a similar tension cord passes, but it makes four turns, bearing analogous weights to the former pulley. One of these weights is seen at *s*, figs. 104, 106.

When the warp has been made fast, by securing its ends in the longitudinal groove of the beam and by forcing the wedge-rule down upon the threads, and when it has been led over the guide-roller, K, and the breast-beam, M, and is tied in several little parcels to the cloth-beam, N, held by its ratchet-wheel, it will be stretched to a degree determined by the difference of the above pulley-weights.

Let us recapitulate the train of its decussating operations beginning at the moment when the shed is closed, that is, when the two heddle-leaves are at the same level, as well as the tappets of the treadles, which are now pressed by the intersecting points of the tappet-wheels. The batten is likewise at the limit of its advance, in the direction of the cloth, namely, striking home the shoot of weft. Supposing the loom to make 120 pecks in the minute, it will make, of course, a single peck in half a second; hence the fly-shaft makes a turn in half a second, and the tappet or eccentric-shaft makes a turn in a whole second. In moving from the above position the tappet-wheels must make $\frac{1}{12}$ of a revolution in order to open the warp-shed completely, during which movement $\frac{1}{12}$ of a second will elapse: it remains open $\frac{4}{12}$ of a second, and takes again $\frac{1}{12}$ of a second to close, so that $\frac{6}{12}$, or one-half of a second, elapse between the moment when the warp begins to open, and the moment of its closing, while it remains completely open $\frac{4}{12}$ of a second.

The shuttle is thrown at the moment when the tappet-roller at R, strikes the bent lever P beneath it, but the warp must not be merely opened for the shuttle to be thrown; the batten must be then at its utmost limit towards the heddles, in order to give the shuttle "ample room and verge enough." This is the condition which determines the place of the tappet-rollers upon the eccentrics. As the batten arrives near the heddles after $\frac{3}{12}$ of a second, it is obvious that the said roller should strike its lever a little before $\frac{3}{12}$ of a second have elapsed, or a little before the middle of the great arc of the eccentric; thus the shuttle starts before the batten has receded to its utmost limit towards the heddles, and it should have run through a little more than one-half of its race when the batten reaches that limit, so that it may arrive in time at the other end.

When the shuttle completes its race, the batten has already passed the limit of its excursion towards the heddles, and is on its return to strike home the shoot of weft newly placed between the two portions of the opened warp. It has now its maximum velocity, because the cranks, B, F, are at nearly right angles to the links which move the swords, G, of the battens. This velocity diminishes in order that when the dents of the reed, borne along by the lay, come into contact with the weft to drive it home, they may act by gentle pressure rather than by a blow, so as not to injure the yarn. The warp being closed at the same instant, the pressure does not affect the loops of the heddles, but is exercised upon the warp and the cloth, wholly in a longitudinal direction.

Mr. Roberts obtained a patent, so long ago as November, 1822, for a power-loom having six heddles, adapted to weave twilled cloths or fustians, and such other fabrics as have the threads crossed in weaving, in that peculiar manner called twill. In this case, the tappet-wheel is formed of two equal parallel rims, a few inches apart, which carry between them nine small axles; on each of these axles are six small friction-rollers, making, in the whole, fifty-four friction-rollers. These rollers are intended to act upon twelve curved lever-treadles (such as P, P, in the immediately preceding description). This tappet-wheel, by its revolution, causes the said friction-rollers to strike alternately upon one or other of the treadle-levers, and to force them down, by which means the respective heddles are depressed and raised at certain parts of the operation, so as to draw the sheds of the warp up or down to permit the shuttle to pass, and to dispose the warp according to that particular arrangement which is calculated to produce a twilled fabric. In order to vary the twill the friction-rollers are capable of being shifted, and, by so disposing the collets between the rollers, certain of them may be placed so as not to act upon one or more of the treadle-levers. The other arrangements of this twill-loom resemble those of the plain-work loom above described.

The second improvement specified by Mr. Roberts under that patent, applies to that description of loom employed for the weaving of figured goods, and consists in certain machinery to be placed above the loom, for the purpose of effecting the raising and depressing of such parts of the warp as are usually operated upon by the draw-boy. There is very considerable difficulty and labour in setting-in any particular pattern, figure, or design by the old mode, but they are in a great measure avoided by the plan proposed under the present patent.

Mr. Robert Bowman, of Manchester, had, in January, 1821, obtained a patent for an ingenious power-loom calculated to perform several of the functions assigned to that of Mr. Roberts. The patentee observes, that the manner in which power-looms had been hitherto constructed did not admit of employing so many heddles as were requisite for weaving those kinds of fabrics called *fustians*,—such as velvets, velveteens, corduroys, &c., which are of the nature of twilled or tufted cloths. He describes his present improvements as consisting of such simple modes of harnessing the heddles of power-looms, and of applying the tappets or wipers to draw down the heddles, that he is enabled to manufacture the before-described cloths by power-looms, with the same facility and perfection that they could be produced by hand-weaving.

The heddles (six in number) in Mr. Bowman's loom are suspended by cords which proceed from the extremities of levers at the top of the machine, and are also attached to another set of levers, or treadles, at its bottom. The moving mechanism is exterior to the cheeks of the loom, at the left-hand side. The outer ends of these levers are connected by cords or rods which brace the heddles to any required tension, and, being equipoised, are free either to rise or fall without causing any unnecessary strain upon the warp. The movement for raising and lowering the heddles is obtained by means of two sets of tappet-wheels, or rosets, as many in each set as there are heddles, which tappet-wheels are fixed upon two axles,—one above, the other below, the main axle of the machine. The tappet-wheels or eccentrics are turned by means of a pinion upon the end of the main or crank-shaft, which takes into the toothed wheels upon their axles, and each of the tappet-wheels is designed to make one revolution for nine shoots of the shuttle.

In other respects this power-loom does not differ in principle from the one we have described in detail. It differs from Mr. Roberts's fustian-loom, in having several tappet-wheels instead of one compound wheel, mounted with fifty-four friction-rollers, and in having its lever machinery on the outside of the end frame of the loom. Both are calculated to make good work, and well merit their respective shares of public approbation.

Mr. William Horrocks, formerly of Stockport, afterwards of Portwood, in Cheshire, of whose improvements mention has been made, obtained a patent in December, 1821, for an invention which consisted in adapting an apparatus to it for the purpose of wetting the warp and weft at stated intervals during the process of weaving. He placed an oblong trough, containing water, or a solution of soap and water, across the loom under the warp, which he applied by a rod or bar covered with cloth, which was made, by two short arms, alternately to descend into the trough and rise up to the under side of the warp, thereby conveying a small quantity of the liquid both to the warp and weft, so as to moisten them, and thereby enable the weaver to compress in the fabric any quantity of weft that may be required.

I have not seen this scheme employed in any of the numerous power-loom shops which I visited. It is probable that the improved modes of dressing the warp and preparing the weft-cops, have rendered the ingenious appendage of Mr. Horrocks superfluous.

A patent was granted, in October, 1823, to Archibald Buchanan, Esq., of the Catrine Cotton Works, Ayrshire, for an improved power-loom, to produce a variable speed in the vibration of the lay or batten, so that the lay may be as nearly stationary as possible at the time the shuttle is passing through, while it may move with a rapid smart stroke when beating up the web. This invention was therefore confined to that part of the machinery which actuates the lay, and consists in the adaptation of two eccentric toothed wheels to it. This adjustment exists in Roberts' loom.

It is stated by the patentee that, in a loom so modified, he can project the shuttle across a web of a yard wide, at the rate of 130 times per minute, without producing more breaking of the threads than usually occurs in looms driven at the rate of 80 or 90 shoots per minute.

I have seen this loom doing good work at the above speed in Scotland; but whether from the increased complexity of its construction, or whether from the improved mode of adjusting the crank-lever mechanism above described, Mr. Buchanan's loom has never come into general use in the Lancashire district. His specification is written in a clear philosophical style, characteristic of his known scientific attainments.

Messrs. Stansfield, Briggs, Prichard, and Barraclough, of Leeds, or its vicinity, obtained a patent in July, 1823, for three improvements upon power-looms: the first two being peculiar modes of delivering the warp as it is needed, and the third a method of increasing and diminishing the tension of the warp, at intervals, for the purpose of assisting the operation of weaving.

According to one of the plans, the warp is delivered by means of a ratchet-wheel made fast to the end of its beam, which is drawn round by a pall or catch-arm, as described for turning the cloth-beam of Sharp and Roberts' loom, with an adjustment, by the pressure of a lever, for equating the speed of rotation to the diminishing diameter of the beam, as its warp is unwound.

The third improvement is a mode of varying the tension of the warp-threads, so as to relax them when the sheds are opening, and to draw them tight when the batten advances to beat up the weft. There are two small rollers extending across the back of the loom,—one immediately below the warp, the other above it: the former is pressed up against the threads by a small wire spring. By a cam, or heart-wheel and levers, the upper roller is made to press down upon the warp and tighten the yarns, and to rise up and leave them slack alternately.

This ingenious device seems well adapted to the very extensile filaments of wool, or delicate silk threads; but it has not, as far as I know, gained a footing in the cotton-factory loom-shops.

In June, 1824, Mr. William Harwood Horrocks, of Stockport, obtained a patent for a newly invented apparatus for giving tension to the warp in looms; consisting in a method of restraining the delivery of the warp by the friction of a hoop which embraces a wheel at the end of the beam. This hoop is formed of two semicircular bars of iron, which are made to embrace a pulley upon the end of the warp-beam, with greater or less force, by means of screw-bolts passing through the junction-ends of the two half-hoops.

Mr. Joseph Clissold Daniel, of Stoke, Wilts, patented, in July, 1824, a power-loom for weaving woollen cloth, which, on account of its ingenious modification, merits a brief notice here. The novel features are threefold :—1. The introduction of a spring behind the lay or batten to which the crank-rod is attached, that causes the lay to vibrate; 2. The employment of a weighted lever, which tumbles to and fro on the treadle-shaft, for the purpose of throwing the warp open to receive the shuttle; and, 3. The introduction of oblique brushes, or card-rollers, in the breast-beam, in order to stretch the cloth out towards the sides, and prevent its wrinkling in the work-beam as it rolls up.

