WEAVING.—No. XXVI.

THE POWER LOOM—*concluded.*

DR. CARTWRIGHT'S loom (see Fig. 259, page 506) deserves more than usual attention, for his patent is so full of curious details which he believed he could carry out that it is no wonder he failed in doing so. He had evidently looked at the problem before him in a theoretical point of view, and for almost every contingency as well as action in the operation of plain weaving he had provided plans by which they could be accomplished. Some of these details show great ingenuity, and have since the doctor's time been successfully carried out. For instance he says in his specification:

"F is the movable frame having the part adjoining to the lathe supported by loops on two rods fastened to the lathe, and the outer part supported by loops on two rods *e e*, *f f* fastened at each end upon a board lying under the warp, and on which rod it glides. It vibrates with the lathes, and at every vibration passes under hooks, which are severally suspended upon each thread, and which are strung upon the rod *g g*. Note. If a thread breaks, the hook which was suspended upon it, drops down upon the board lying under it, and catches the frame, which is made bevel-edged for the purpose of slipping under the nose of the hook, the lathe going to while the frame is held by the hook. The pulley E is turned round and an oblique direction given to the lever D. In this direction it strikes, or is wedged against the inside of the lever C, which is thus forced from the wheel A; and as the lever C carries the socket B along with it, the socket and the wheel are disunited, and the machine stopped. Note, the pulley is brought back to the place by a coiled spring, like the mainspring of a watch, in the inside of it. The coiled spring serves also to keep the movable frame steady to its place. G is a small staple in the shuttle swinging upon a wire *h h*. The velocity of the thread passing under it prevents the staple from dropping below the bottom of the shuttle. If the thread breaks, the staple drops, and in its passage catches the hook H, which projects a little above the floor of the fly or board on which the shuttle runs. H is a hook, connected by a wire to the lever D. The hook swings upon a centre at *i*. When caught by the dropping of the staple G, it gives an oblique direction to the lever D, and consequently stops the machine. I is the principal axis, at one end of which is the worm *k*, working upon the wheel *l*, and giving motion to the axis *m m*; at each end of which axis is a worm, each worm giving motion respectively to the two wheels K and L. Note. The wheel *l* works upon a round part of the axis *m m*, which it puts in motion, by being connected with the movable square socket M. When the square socket is drawn off, which it may be, by the lever N, the axis *m m* stands still, consequently the cloth does not wind up. This will be necessary should the shuttle at any time pass without carrying any woof along with it. K is a wheel fast upon the axis of the cylinder O O, which, by binding in its revolution against the cylinders P P and Q Q, either one or both of them, takes up the cloth as it weaves. L is a wheel connected with the axis of the cylinder *r r*, which lets off the yarn in the same manner as the wheel K takes up the cloth. Note. The wheel L revolves upon a round part of the cylinder's axis, and is kept to its place by the endless screw *a*, and working upon the wheel β. which is fast upon the square part of the same axis. By means of the endless screw the yarn is made slacker or tighter, as occasion may require. M is a square socket, connecting the wheel *l* with the axis *m m*. Note. By varying the number of teeth upon the wheel *l*, as also by varying the number of teeth upon the wheels K and L, the cylinders take up and let off faster or slower, and consequently more or fewer threads may be put into any given space according to the discretion of the operator; hence the work is made invariably uniform. N N the wheels which force back the laths. O O the springs which throw it to. P P are the wheels which force up the rods S S. To each rod is joined a wire, the extremity of which lies against the back of the corresponding picker. When the rods are alternately set at liberty from the wheels P P, the springs U U strike and the shuttle is thrown. Note, the wheels P P have that part immediately following the place where the rods strike off formed spirally like a screw, for the purpose of drawing up the rods to their places again. Q Q are the pickers gliding in grooves, and having springs. V V gradually pressing as the picker recedes from the shuttle against the sides of the frame in which they slide, and thereby preventing the shuttle from rebounding. R R, are the wheels or tappits that work the treadles that draw down the yelds or harness, and open the shed; see Fig. 1. S are the temples closed by the springs *w w*; T are the temples opened by the treadles *x x*, which are pressed down by the cogs Y Y upon the wheels P P. Note, when the temples are open, the space from the points *z z* is less than when the temples are closed. Note, also, that when the cloth is set at liberty from the temples, it contracts. In proportion as it contracts, the temples must be made to open more or less so as to keep the points *z z* in contact with the selvedge of the cloth, that when the temples close the cloth may be stretched out again to its proper dimensions. U is a trough for containing the composition for dressing the warp. N is a cylindrical brush revolving within the trough U, and feeding the cylindrical brush W. W is a cylindrical brush conveying the dressing composition from the feeding brush to or against the lower yarn cylinder. Note, the cylindrical brushes receive their motion either from a wheel upon one of their axes which lies under the worm working upon the wheel L, or from a wheel upon the axis of the lower yarn beam working upon a wheel on the axis of the upper cylindrical brush, which wheel conveys the motion to a wheel on the axis of the lower cylindrical brush. X is a dry brush for working the dressing composition into the yarn, and laying the filaments of it smooth.

