of keeping the heald parallel—and in case one spring should break, or only one be sufficient in strength, it can be worked all the same. This motion is often applied to power looms.

The number of treadles that can be conveniently used in a loom is very limited, and rarely exceeds eight. The weaver, therefore, dispenses with them whenever it is possible to do so. This is generally effected by means of small machines which are worked by either one or two treadles. At the present time small Jacquard machines are generally used for that purpose. But before we enter upon the subject of these appliances there is one machine which must be described, for it forms a connecting link between the systems we have already described, and the use of those machines which are complete in themselves.

The machine we allude to is a shedding motion with the action similar to Fig. 78, viz., a rising and falling shed with a stationary bottom, and is represented in Fig. 86 attached to the healds, but detached from the loom. It consists of a box, *a*, which contains a number of wooden hooks which move in slots. In order to show them, one end of the box has been omitted in the drawing. Each hook is connected with a separate tumbler *c*, in such a manner that when the hook is drawn downwards it raises the headle to which it is fixed. After the hook traverses the slot board *x*, it passes through a ring or eye to which, on one side, is tied an elastic cord or spring *s*, while on the other it is attached to a cord that leads up to the opposite ends of the tumblers C. Two flat bars *b b'* are made to slide up and down in slots in the ends of the machine. These bars are each connected to a separate march M, and thence to the treadles T, and they are counterbalanced by having the connecting cords placed in the groove of the pulleys, one of which is shown at *c*. As the treadles rise and fall, so do the bars to which they are connected. Each of the hooks is connected to the headles, according to the numbers shown.

Now, by drawing any one of the hooks forward, it is brought into contact with the corresponding bar, by which it is drawn downwards, and it at the same time raises one of the headles. It also pulls forward one of the cords D, and, therefore, the hook to which that cord is attached; consequently it throws the next hook into contact with the next bar, and the headle to which it is attached is then raised. Thus each headle is raised in the order in which the tie is made. Eight hooks are generally used, but we have shown only half that number. The board *n* has holes in it through which are passed the cords D, which draw the hooks forward, while the springs *s* replace the hooks to their former position.

This contrivance is known as the "Jack-in-the-box," and was invented by Theodore Jennings, of Bethnal-green, about the year 1840. Although the principle upon which it is based—viz., the application of one heald to select the next one to rise—was not new, still the modification shown is not only very ingenious, but well adapted for satin weaving, and it is much used in silk weaving at the present time.