Certain contrivances adapted to a power-loom, by which the warp-threads are given out from the beam, and the cloth taken up by the work-roll in a more advantageous manner than has heretofore been effected, were made the subject of a patent granted to Mr. Thomas Woolrich Stansfield, of Leeds, in July, 1824. The warp-threads are here made to pass *downwards* from their beam over two tension-rods at the back of the loom, and then up over the usual guide-roller which lies on a line with the shuttle-race and breast-beam. There is a lever attached to the undermost tension-rod, which starts each time that the lay strikes the weft, by the twitch thereby given to the warp, and which withdraws for a moment the detent at the reverse end from the ratchet-wheel attached to the warp-beam, by which means one tooth escapes, and allows an adequate supply of warp to be delivered. There are other ingenious devices in this machine, for which we must refer to the specification. The second subject of this patent is a mode of putting a series of looms to work by one rotatory shaft, and of stopping the action of any one of these looms without interfering with the other looms connected with the same shaft.

John Potter, Esq., of Smedley, near Manchester, obtained a patent in May, 1825, for the "invention of certain improvements in power-looms for weaving various kinds of figured fabrics." A series of heddles are mounted upon cords connected with a series of top and bottom levers attached to the loom; and as these levers rise and fall, the heddles, with certain of the warp-yarns connected with them, move up and down also, between every throw of the shuttle. The contrivance by which the levers are to be moved is very similar, in one part, to the mechanism of a barrel-organ, and in another to the principle of the Jacquard loom.

The third subject is a mode of preparing warps upon a plan analogous to that already explained in describing Lillie's sizing machine.

A patent was granted in the same year to Mr. Spilsbury, of Leek, for a power-loom for weaving figured goods, which had for its object a simple and economical method of reading in, and weaving an elaborate pattern. The improvements may be referred to two heads; 1, to the means proposed in place of a draw-boy, for raising the various parts of the warp, so as to produce any required pattern; and 2, to the mechanism for working the different evolutions of the loom. This improved mechanism was primarily intended for weaving silk, and has not, as far as I know, been hitherto introduced into the cotton trade.

Mr. John Harvey Sadler, of Hoxton, near London, obtained a patent in May, 1825, for an improved power-loom, in which motion was given to the working parts by means of a rotatory power, so applied that its mechanism should occupy no greater space than is required for the standing of an ordinary hand-loom. On measuring the dimensions of Sharp and Roberts' power-looms by the scale of the figures given in this work, it will be found to occupy much less space than most hand-looms.

The improvement in the power-loom for weaving tapes, for which Messrs. Worthington and Mulliner, of Manchester, obtained a patent in June, 1825, would merit a detailed notice, from its practical utility, did the small-ware manufacture fall within the scope of the present work. It is a very ingenious modification of the power-loom above described, and is now working in a most satisfactory manner, in Messrs. Worthington's excellent factory.

An improved method of making heddles, by Mr. John Rothwell, of Manchester, became the subject of a patent in January, 1826. He proposed to make the loops of the heddles double, that is, passing over the shafts at the top and bottom, and meeting both at the back and front; and also that they should be formed of long and short loops alternately. By these means the knots of the one series of loops will be a little distance above the knots of the other series of loops; and the warp-threads will be enabled to pass each other with greater freedom, and of course with less friction;

the space for the warp being open in the middle. Heddles are usually made of fine woollen or hempen cords, twisted very hard, and sold under the name of heald, or heddle-yarn. Heddles have also been made of wires.

A curious contrivance of Messrs. Stansfield, Pritchard, and Wilkinson, of Leeds, was secured by patent in July, 1825. It consists, first, in a small appendage to the shuttle, by which, in the event of the *weft* thread breaking, the shuttle is arrested in its race, and the actions of the loom stopped; secondly, in an apparatus attached to the back of the lay, for the purpose also of stopping the shuttle when any of the *warp* threads break. I am not aware that these refinements have been brought into play in any of the great power-loom factories about Manchester. They merit attention, and will no doubt be eventually adopted, with more or less modification.

The patent granted to Mr. George Scholefield, in March, 1828, for certain mechanical contrivances, which connect all the operating parts of a common loom together, and cause them to act simultaneously whenever motion is given to the loom, seems to be important; as the machine will enable any person, without previous experience or knowledge of the art, to weave cloths with facility. The plan has been hitherto, I believe, restricted to the weaving of woollen goods.

It is difficult, in perusing the specification of a patent, to determine the value of the invention, which depends often upon some apparently insignificant circumstance.

This remark may be justly prefixed to the following notice of the power-loom of Mr. John Paterson Reid, for weaving lappets, and figured muslins in general.

P 2

He obtained a patent for his improvement in April, 1827, and he has since proved its value by the superior quality and economy of his manufacture of the above styles of goods.

The batten, or lay, in his looms, does not vibrate upon centres, as usual, but slides to and fro in a horizontal direction, by means of guide-rods, which pass between guide-rollers. The batten is actuated by an arm connected with an eccentric wheel at the one end, and with a spring fixed to the under side of the batten at the other. This eccentric wheel turns upon an axle, and, as it revolves, its circumference acts against a friction-roller at the end of the batten, contrived for the purpose of guiding the batten steadily, as it advances and retires.

When the smaller radius of the tappet, or eccentric wheel, is in contact with the said roller, the batten is brought back, which is the time of the shuttle's being projected across, between the sheds of the warp; the wheel is therefore made with this part of its circumference nearly concentric, so that it may continue to turn round without advancing the batten, until the shuttle has got clearly through the warp, and been lodged in its box at the end of its race. The opposite radius of the eccentric wheel is large, in order to push forward the batten with the requisite force, for beating up the weft. But as some degree of elasticity is necessary in beating up the weft, to prevent the delicate threads from breaking, the rod is attached to a spring, which allows the batten to recede a little when driven up with force; thus imitating the tact of the weaver's arms. The spring may be made in any way that shall be found eligible, and it may be rendered susceptible of greater or less tension by methods indicated by the patentee.

Mr. Thomas Robinson Williams, under a patent obtained in February, 1830, proposes to substitute, for the warping-mill, a creel, containing a series of bobbins connected with the warp-beam end of the loom, whose threads are passed round two different friction-rollers before they proceed in the horizontal warp-plane, towards the heddles. Such a loom would be so cumbersome and inconvenient to work, as to be disadvantageous in practice.

An invention for stopping the loom when a weft-yarn breaks, was made the subject of a patent, by Mr. Archibald Douglas, of Manchester, in April, 1833. He included, also, in the same specification an apparatus to be connected with the batten, by means of which the action of springs attached to it is regulated, and adapted to the production of different figures, as a solid stripe or cord across the work; and likewise an improved apparatus for regulating the taking up motions of a loom, and the number of pricks in an inch. The apparatus seems to be ingenious, but is too complex to be understood without numerous figures of reference, for which we cannot afford space in the present work. Should it become an integral part of our cotton manufacture, a detailed account of it may be introduced on a future occasion.

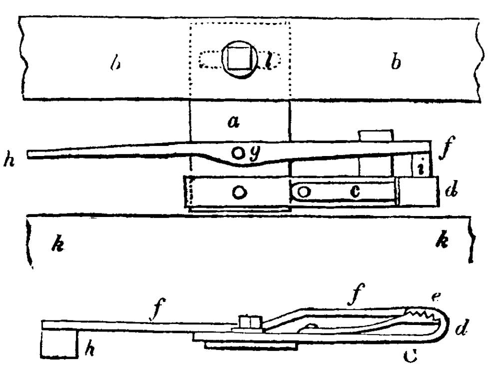
A more immediately applicable improvement upon power-looms, is that of the self-acting temple, or templet, for which William Graham, Esq., of Glasgow, obtained a patent in May, 1833.

We have already explained that the temple is an apparatus to be attached to looms for the purpose of keeping the cloth, as it is woven, distended to its full width, and thereby preventing the warp from being abraded against the dents of the reed, which would happen, were the cloth allowed to shrink into a narrower breadth than the sheet of warp.

In hand-looms the temples are formed by two stretcher-pieces of hard wood, connected together in a nearly parallel direction by cords, and laid across the web; the ends of these stretchers being studded with pin-points, which penetrate the list or selvage upon either side, and thereby keep the cloth extended.

In power-looms, for want of a self-acting temple, each loom must be constantly watched by an operative. To obviate this expense and inconvenience, several plans have been devised; such as revolving stars placed in such positions as should cause the points to take into the lists of the cloth. None of these schemes have been found to answer so well as the American *nipper-temples*, which form the subject of the present patent.

Fig. 108 is a horizontal view of one of the nipper-temples, and fig. 109 is a vertical section of the same.



Figs. 109 and 110.——American Nipper-Temples.

One of these nippers is to be fixed near each end of the breast-beam, where it is acted upon by the swinging of the lathe, or batten, which opens the chaps of the nippers at every operation of beating up, and thereby releases the cloth, and allows it to be slidden forward, over the breast-beam.

The plate, *a*, to which the nippers are attached, is to be fixed to the breast-beam of the loom, *b*, *b*, by means of a screw-bolt passed through the said beam, as shown in the figure. When different widths of fabric are required to be woven, the temples must be shifted nearer to, or further from, the *ends* of the breast-beam, which may be done by means of a long slot, *l*, shown by dotted lines in fig. 108.

Towards the outer end of the plate, *a*, a bar, *c*, is attached, which is turned up at the end, and bent back to form the upper chap, *d*, of the nippers. The lower chap, *e*, fig. 109, forms part of a spring-piece affixed to the bar, *c*, and is pressed up by its spring against the upper chap, *d*; the inner surfaces being channelled like a file, to enable them to hold fast. Between these two chaps the list of the cloth is passed, and being thus held by the nippers upon each side of the loom, the cloth is kept stretched to its proper width.

A horizontal lever, *f*, *f*, fig. 109, turns upon a fulcrum-pin, *g*, fixed in the plate, *a*; and at one end of this lever there is a broad piece, *h*, hanging down, and at the other end a knife-edged tooth, *i*, projecting.