"Y is the yarn bobbin frame, which may be substituted for the yarn beam at the discretion of the operator, from which the cloth is woven without the trouble of winding, warping, or beaming. Z is a box or drawer for receiving the cloth."

The detail drawings accompanying the above specification are very crude, and would rather confuse than assist the description so clearly given, and for that reason they have been omitted here. Now the first part of the above described details of the patent refers to the contrivance to stop the loom when a warp thread breaks, and it will be granted that to accomplish the feat of doing so by automatic means, when any single thread of the two or three thousand that may constitute the warp, breaks, must necessarily call forth no ordinary amount of skill. But although the doctor may not have succeeded practically in carrying out his ideas it is gratifying to know that the principle upon which the contrivance is based is now successfully applied to the warping frame.

He also describes a method for stopping the loom when the weft thread breaks, also let-off and take-up motions for the warp and cloth beams. Temples for stretching the cloth laterally as it is woven, or rather to keep it from contracting, which thin warps and heavy weft are liable to, are mentioned, as well as other matters which have since taken years to bring to perfection. At that time it was customary to size or dress the warp in the loom, but the doctor not content with this, actually attempted to do away with warping by weaving the threads direct from the creels or bobbins, as may be seen on referring to the figure (259).

Other inventors kept more within compass, and did not attempt stopping the loom warping, &c., as above described. Still the operation of dressing the warp, to prevent the fraying of the single twist yarn in the process of weaving, which is unfortunately taken advantage of for another and very different purpose, namely, to weigh or thicken the cloth, making it appear of double the strength and quality that it really is. But it occurred to Mr. W. Radcliffe, the inventor of the dressing frame, that dressing should not be done in the loom itself, but by a separate process. He, therefore, set himself the task of dividing the operations on the principle that Arkwright had so successfully adopted in cotton spinning, and he became successful also. When carrying out the invention of the dressing frame he, at the same time, was attempting to overcome the difficulties that prevented the power loom from being of much practical value, for at that time the new spinning machinery was producing more yarn than could be woven, and large quantities were exported instead of being woven in this country. This, to Radcliffe, seemed little less than a crime, and he "pledged himself" not to rest until he had, by division of labour and suitable machinery, put a stop to it. This was in the year 1800.

In 1828 Radcliffe published a book in which he relates the circumstances that had induced him to strive in the manner he had done. The work was published at Stockport, and its title is the "Origin of the New System of Manufacture commonly called Power-Loom Weaving, and the purposes for which this system was invented and brought into use, fully explained in a narrative containing a candid statement of the strenuous, persevering, and uncompromising endeavours of William Radcliffe." A second edition was published in 1840.

It might reasonably be expected from such a title that the book contained useful and interesting information of a practical nature, describing every incident of importance in connexion with the "new system of manufacture," especially as no man had better opportunities or could know more of the subject than the writer. Instead of this being the case the "statement" is simply a strange mass of political opinions of a one-sided nature, and does not contain half a dozen pages bearing upon the real subject. In what little he does say he charges Mr. Horrocks with having, after he had been shown it, made claim to one of his, Mr. Radcliffe's, contrivances, namely, the taking up motion to wind up the cloth as woven. But Mr. Horrocks, although he shows a take-up motion in the drawings accompanying his specification, does not claim it, for he distinctly states in his specification that he claims only such portions of the loom, as his invention, that are marked on the drawing in figures and not letters,

Mr. Horrocks therefore claimed as follows: (see Figs. 261 and 262) "1 1, spiral wheels on shaft D; 2 2, levers, to which weights 8 8 are hung; 3 3, cranks (pulleys and chains will answer the same purpose); 4, 4, rods of iron or any other material passed through cylindrical apertures in levers 2 2, and secured with a nut. These rods having room to play through the levers prevent the one acting against the other; 5, a cross piece connecting the cranks 3 3, with 6, a crank, fixed on 7, a shaft; 8 8, weights, which being attached to levers 2 2, they are alternately raised by the revolution of the spiral wheels on shaft D, and depressed by falling from the longest to the shortest radii of the same. The rods 4 4, being connected with the levers 2 2, and joined to the cranks 3 3, which are connected with the crank 6 by means of the cross piece 5, the crank 6 works on the shaft 7 as a centre. To this shaft is fixed the lever P, to which is tied the cords Q; these cords are tied to the pickers R R. Now, supposing one of the levers 2 to be on the longest radii of one of the spiral wheels 1, by the revolution of the said wheel it would drop to the shortest radii of the same. This would move the cranks 3 3, and 6, and consequently the lever P, with a sufficient force to throw the shuttle from one box to the other, and the depression of the other lever 2 would throw it back again."