The under part of the front of the batten is partially represented at *k*, *k*, which, when it goes forward to beat up the work, strikes against the end, *h*, of the lever, *f*, and causes the knife-edged tooth, *i*, at the reverse end to be forced in between the chaps, *d, e*; which merely opens the chaps, and releases the cloth at the moment that the weft is beaten up, thus allowing the reed to drive the work forward, over the work-beam as usual. But the instant that the batten retires, the tooth, *i*, slips back out of the chaps of the temple, and the cloth is held tight, as before.

In this way the nippers act at every stroke of the batten, opening, so as to release the cloth, and closing again to keep it at a tension, constituting self-acting, or perpetual temples.

In July, 1834, Messrs. John Ramsbottom and Richard Holl, of Todmorden, Lancashire, obtained a patent for certain improvements in the construction of power-looms; consisting, 1, in a peculiar arrangement by which two pieces of fabric may be woven at one time through the agency of a rotatory axle; 2, a contrivance for instantly stopping the working parts whenever the weft-thread breaks; and 3, an apparatus of self-acting temples.

In this improved loom, the warp-threads are placed vertically in two ranges; the one range extending from a roller below, towards a work-beam at top in front of the loom; the other range extending similarly at the back of the loom; and the double batten or lathe, in which the reeds are mounted, instead of making pendulous movements, as in common looms, rises and falls in vertical planes, while the heddles are moved to and fro in horizontal planes by means of a vibrating lever.

The contrivance for stopping the loom on the breaking of a weft-thread is very ingenious. It consists of levers, called by the patentees hands with fingers, attached to rods extending across the loom, and turning in bearings upon the side standards. At each end of the reed there is an aperture in the shuttle race, covered by a grating of parallel slender iron wires, set sufficiently apart to allow the vertical wire-fingers (like a many-pronged fork) of the mechanical hand, to fall through when no obstacle intervenes. When the weft-thread is entire, it is stretched across the surface of that parallel wire grating, and sustains the weight of the tiny fingers; but if it is broken, the fingers will fall through into the entrance of the shuttle-box. In the latter case, the rod across the loom is turned, and a lever attached to it presents a catch to a transverse bar projecting from the end of the lathe, whereby a trigger is let off, which shifts the driving band from the fast to the loose pulley upon the main shaft of the loom.

The above double loom is remarkably compact, occupying, apparently, much less space than a single power-loom of Messrs. Sharp and Roberts' construction. Whether it will be equally convenient and durable in working, must be determined by experience. Its arrangements are, in many respects, novel, and are highly creditable to the mechanical knowledge and skill of its inventors. The temples operate in a similar manner to the American, above described.

The latest of the improvements proposed upon the power-loom which we shall notice is that patented by Mr. Amassa Stone, of Rhode Island, in the United States, now resident in Liverpool, in October, 1834. It consists in a new adaptation of mechanism for the purpose of connecting the operation of beating up the weft-thread, with that of giving out or delivering the warp, and taking up the cloth; whereby, when from the breaking of the weft, the striking up of the reed meets with little or no resistance, the delivery of the warp, and also the taking up of the cloth is suspended, although the general evolutions of the loom continue.

After every flight of the shuttle through the open shed of the warp, the lathe advances toward the work-beam for the purpose of causing the reed to beat up the weft-thread; but as the reed is here mounted in the lathe within a vibrating frame pressed forward by springs, the force with which it strikes against the cloth causes a rail parallel to the reed on which its lower edge rests, to recede or spring back from the lathe a short distance.

There is a perpendicular lever bearing at its top against the said lower rail. Whenever the reed-frame recedes, that end of the lever is necessarily forced back, and its lower end advanced, so as to push forward a horizontal rod attached to it. This movement of the horizontal rod near the floor causes the end of a bent arm to be brought close against the vibrating leg or sword of the lathe, and to draw back a click or pall over one tooth in a ratchet-wheel. On the return of the lathe into its original inclined position, the sword will strike against the end of the above bent arm, and cause the click (by a sliding rod) to drive the ratchet-wheel one tooth, and thereby turn a shaft with an endless screw, so as to turn round the warp-beam and deliver warp.

But if the weft-thread happen to break, there will be no delivery from the shuttle, and consequently a want of filling to the cloth; the reed, therefore, in beating-up will not meet with that resistance which it did when the fitting of the weft-thread was complete. Hence in the beating-up of the lathe, the reed-frame will not now recoil as before, nor will the upright lever attached to it be so acted upon as to cause it to shift the horizontal rod at its under end through the same distance; consequently, the pall or click will not be drawn over another tooth of the ratchet-wheel; and the shaft with the worm-screw will remain quiescent, leaving also the warp-beam at rest. An analogous effect is communicated to the cloth-beam.

This ingenious device seems well calculated to answer its end, and will probably be introduced ere long into power-loom factories.

A simple dandy-loom of Radcliffe's construction moved by power, making 84 pecks per inch, weaves 5 pieces of 30 yards each in five days.

Some of the coarse calico fabrics are very light. One great manufactory puts no more than 9 pounds in 36 yards; which is four ounces per yard.

A 72 reed at Stockport signifies seventy-two threads, or 36 dents, in the inch. When the piece is $\frac{7}{8}$ths broad in the dressing machine, there are 4 cylinders or yarn-beams at each of the ends. Each cylinder has 270 threads wound upon it at the warping-frame; hence $8 \times 270 = 2{,}160$, is the whole number of warp-threads in the breadth of the piece.

The 40's warps are woven commonly through a reed containing from 72 to 80 threads per inch, constituting in the language of Stockport, a 72 to 80 reed.

Mr. Orrell's looms made 92 picks per inch in a 72 Stockport reed, and 120 pecks per minute. I have seen a power-loom weaving very regularly under a good workman when making 180 pecks per minute. This was, however, merely for a short time to satisfy me that such velocity was practicable with Messrs.

Sharp and Roberts' loom. A manufacturer at Stockport informs me that he has brought up the speed of his power-looms, of that construction, to 130 pecks per minute upon an average. At this rate, a girl makes easily six pieces a week on each loom.

Book and jaconet muslins are now currently woven by power-looms, especially in the Glasgow district.

In Scotland, the number of dents or reed-splits in 37 inches, or the Scotch ell, constitutes the number of the reed; hence the above 80 Stockport reed, which contains 40 dents, corresponds to reed 1,480 in Scotland, as $37 \times 40 = 1,480$.

All cotton-cloth contracts about one-tenth of its breadth in weaving, in consequence of the contraction of the warp in the decussation of the weft-threads.

One reed-maker, with a boy, is capable of keeping 1,000 power-looms going in their business. The reeds contain from 900 to 1,500 dents each in their whole length, or from 48 to 80 per inch.

A cut of 60 yards will weigh in 27 inch-wide calico 13 lbs., consisting of Surats and Upland cotton wools.

Of Fustians.

The sets of reeds in which fustians, velveteens, and cords, are usually woven, are those of 32, 34, or 36 beers in 24½ inches; each beer containing 19 dents; so that $19 \times 34 = 646 =$ the number of dents, and the double of that number, or $1,292 =$ the number of warp-threads in the 24½ inches. Each warp-thread consists of good mule yarn, No. 32, doubled and twisted. The weft may be No. 24 mule yarn, and is single.

The ground or back of this style of goods is sometimes plain, or *tabby backed;* and sometimes tweeled, or with a Genoa back. The flushing, or the part of the weft which is cut to form the lines of the velvet, or grooves of the cords, is thrown in and decussated with the ground at various intervals, whence the variety of the patterns is produced. We shall presently explain the art of cutting fustians, and of raising the pile. or forming the cut flushing into ridges above the parts of the weft which are embodied with the warp.

A much finer article of cotton velvet is prepared for ladies' mantles, of which the warp is 52's doubled, and weft 52's. The reed is one of 50 beers of 19 dents = 950 in 24½ inches.

In the plain-backed velvets there are two shots of the flushing thrown in for each shot of the ground. The term flushing signifies the several weft-threads which pass together over certain parts of the surface of the fabric without being decussated with the warp. Some flushed patterns are produced by extra warp or weft, either coarser than the ground, or of a different colour; others, and those the most common, proceed from certain portions of the weft which are floated above or below the warp.

A very luminous and instructive development of the principles of flushing every style of fancy texture is given by Mr. Murphy in his excellent 'Treatise on the Art of Weaving.'

The first process to which fustians are exposed after being woven is steeping in hot water to take out the dressing paste. They are then dried, reeled, and brushed by the machine described p. 328, fig. 111, &c. From twenty to thirty pieces, each eighty yards long, may be brushed in an hour. The breadth of the cloth is twenty inches. The maceration is performed by immersing the bundled pieces in tanks of water heated by waste steam; and the washing by means of a reel kept revolving rapidly under the action of a stream of cold water for an hour or longer.

The cord has been previously cut by the knife, as described next page. After they are brushed in the machine, the goods are singed by passing their cut surface over a cylinder of iron laid in a horizontal direction, and kept red-hot by a flue. They are now brushed again by the machine, and once more passed over the singeing surface. The brushing and singeing are repeated a third, or even occasionally a fourth time, till the cord acquire a smooth polished appearance.

The goods are next steeped, washed, and bleached by immersion in solution of chloride of lime. They are then dyed by appropriate chemical means. After which they are padded (imbued by the padding machine of the calico printers) with a solution of glue, and passed over steam cylinders to stiffen them.

The knife used by hand for cutting fustians has the keel of its guard convex for cords, as it presses upon a tweeled fabric; but it is plane for velveteens where it runs over a single range of weft. Cords receive their last finish by being rubbed with an emery polisher, which is merely a bar of wood faced with coarse emery fixed by glue. Velveteens are finished by friction with bees' wax, and polishing with a wedge-shaped piece of hard wood.

Fustians have usually double yarns in the warp.

Apparatus for cutting the Pile or Cords of Fustians, Velveteens, Corduroys, etc.

Fig. 111 is a longitudinal section, and fig. 112 a cross section of the usual apparatus, as worked by hand.

Figs. 113 and 114 serve to explain the process which precedes the brushing.

After the cloth is taken from the loom-beam, it is carried to the cutter, who rips up the surface-threads of weft, and produces thereby a hairy-looking stuff.

Fig. 114 represents a section of fustian parallel to the weft. *b* the superficial weft-threads before they are cut; and *a* the same afterwards. Preparatory to its being cut, the cloth is spread evenly upon a table about six feet long, upon each end of which a roller mounted with a ratchet-wheel is fixed; the one to give off, and the other to wind up the piece, in the above six feet lengths.

The knife, fig. 113, is a steel rod about two feet long, and three-eighths of an inch square, having a square handle, *d*, at the one end; the other end, *c*, is tapered away to a blade, as thin as paper. To prevent this point from turning downwards and injuring the cloth, its under side is covered by the guide, *a*, which serves to stiffen it, as well as to prevent its lower edge from cutting the fustian.

The operative (male or female) grasps the handle, *d*, in the right hand, and insinuating the projecting point of the guide under the weft, pushes the knife smartly forward through the whole length of six feet, with a certain dexterous movement of the shoulder and right side, balancing the body, meanwhile, like

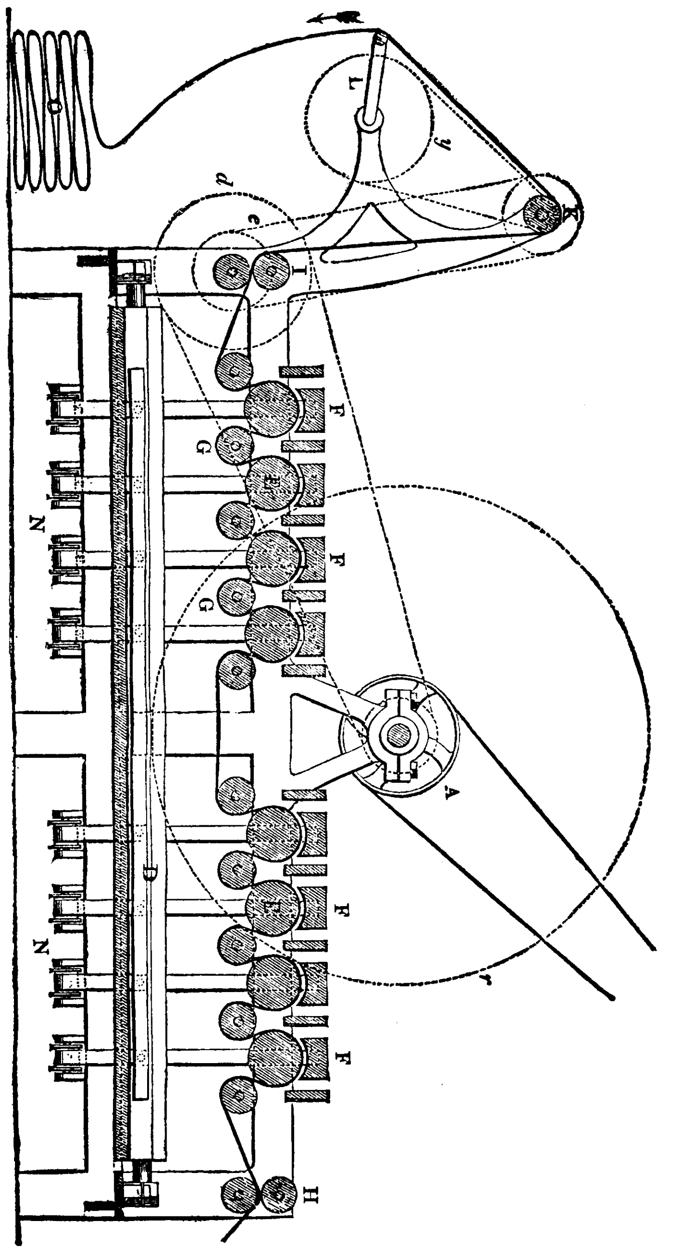


Fig. 111.—Machine for raising the Pile of Fustians. Longitudinal Section. Scale, about half an inch to the foot.

a fencer, upon the left foot. This process is repeated upon every adhesive line of the weft. After being thus ripped up, it is taken to the brushing or teazling-machine, to make it shaggy.

A, fig. 111, is the usual driving-rigger, or fixed and loose pulley, upon the end of the shaft, B. This shaft has a crank bent near its other end, which works the frame, D, up and down by means of the connecting link, C, fig. 112. E, E, are a series of wooden rollers, turning freely upon iron axles, and covered with tin-plate, rough with the burs of punched holes. F, F, F, are blocks of wood, whose concave under surfaces are covered with card-cloth or card-brushes, and which are made to traverse backwards and forwards in the direction of the axes of the revolving rollers, E, E, E, during the passage of the cloth over them.

G, G, G, are guide-rollers for the cloth. This is introduced between the feed-rollers at H, carried under the tension-rollers, G, G, and over the rough rollers, E, being drawn through the series by the discharging rollers at I. The two upper rollers at H and I are loaded with weights hung upon their axles; and the first have, besides, a brake to keep the cloth tightly distended in the machine, so that it may pass very slowly out from the discharge-rollers at I. These rollers are actuated by an endless strap from the pulley, *b*, upon the principal shaft, B, going round the pulley, *d*, upon the under roller at I, as shown by dotted lines in fig. 111. The blocks, F, F, F, get their motion from the straps, *m, m,* which pass over the rollers, M, fig. 112, and are made fast at *t, t,* to the frame, D. This frame vibrates up and down with the crank, C, of the shaft, B.

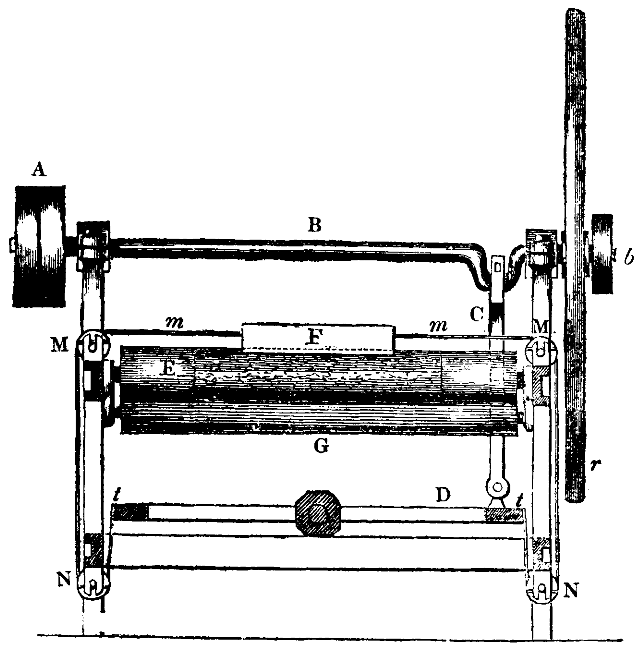


Fig. 112.—Machine for raising the Pile of Fustians. Cross Section
Scale, about half an inch to the foot.

r is a fly-wheel for equalizing the irregular movements of this powerful abrading machine.

The apparatus which lays down the piece of fustian in regular folds, remains to be described. The cloth passes over the roller, K, fig. 111, which is moved by a strap from the pulley, *e*, and afterwards goes over the eccentric rectangular frame, L, which slowly falls and rises by means of the pulley, *y*, and thus delivers the cloth as it comes forwards, in regular folds, upon the floor, as shown at *o*.

The driving-pulley, A, on the main or crank-shaft, B, makes about 150 revolutions in the minute.

The fustian, by passing through this machine, has its cut-up surface made uniformly shaggy.

Smooth fustians, when cropped or shorn before dyeing, are called moleskins; but when shorn after being dyed, are called beaverteen: they are both tweeled fabrics. Cantoon is a fustian with a fine cord visible upon the one side, and a satiny surface of yarns running at right angles to the cords upon the other side. The satiny side is sometimes smoothed by singeing. The stuff is strong, and has a very fine aspect. Its price is one shilling and sixpence a-yard.

Common plain fustian, of a brown or drab colour, with satin top, is sold as low as 7*d.* a yard.

A fustian, with a small cord running in an oblique direction, has a very agreeable appearance. It is called diagonal. Moleskin shorn, of a very strong texture, and a drab dyed tint, is sold at 20*d.* per yard.

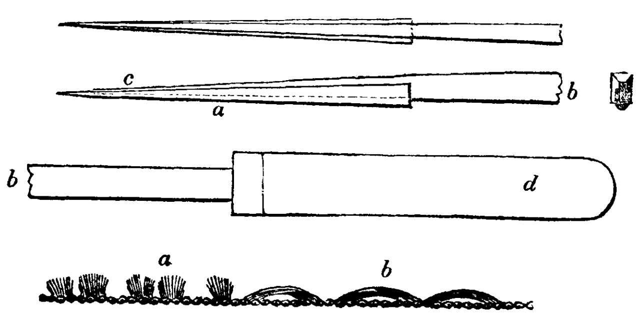


Fig. 113.——Knife for cutting the cords:—the broken ends *b*, *b*, should be joined.
Fig. 114.——Representation of the cords.

For the following catalogue of fustians I am indebted to Messrs. Leese, Kershaw, Callender, and Co., the eminent warehousemen, of Manchester:—

I.—Velveteens 27 inches wide.

1. As they leave the loom, with a downy surface on the one side and tweeled on the other.

2. Cut in fine parallel lines, velvety-looking on the cut side.
3. Singed, scoured, and dressed for dyeing.
4. Dyed and finished as black velveteens; a beautiful fabric. Price from 1*s*. 4*d*. to 2*s*. 9*d*. per yard.
5. Fired, scoured, and dyed, but not cut, as drab cantoon. Price 10*d*. to 21*d*.
6. Shorn, dyed, and finished, as drab beaverteen. 9½*d*. to 2*s*.
7. Shorn, dyed, and re-shorn, as moleskin. Price 10½*d*. to 2*s* 9*d*.

II.—Eight-shaft cord, vulgarly called corduroy.

1. As it leaves the loom, cord grooves partially filled with transverse yarns, back surface twilled and smooth.
2. Stiffened with glue for cutting.
3. Cut grooves, well defined and sharp. Surface of the cords velvety.
4. Brushed, singed, scoured, and dressed for dyeing.
5. Dyed and finished.

Eight-shaft can be made at prices from 6*d*. a-yard to 20*d*. The stuff is 18 inches wide when finished. If they be 27 inches wide, their price is from 13*d*. to 2*s*. 6*d*.