Mr. Radcliffe was descended from an old Cheshire family of Mellor Hall, and one of his ancestors having been slain in Stockport in a skirmish with the Roundheads, a large portion of his estates was seized by them. When Dr. Cartwright was allowed the grant of 10,000*l*., Mr. Radcliffe and the doctor's engineer were the only two witnesses examined on the subject of the originality and importance of the doctor's inventions in support of the rightfulness of the claim.

For many years but little improvement was made in the power loom, and its introduction was bitterly opposed by the hand-loom weavers. In 1813 a loom was patented by Mr. P. Ewart, of Manchester, to be driven by the "pressure of steam or air," in short, a pneumatic loom. This class of looms, which appears to have originated with Ewart, has by no means died out, for at the present time it has many supporters.

Mr. B. Taylor, of Glasgow, obtained a patent in 1818 for a barrel loom with double cylinders. The barrel loom is provided with pegs to work the pattern through the medium of needles as in the Jacquard machine, the pegs being used in lieu of the perforated cards. The object in applying two barrels or cylinders was to gain the advantage of a counterpoise harness, one shed rising whilst the last one was falling. Mr. Cross, of Paisley, also, about this time, invented a counterpoise harness for the draw loom on a similar principle to the above. But both of these looms were very shortly superseded by the introduction of the Jacquard machine.

In 1820 Mr. R. Bowman applied a double series of tappet wheels one above the other, so that the studs being made to rise and fall between the tappets or cams fixed on the periphery of the wheels gave motion to the headles, causing them to rise and fall, and counterpoise each other. This principle of counterpoising the headles is one of considerable importance, and many attempts have been made to effect it. Even at the present day there are few shedding motions without springs or weights to contend with instead of taking advantage of the counterpoise principle. In 1838 Mr. B. Woodcroft patented his tappet motion, which consists of providing a disc for each headle, having tappets or cams bolted on the sides of it, forming a groove in which studs work and are made to rise and fall according to the groove. If there are six headles of course six discs would be required. During four or six picks (according to the size of the discs) of weft, the discs make one revolution. Therefore, with six discs and six cams on each, any figure capable of being worked with six headles and six changes or picks may be accomplished. But these tappet motions are very limited in the extent of design and are cumbersome, however well designed they may be, and require no little trouble to alter the cams for each change of pattern. A wrong notion exists as to the extent or number of changes of pattern that tappet motions can make. One maker of them states that with 36 cams—that is to say six discs with six cams on each disc—the number of changes that can be made would be equal to 42 places of figures; a number so vast as to be inconceivable. The fact is the calculator has assumed that the number of patterns would be equal to the

number of permutations that may be made with 36 pieces, but such is not the case, for any two or more pegs in a musical box may be made to change places or permutate with each other, but they would not, thereby, alter the tune.

Tappet motions are being superseded by small and compact shedding motions to which the Jacquard principle is applied. Some of these are very ingenious and perfect in their action.

The Jacquard machine was first applied to the power loom about the year 1830, and it has undergone numerous modifications to adapt it to particular purposes, such as double-lift Jacquards for double cloth weaving, and double action for rapidity of working.

The weft stop motion for stopping the loom when the weft thread breaks, and many of the minor parts of the loom, have undergone endless modifications, but are now so comparatively perfect as to leave little to desire.

At the present time the attention of inventors of improvements in looms appears to be to supplant the old tappet motions by substituting small shedding apparatus to which the Jacquard principle is applied. Various kinds of change boxes have been introduced, governed also by Jacquard apparatus. Many attempts have been made to apply, with advantage, swivels to power looms, and velvet weaving by power is also receiving great attention. To change the shuttle without stopping the loom in the event of the weft becoming exhausted or broken is also talked of.

Notwithstanding all the improvements that have been made it appears to be the opinion of many competent men that the power loom is not by any means what it should be, and it is still to undergo considerable changes before full advantage can be reaped from it.

To trace the history of the vast improvements that have been made during the past fifty years would be far beyond our limits. Inventions after inventions have been made and introduced which for a time have been of considerable importance, but have been quickly superseded by others of greater value. The variety and number of patents relating to weaving testify to this, for they are more numerous than those relating to any other art. Instead, therefore, of following the subject during this period from step to step, and describing different inventions now obsolete, the most recent and approved machines will be shown and the advantages they may possess over such that have preceded them.