III.—Double Genoa cord, exists in

1, 2, 3, 4, 5, states, as the eight-shafts.

Their aspect is not dissimilar, but their texture is stronger. Their price varies from 7½*d*. to 21*d*., when 18 inches wide; and from 13*d*. to 2*s*. 6*d*., when 27 inches.

The weight of 90 yards of the narrow velveteen, in the green or undressed state, is about 24 pounds. The goods made for the German, Italian, and Russian markets are lighter, on account of a peculiarity in the mode of levying the import duty in these countries.

Velveteens as they come from the loom, are sold wholesale by weight, and average a price of 20*d.* per pound. They are usually woven with yarns of Upland and Brazil cotton wool, spun together for the warp; or, sometimes, New Orleans alone. The weft is usually Uplands, sometimes mixed with East India cotton wools.

Trowser velveteens are woven 19 inches wide, if they are to be cut up; if not, they are woven 30 inches, and called beaverteen.

Cutting or cropping fustians by hand, is a very laborious and delicate operation. The invention of an improved apparatus for effecting the same end with automatic precision and despatch, was therefore an object of no little interest to this peculiar manufacture of Manchester. An ingenious machine, apparently well-calculated for this purpose, was made the subject of a patent by Messrs. William Wells and George Scholefield, of Salford, in November, 1834.

In the ordinary mode of working by hand, a single cord only is cut open at one operation, by the skilful workman guiding the knife along the piece, and keeping its point carefully in; but in this machine a series of knives are enabled to act simultaneously, and to cut many cords in width at the same time, from end to end of the piece, without interruption; the corded fustian being extended upon rollers, and drawn progressively forward over the properly inclined stationary knives. There is, also, a provision in the event of any one of the knives slipping out of the cord in which it is intended to operate, or of passing through the fabric, or of being (by any knots in the cords) obstructed in its work, that the operations of the machine may be instantly stopped, in order that the error may be corrected before any further mischief ensues.

In an oblong rectangular cast-iron frame, two cylinders or drums are mounted horizontally, turning on axles supported in plummer blocks upon the side rails near the end of the frames.

Round the circumference of the one drum, the whole length of the piece of corded fustian is to be wound, in the first instance, and its end being then passed through the machine, and its waste-end or forcel made fast to the other drum, the rotation of this upon its axis will cause the length of the piece to be drawn forwards under the cutting knives, in winding it upon its circumference. The rotatory movements of these drums are produced by toothed wheelwork, mounted in the side rails of the frame.

Fig. 115, is a sectional representation of a part of the machine detached for the purpose of explaining

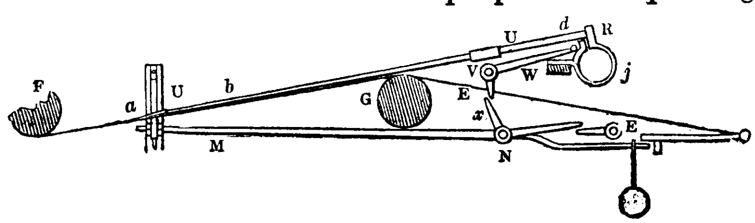


Fig. 115.—Machine for cutting Fustian by Power.

the cutting operation more clearly. Here only one of the knives is shown; the fustian-web, E, E, being stretched in the machine under the roller, F, and over the roller, G, for the purpose of laying it, and conducting it along under the knife, at such an angle, as may be desirable for applying the knives, as formerly represented, with the best effect to cut open the cords as the fustian advances.

A series of the knives, in any convenient number, are placed side by side in the machine, extending longitudinally as one knife is shown in the figure. The point of each knife so placed, is to be inserted into the rib or cord which it is intended to cut open, and the hinder part of each knife-handle is let into the socket or rest of a circular spring, *j*. A number of these circular springs, equal to the number of the knives, are to be fixed on a bar (shown in section at R) extending across the machine. Things being so arranged, the shaft of the drawing or winding-on drum (placed to the right hand of the figure) is to be put into geer with the driving power, and the other or feeding drum (towards the left hand in the frame) released, so as to turn freely round. As the web advances up the inclined plane, it will be cut open by the knives. The drum (about 20 inches in diameter) makes about nine turns in the minute.

A certain number of parallel cords having been thus cut from end to end of the piece, the right hand drum now covered with the fustian, is to be thrown out of geer, and the naked drum is made to revolve the reverse way, so as to re-wind the cloth from its fellow. This being done, the above operation is renewed on another parallel series of ribs in the fustian, till the whole be cut open.

If the point of one of the knives happens to penetrate through the cloth, it necessarily falls upon a transverse bar (not seen in this view) below the point, *a*. That bar is connected with the ends of arms or levers, M, M, extending from a shaft, N, which is mounted upon standards in the side frames of the machine; the transverse bar and arms, M, being balanced by weights upon the opposite side of the shaft, N, so as to enable that bar to be supported by very delicate spring catches in standard pieces, fixed to the sides of the frame-work.

When one of the knives falls upon the said transverse bar, its weight forces the bar down from its support in the spring catches, when the teeth of a small ratchet-wheel, which has been kept revolving, strikes against the fallen bar with such force as to cause a tail lever to cause the driving strap to shift to the loose pulley on the driving shaft; somewhat in the same way as the power-loom is stopped when the shuttle does not come home into its box.

If any obstruction (like a knot in the cord of the fustian) should come against the point of one of the knives in operation, as the fustian is drawn forwards, the resistance will force the knife back, and its spring-holder, *j*, giving way, will cause the hinder part of the socket, *d*, to strike against a transverse bar, R; and this bar being connected by arms with an axle, its recession will act upon certain levers, (not visible in this view,) which will shift the driving-strap to the loose pulley, as before.

In the event of any one of the knives jumping up out of the cord-channel which it was cutting, the force of the spring-holder, *j*, would project the knife forwards, and cause it to fall out of its socket, *d*, when the weight of the knife-handle as it falls, striking upon a transverse rod supported by arms, U, U, from a strap, V, will cause the arm, W, to force back the lever, *x*, extending from the axle, N, and thereby to raise the tail-piece, which shifts the driving-strap.

CHAPTER VI.

The Bobbin-Net Lace Manufacture.

SECTION I.

Historical Notices of it in connexion with Frame-Work Knitting, or the Stocking-Frame.

THE stocking-frame, to any one who attentively considers its complex operations, and the elegant sleight with which it forms its successive rows of loops or stitches, will appear to be the most extraordinary single feat,—the most remarkable stride, ever made in mechanical invention. In the Stocking Weavers' Hall, in Red Cross Street, London, there is a portrait of a man, painted in the act of pointing to an iron stocking-frame, and addressing a woman, who is knitting with needles by hand. The picture bears the following quaint inscription:—"In the year 1589, the ingenious William Lee, A.M., of St. John's College, Cambridge, devised this profitable art for stockings, (but being despised, went to France,) yet of iron to himself, but to us and to others, of gold; in memory of whom this is here painted."

It was only twenty-eight years prior to the construction of this machine, that the art of knitting stockings, by wires worked by the fingers, had been introduced into England from Spain.

According to one story, Lee was expelled from the University for marrying contrary to the statutes. Having no other means of subsistence, he and his wife were obliged to live on her earnings as a stocking-knitter; when, under the pressure of want, Lee contrived his frame as a method of multiplying production.

But the following is probably a more correct account of the origin of this contrivance. According to an ancient tradition in the neighbourhood of Lee's birth-place,* the stocking-frame was meditated under the inspiration of love, and constructed in consequence of its disappointment. Lee is said to have been in early youth enamoured of a fair mistress of the knitting craft, who had become rich by employing a number of young women at this highly-prized and lucrative industry. The young scholar, after studying fondly the dexterous movements of the lady's hand, had become himself not only an adept in the art, but had imagined a scheme of making artificial fingers for knitting many loops at once. Whether this feminine accomplishment excited jealousy, or detracted from his manly attractions, is not said; but his suit was received with coldness, and then rejected with scorn.

Revenge now prompted him to realize the ideas which love had first inspired. He devoted his days and nights to the construction of the stocking-frame, and brought it, ere long, to such perfection, that it has remained nearly as he left it, without receiving any essential improvement. Having taught its use to his brother and the rest of his relations, he established his frame at Culverton, near Nottingham, as a formidable competitor of female handiwork, teaching his mistress, by the insignificance to which he reduced the

* Woodborough, seven miles from Nottingham.

implements of her pride, that the love of a man of genius was not to be slighted with impunity.

After practising this business during five years, he had become aware of its importance in a national point of view, and brought his invention to London to seek protection and encouragement from the Court, by whom his fabrics were much admired. The period of his visit was not propitious. Elizabeth, the patroness of whatever ministered to her vanity as a woman, and her state as a princess, was in the last stage of her decline. Her successor was too deeply engrossed with political intrigues for securing the stability of his throne, to be able to afford any leisure for cherishing an infant manufacture. Nay, though Lee and his brother made a pair of stockings in the presence of the King, it is said that he viewed their frame rather as a dangerous innovation, likely to deprive the poor of labour and bread, than as a means of multiplying the resources of national industry, and of giving profitable employment to many thousand people.

The encouragement to English ingenuity which the narrow-minded pedant, James, refused, was offered by Henry IV. and his sagacious minister, Sully. They invited Lee to come to France with his admirable machines. Thither, accordingly, he repaired, and settled at Rouen, giving an early impulsion to manufactures which has conduced not a little to their great development since, in the department of the Lower Seine. After Henry had fallen a victim to domestic treachery, Lee, envied by the natives whose genius he had eclipsed, was proscribed as a Protestant, and obliged to seek concealment from the bloody bigots in Paris, where he ended his days in secret grief and disappointment. Some of his workmen made their escape into England, where, under his ingenious apprentice, Aston, they mounted the stocking-frame, with some improvements, and thus restored to its native country an invention which had been well nigh lost to it.

The first frame was brought into Leicestershire in the year 1640, and thus laid the foundation of the hosiery trade of that county, since so prodigiously enlarged in it and the adjoining counties of Nottingham and Derby.

In the year 1663, Charles II. granted to the Frame-work Knitters' Society of London, a charter, which had been refused to them a few years before by Oliver Cromwell.

Jedediah Strutt, the founder of the distinguished house of Belper, invented, in the year 1758, a machine for making ribbed stockings. About that time he settled in Derby, and established that manufacture under protection of a patent, in conjunction with his brother-in-law, Mr. Woollatt, a hosier of that place. During a portion of the patent period, Mr. Samuel Need, of Nottingham, was a partner in the concern. The patent right was twice tried in Westminster Hall; first by the hosiers of Derby, and next by those of Nottingham; after which it was quietly enjoyed by the patentee till the end of the term of fourteen years. This improvement suggested several more, such as open-work mittens, and fancy articles in the stocking stitch.

Lee's frame was exceedingly simple, being a *twelve gage*, with jacks only. Aston, of Thornton, a miller by trade, added the lead-sinkers, which are still in use.

The trucks were placed on the sole-bar by Needham, a frame-work knitter in London; and the caster-back and hanging bits were added by Hardy, another London artisan, about the year 1714. Thus the stocking-frame seems to have reached a nearly perfect state, for it has acquired no new powers or facilities of operation from any subsequent contrivance. The Derby rib-machine, applied to the stocking-frame, is called, by the trade, the one-and-one and the two-and-one rib-machine.

There is a manufactory of hosiery at Belper which is supposed to be the most extensive in the world. It employs about 400 silk stocking-frames, which produce 200 dozen pairs of hose weekly, and 2,500 cotton hose frames, each turning off, on an average, nine pairs weekly, the whole amounting to little less than *one hundred thousand dozens* in the year.

The principle of the stocking-frame was applied to the knitting of various other articles in the course of the last century. In 1766, Crane manufactured a rich brocade for waistcoats on a similar frame; and about two years thereafter he attempted vandyke work, by appending a warp-machine to a plain stocking-frame. Mr. Robert Frost, of Arnold, near Nottingham, invented the figured eyelet-hole machine; and, in concert with Mr. Thomas Frost, now of Worcester, he obtained patents for various inventions, which led the way to the net and lace-frames.

The first machine for making lace with a stocking-frame was constructed in 1777, which has been claimed both by Mr. Robert Frost and by Holmes, a poor workman of Nottingham. This was, ere long, superseded by the point-net machine, the ingenious invention of Mr. John Lindley, senior. On the death of this individual, Mr. Taylor, of Chapelbar, secured a patent for an improvement on the same principle. A still further improvement on this machine was made by Mr. Hiram Flint. At the beginning of the present century, nearly the whole of machine-made lace was produced from these point-net machines—mechanisms probably more delicate than any other ever used for manufacturing purposes, either in this country or elsewhere. There were no fewer than 1,000 such machines then in active work.

In the year 1802 or 1803, the manufacture of lace-net from the warp-machine was successfully revived by some individuals in Nottingham. This kind of lace had been formerly made by an ingenious workman called Dawson, the inventor of the brace machine, but had been discontinued for some reason not generally known. Several important improvements began now to be made on it, which gave to this modification of network such value, that, in 1808, it competed in the market with point-net.

Notwithstanding this advance of the Nottingham lace-trade, the fabric was always considered to derive its principal merit from its imitation of the bobbin or cushion-lace. The resemblance was, however, very imperfect, as the net made of cotton thread was greatly inferior in strength, durability, and transparency to the proper lace fabric. To remedy these imperfections became, therefore, an object of pursuit to many ingenious artisans, and liberal encouragement was afforded towards its attainment by the lace manufacturers of Nottingham, and particularly by Mr. Nunn. Any person who undertook to construct, on feasible principles, a machine capable of making bobbin-net lace, was zealously patronized. Most sober-thinking persons, however, regarded the project as akin to the perpetual motion,—a thing not to be realized.

Among the many individuals who devoted their minds to the subject was John Heathcote, of Loughborough, a stocking-weaver by trade, who had studied for some time the mode of mounting the net-machinery of Nottingham. To him belongs the distinguished honour of solving this very difficult problem, and of practically demonstrating that a machine might be made to satisfy the wants and wishes of the trade. His first operative frame was the result of many troublesome trials, which would have baffled a man of ordinary talent and enterprise. At length, in the year 1809, he had matured his plans so far as to warrant his securing the exclusive use of them by a patent, famous for its pecuniary productiveness to him and his partner, Mr. Lacey; as also for its being the fruitful parent of many mechanical constructions eminently subservient to the trade and commerce of the kingdom.

Without meaning to impugn the merit of Mr. Heathcote, it may be stated that the principle of his patent had been embodied, since the year 1803, in a machine for making fishing-nets, the invention of Robert Brown, or his partner, George Whitmore, both of Nottingham. "This machine possesses all the essential principles and properties of Heathcote's patent bobbin-net machine, and is, in fact, to all intents and purposes, a bobbin-net machine*." To this machine must be traced

* Mr. Morley, the very eminent bobbin-net lace-manufacturer, of the great firm of Boden and Morley, of Derby, pronounces this judgment.

the origin of the curious invention of the bobbin and carriage: to it also must be referred the method of using two divisions of threads, the warp and the bobbin; and to it alone must be attributed the beautiful idea of passing, or, as it is generally termed, twisting, two divisions of threads, with order and regularity, and without entanglement, distinctly round each other. The specification of Robert Brown's patent for this machine was enrolled at the Patent Office, and may, therefore, be referred to as an undoubted document.

The idea of reducing the thickness of the bobbin and carriage to a scale fit for the fine meshes of bobbin-lace, seems to have originated with Edward Whittaker, of Radford, who, being acquainted with Robert Brown, had obtained a knowledge of his fishing-net machine. Whittaker was assisted in realizing his project by Messrs. Hood and Taylor, then lace manufacturers in Nottingham, who sent him over to Loughborough, partly with the view of removing him from the Nottingham mechanics, but principally to place him in communication with Mr. Hood's brother, a frame-smith at that place, who was to execute the iron work of the machine. After some time, Messrs. Hood and Taylor grew weary of the undertaking, when Charles Hood, of Loughborough, retained possession of the apparatus, on the score of debt due to him, and thereafter sold it to Mr. Heathcote for the paltry sum of 8*l.* or 10*l.* This gentleman, having thus obtained an acquaintance with several elementary principles of lace-making, applied himself diligently to their practical combination, and, in the following year, patented his very ingenious bobbin-net machine. Like most other novel mechanisms, this one, however creditable to the talent of the patentee, was complicated with many distinct movements, and effected its end by very circuitous means. The manufacture of lace by it was slow and expensive, in consequence of its imperfect mode of making the selvages, and by the employment of stretchers, or long strips of wood, pointed at each end with pins, for the purpose of preventing the net from running in at the edges. The workman was thereby obliged to stop work at every four or five holes, in order to adjust his bobbin, and replace the stretchers. In spite of these defects, the machine commenced a new era in the manufacture of lace, and shewed itself to great advantage alongside of the method of making it by hand upon the cushion. The prospects thus opened up, induced many workmen to devote their skill to lace-machinery. Accordingly, in 1810, John Brown, of Nottingham, invented his celebrated traverse-warp machine, — one admirably adapted for making a number of narrow breadths, or strips of lace, but not fitted for the manufacture of broad fabrics. It was, moreover, a delicate and expensive apparatus, difficult to manage and adjust.

In the year 1811, Mr. William Morley, also of Nottingham, invented his straight bolt machine, more simple in construction, more concentrated and easy in the movements than its predecessors; circumstances which, with the improved method of changing the bobbins upon the selvage, and the introduction of the spur or selvage-wheels for the lace to run over, gave Morley's machine a great superiority over Heathcote's. The horizontal movement of this mechanism, however, occasions an alternate tightening and slackening of the bobbin-threads, and a corresponding imperfection in the appearance of the net, unless constant care be taken by the workman.

The pusher machine was invented in the same year by Samuel Mart and James Clark, of Nottingham. It was used for a long time, by many persons, for making narrow edgings of lace. It undoubtedly possesses peculiar advantages, but is costly and delicate in construction, and subject to many inconveniences, which render it unsuitable for general use. The following year is remarkable in the history of the lace trade for the invention of the circular bolt machine, by Mr. Morley,—a mechanism possessing all the advantages of his straight bolt machine, without its disadvantages.

About the same time, Mr. John Leavers, sen., of New Radford, brought forward the lever machine, conjointly with one Turton, of the same place. This apparatus bears a strong resemblance to Mr. Heathcote's in many prominent features, and cannot, therefore, be considered as forming a distinct invention; but may be designated as a single-tier Loughborough machine. It deserves particular notice, however, in consequence of its general adoption by the trade. As originally constructed, it stood in a horizontal position, somewhat like one of the other machines lying on its side. This difference is supposed to have been given in order to make it look as much as possible unlike to Heathcote's, with the intention probably of evading his patent right, rather than from any advantage it could derive from that position. On the contrary, it was hereby subject to many disadvantages, and was, in consequence, changed to the upright posture, by Mr. John Leavers, jun., son of the former. After all, the general aspect of this machine is awkward, its movements complex, and its adjustments delicate—disadvantages, however, more than counterbalanced by the good quality of its fabric.

Many alterations and improvements have been since made in lace machinery, but nothing which deserves detailed notice, except the working of it by power. The first attempt of this kind was due to John Lindley, of Loughborough, who constructed a machine possessing the properties of the lever and traverse-warp machines combined. He worked it by a rotary movement, at Tottenham, near London, in conjunction with Mr. C. Lacey, the original partner of Mr. Heathcote; but the project was so unsuccessful, as to ruin those concerned. About the same time Mr. Heathcote applied the rotary movement to the circular bolt machine, and mounted a manufactory on that principle, at Tiverton, in Devonshire. A few years thereafter, several other establishments sprung out of the same place, and settled in Devon and Somerset, constituting a considerable body of lace manufactories in the West of England.

The persons who have distinguished themselves most in the department of lace machinery as a part of the factory system, are Mr. Heathcote, Mr. Morley, Mr. Sewell, Mr. William Jackson, and Mr. William Henson. William Mosely, of Radford, attempted to work the lever machine by a rotary motion without success; others, who made a similar attempt with the pusher and traverse-warp machines, met with no better fate. It is a remarkable fact, highly creditable to the mechanical sagacity of Mr. Morley, that no machines, except those on the circular bolt principle, have been found capable of working successfully by mechanical power.

The number of twist-lace machines at work in this country may be estimated at upwards of 4,000, of which the majority are constructed either on the circular bolt or lever principle. Heathcote's patent machine, known by the name of the Loughborough, or, more properly, the Old Loughborough, may be considered to be entirely obsolete. The number of traverse-warp machines is not considerable, and is on the decline. The pusher machines are very limited in number, but they are kept up on account of a kind of lace, called a Grecian net, a showy fabric, for which they are peculiarly adapted.

The quantity of bobbin-net lace now produced in the kingdom is prodigious, and has caused a depression of prices quite unparalleled in any other department of the cotton-trade. Four-fourths lace was sold in 1809 by Messrs. Heathcote and Lacey for five guineas a-yard. Lace of a better quality may now be purchased for 1*s*. 6*d*. Quillings, or narrow edges of lace, as first made by the traverse-warp machine, three inches broad, were sold in 1810 for 4*s*. 6*d*. a-yard; and they are now selling, of a better fabric, for 1½*d*.

Besides the lace machines in Nottingham, Loughborough, and in the West of England, there are in the town of Derby alone 150, of which those in the beautiful factory of Messrs. Boden and Morley turn off fully 40,000 square yards per week, a quantity capable of covering eight acres of land.*

* See Statistics of the Bobbin-Net Trade in Book IV.

SECTION II.

Bobbin-Net Lace Manufacture.

The annals of industry offer no example of such remarkable vicissitudes in the wages of labour, and no such instructive lessons of the influence of mechanical improvement to lower the remuneration of the few, while it multiplies the employments of the many, as the manufacture of bobbin-net lace. For several years after its first commencement, about the year 1810, it was no uncommon thing for an artisan to leave his usual calling, and, betaking himself to a lace-frame, of which he was part proprietor, realize, by working upon it, 20*s.*, 30*s.*, nay, even 40*s.* a-day. In consequence of such wonderful gains, Nottingham, the birth-place of this new art, with Loughborough, and the adjoining villages, became the scene of an epidemic mania. Many, though nearly devoid of mechanical genius, or the constructive talent, tormented themselves night and day with projects of bobbins, pushers, lockers, point-bars, and needles of every various form, till their minds got permanently bewildered. Several lost their senses altogether; and some, after cherishing visions of wealth, as in the old time of alchemy, finding their schemes abortive, sunk into despair and committed suicide.

Such has been the progress of mechanical improvement in the lace manufacture, that the cost of labour in making a *rack*, which was, twenty years ago, 3*s.* 6*d.*, or forty-two pence, is now only *one penny*. One of Mr. Morley's overlookers informed me that he had been, a few years ago, proprietor of a lace machine, for which he had paid 230*l.*, and by which he could earn 30*s.* a-day, which he sold two months before the time I saw him (in October, 1834), for *two pounds.*

The prices of this beautiful fabric have fallen, as already stated, in an equally remarkable manner. Twenty years ago a 24 rack piece, $\frac{5}{4}$ broad, fetched 17*l.* in the wholesale market; it is now sold for 7*s.* Such are the wonderful achievements of machinery!

Ordinary bobbin-net resembles in its texture the plainer kinds of pillow-made lace. The threads, as we have said, are entwined together, so as to form perfectly regular six-sided holes, the two opposite sides of which, the upper and under, lie in the direction of the breadth of the piece, so as to stand at right angles with the selvage, or border line.

Figure 117 will serve to explain clearly how those regular and equal-sized hexagons are produced by the crossing and intertwisting of the threads. Here we see, upon a magnified scale, how the fabric results from the conjunction of three lines of thread; one of which proceeds from above downwards, in a winding path; another of the lines runs towards the right, and a third to the left, both of them, also, in zig-zag directions. These obliquely-disposed threads wind round the up-and-down or warp-threads, and also cross each other in the interval betwixt the warp, both after a like manner, which may be clearly understood by inspecting the figure, without further explanation. The warp-threads are, as above stated, extended at first in straight perpendicular lines in the machine, and derive their serpentine curvatures, in the course of the work, from the tension or draught of the obliquely-disposed weft-threads, by which they are alternately drawn to the right and the left during the interlacement. If we suppose these warp-threads to be inflexible wires, the fabric would have, consequently, the appearance represented in fig. 26; and although it does not really resemble that drawing, yet the manner of entwining the threads will be more readily apprehended from the inspection of that sketch. The warp-threads proceed in the direction, *a a, a′ a′, a″ a″*; the one half of the bobbin, or weft-threads, takes the direction *b b, b′ b′, b″ b″*; and the other half crosses round the first half, in pursuing the winding path, *c c*, or *c′ c′*, towards the opposite border of the web. In tracing the route of a single weft-thread, we shall find that it persists in the same course till it reaches the last or outermost warp-thread, around which it winds itself, not merely once, as it has done round the other warp-threads, but twice, and then turns back to wind itself in the opposite direction. This return of the weft-threads forms the selvage of the piece.

The beauty of bobbin-net lace depends, not only upon the quality of the threads, but principally upon the perfectly hexagonal shape of the holes, and equality of their sizes. The nearer the warp-threads lie alongside of each other, the smaller are the holes, and the finer looking is the lace. The number of warp-threads in a piece one yard wide may vary from 700 to 1,200, which corresponds to from about 20 to 34 in the inch. The breadths of the holes cannot, however, be directly deduced from these numbers, because the holes are enlarged by the serpent-like bendings of the warp-threads.

Bobbin-net is usually brought into the market in pieces, of from 20 to 30 yards, or even more, in length, and of very variable breadths. The narrow ribands of bobbin-net, called quilling-lace, or ruffles for cap-borders, from about the breadth of the finger to that of the hand, are worked in many breadths at a time in the same machine, in which the warps of the different quillings are stretched in the same vertical plane, and are connected together in the working, in order to prevent, by their mutual tension, those irregularities in the forms of the meshes, which would be apt to happen in the crossing of the weft, if they were woven separately. This temporary conjunction is made by means of a single warp-thread destined for that purpose, which is drawn in a zig-zag direction from the border of one riband to its neighbour, being entwined by the weft with both. When the fabric is formed, by cutting and drawing out these union threads, the quillings become distinct pieces.

The different systems of bobbin-net lace machinery, all of which have been invented, or at least been made practicable, since about the year 1810, may be referred to the following heads :—

1. The Old Loughborough double tier, or Heathcote's.
2. The single tier, on Stevenson's principle.
3. The improved double tier, or Brailey's.
4. The single tier, on Leaver's principle.
5. The Old Loughborough improved, with pumping tackle.
6. The pusher principle.
7. The traverse-warp, or Brown and Freeman's machine.

8. The traverse-warp rotary, or Lindley and Lacey's.
9. The straight bolt, or Kendal and Morley's.
10. The circular bolt of Mr. Morley.
11. The circular comb, or Hervey's.
12. The improved levers.

The above-named machines comprehend the greater part of the principles upon which the apparatus for manufacturing lace have been founded. Steam-power has been applied to three of them; to the circular comb machine, or Hervey's; to the circular bolt machine, and to the straight bolt machine.

Before describing the circular bolt double-tier machine, with two sets of bobbins, it may help to communicate a clearer conception of the bobbin-net fabric, if we first describe the changes of position among the threads upon the single-tier system. The operation is, however, quite similar in both machines.

In the original machine, on the pusher principle, commonly called Crowder and Days' *improved pusher,* first introduced in the year 1820, fourteen general motions of the mechanism were necessary to complete the intertwisting of the threads in the formation of one hole or mesh; but in another form of the same machine, made the subject of a patent by Mr. Joseph Crowder, of New Radford, near Nottingham, in May, 1825, only ten motions are required to effect the same object. These improvements may be referred to three principal heads; 1. The employment of two series of pushers upon each side of the machine, to push the bobbins across between the warp-threads, backwards and forwards; these are attached to two distinct bars in front, and to two in the back of the machine, which are called the upper and lower front and back pusher-bars. 2. The employment of a single guide-bar for conducting the whole series of warp-threads in place of two which had been previously used; it derives its lateral traverse movement called *shogging*, from certain cam-wheels. 3. The introduction of two bars called *locker-bars, or fetchers,* similar to the bars employed for completing the transfer of the bobbins across the upright plane of the warp-threads, which had been partially driven through by the pushers. The bobbins are represented in their places at G, G, in plate X., fig. 1; and separately, in the same plate, figs. 3 and 4. The slits, called *gates*, in the bolts or combs in which they travel backwards and forwards across the warp are shown separately in fig. 6, and at *k, k'*, in fig. 1 of the same plate. In that species of machine there are two sets of bobbins, the working of which will hereafter be explained. For our present illustration, only one row of bobbins is to be considered.

The progressive formation of the meshes through the operation of these ten movements will be rendered more intelligible by the following development, taken along with the following figures, 116, 117, 118,—128.

These sketches represent the relative positions of the main parts of the machine, before the lace-weaving begins, and also after each of the ten movements. The number of warp-threads introduced for the purpose of our explanation is eight; it may be increased to any amount by the fancy of the reader. These threads are marked with numbers in their natural order; as well as the bobbin-carriages, which are introduced through the gates or channels of the bolts in the lines between the warp. To make the station of the carriages manifest, those anterior to the warp upon the front bolt or comb are drawn in full lines; those behind the warp, upon the back bolt, in dotted lines. The two strong lines, *j, j, j, j, k, k, k, k*, denote the front pusher-bar, and the letters of the alphabet, the

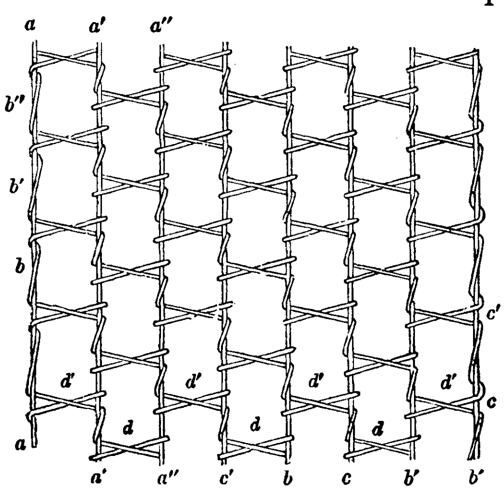


Fig. 116.—Bobbin-Net Lace Meshes.

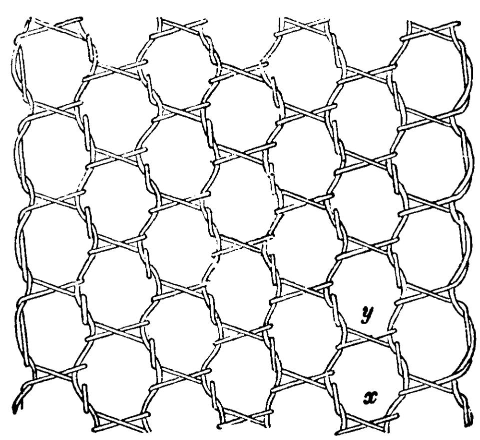


Fig. 117.—Bobbin-Net Lace Meshes.

pushers themselves; under the dotted lines, *h, h, h, h, i, i, i, i,* we may figure to ourselves the two back pusher-bars. In the machine, these back and front pushers are placed at the same height, and upon a level with the bobbin-carriages. This position could not, however, be represented in the present figures, but the imagination will readily supply this deficiency. The relative dimensions of the parts may be thrown entirely out of view, without affecting the illustration.

At the commencement of the operation, all the parts of the machine are supposed to be in the state figured in 118. The driving arms are placed so that the front pushers, *j, k,* are near to the warp; all the bobbin-carriages are stationed upon the back bolt (as *k'*, plate IX., fig. 1.) The front pushers, upper and under, stand in pairs, the one right over the other; the back pushers are shoved towards each other so that a pusher is opposite to each carriage. The front locker, or fetcher-bar, is raised up, the back one is in its lowest position. The warp-threads are stretched in a vertical plane (*see* F, plate X., fig. 2.) To each of

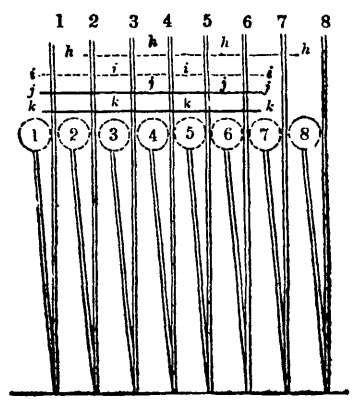


Fig. 118.

them a weft-thread is twisted fast underneath. The ten motions by which a row of meshes or holes is formed obliquely across the whole piece, proceed in the following manner:—

1. The whole series of bobbins are moved from the back to the front bolt, drawing along with them all the weft-threads, through the intervals of the warp-threads, at the same time that a horizontal roller on the lower part of the machine makes a tenth part of a revolution. The warp is moved one gate or bolt-space to the left by the traverse of its guide-bar; whilst the two bars with the bolts, and the pushers *k, i, h,* remain in their places. The position of the several parts now is as represented in fig. 119. Each of the bobbin-carriages has, at present, one of the front pushers, *j, k,* before it, the last carriage (8) excepted. The warp-threads have, in consequence of the traverse of the guide-bar taken an oblique direction, and hence the carriages are placed in such a position that at their next passage through the warp they may go by the right side of those warp-threads from whose left side

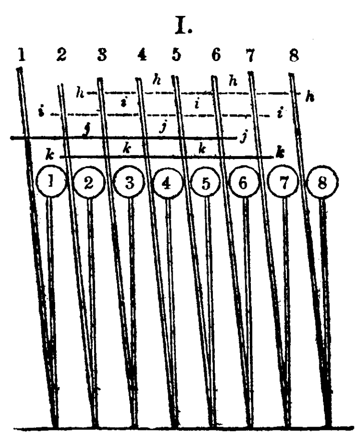


Fig. 119.

they had last emerged. In order to perceive this more plainly, we have only to compare the positions of the carriages 1, 2, 3, &c., with the warp-threads marked with the same numbers in fig. 118 and 119.

2. At the second movement the pushers, *j*, *k*, advance towards the warp, and push the whole of the bobbin-carriages, with the exception of the last, (upon which no pusher is acting,) from the front to the back bolt, on to which the fetcher-bar draws them. The bobbins, as we have said, return now by the right of those warp-threads by whose left they originally passed. The back bolt, with the carriages resting on it, is moved a gate to the left, and the lower back pusher-bar a side-step to the right. The pushers *h*, *j*, *k*, the front bolt-bar and the guide-bar remain at rest. Fig. 120 represents the position of all the parts after the second movement.

3. At the third movement, the back pushers, *h*, *i*, which now stand in pairs nearly over each other (*see* fig. 120,) drive only the half of the bobbin-carriages (those which are marked with the odd numbers, except No. 1,) forwards through the warp, and to the

II.

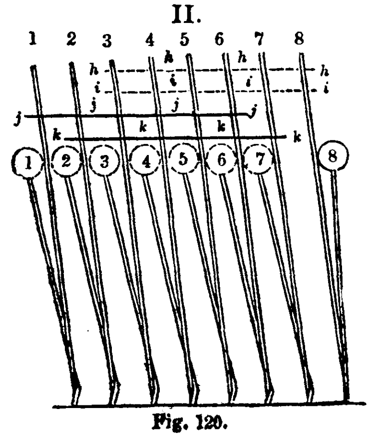


Fig. 120.

left of their respective warp-threads. The pusher-bar *j*, moves one side-step to the right; the guide-bar does the same; all the other bars remain unmoved. Fig. 121 shows the position of the parts after the third movement. The warp-threads are once more vertical, and one-half of the bobbin-carriages are placed upon the front bolt, and one-half upon the back bolt; the front and back pushers stand in pairs over each other.

4. The condition of the front pushers, *j*, *k*, is the cause of their making an empty, that is, as to the disposition of the bobbin-carriages, an inoperative movement, since they pass free between the front gates, and cannot reach their opposite carriages that are standing upon the back bolt. A glance at fig. 121 will remove all doubt in this respect. The front bolt, with the half number of the bobbins standing in it, moves one gate to the left, and the back bolt, with the other half of the bobbins, moves one gate to the right, at the same time, the front pushers, *j*, *k*, make a side-step to the left, to get out of the way of the bobbins, which might otherwise strike them on the sides. The back pusher-

III.

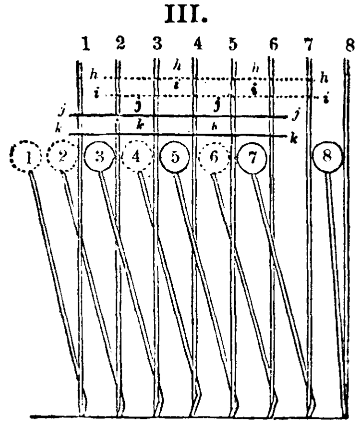


Fig. 121.

bar, and the guide-bar remain at rest. Fig. 122 shows the changes introduced by the fourth movement.

5. The remaining half of the bobbin-carriages are shoved through the warp from the back to the front bolt, to the left of their warp-threads. The upper front pusher-bar, *j*, traverses one step to the right, the under front pusher-bar, *k*, two steps to the right, the front bolt with the bobbin-carriages one step to the right, and the guide-bar one step to the left. The back bolt, and the two back pusher-bars, *h*, *i*, remain still. The third to the fifth movements have crossed the threads of the bobbins round the threads of the warp. In fig. 116 these crossings are marked with *d*. It is necessary to make these fast before the work proceeds further. The needles upon the point-bars serve for this purpose (*see* explanation of plate IX., fig. 2). At the moment when the fifth motion has completed the crossing of the threads, the front point-bar applies its needles to that crossing, and keeps it fast. The motion of the point-bar is a compound one, for its needles must be withdrawn from the web in a truly

IV.

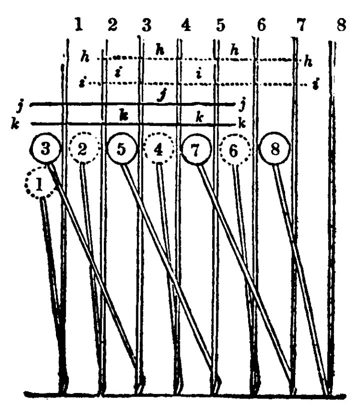


Fig. 122.

horizontal direction, and then be lifted up. With the downward pressure of the thread-crossing by the point-bar the first half of the row of meshes is completed. The present position of the parts of the machine is shown in fig. 123. The sections of the needles which hold down the crossings of the threads are here represented like small circles, in order to make the crossings obvious.

6. At the sixth movement the front pushers, *j, k,* shove all the carriages from the front to the back bolt, with the exception of the first, which is left alone behind. The under pusher-bar of the back pair, *i,* moves one step to the left, and the guide-bar one step to the right, while the other bars remain at rest. Fig. 124 shows the positions thence resulting.

7. The seventh movement brings all the bobbin-carriages from the back to the front, in which they pass on the left side of their respective warp-threads, on whose right they were at the sixth movement. The under front pusher-bar, *k,* moves one step to the left, the guide-bar also one to the left, the back-bolt, which

V.

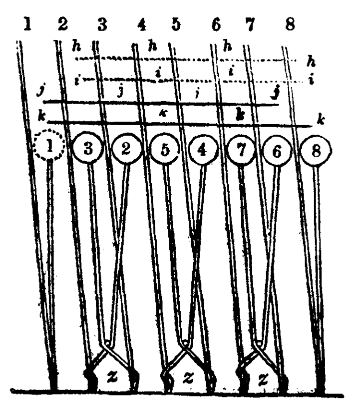


Fig. 123.

is empty, also moves one step to the left. All the other bars remain in their places (*see* fig. 125).

8. At the eighth movement one-half of the bobbin carriages (in the order of their station, 1, 3, 5, 7, &c.) move from the front to the back bolt, as no pushers of the bar, *j, k,* stand opposite the other carriages. The carriages now pass each one to the right of its warp-thread. The guide-bar takes a step to the left, and the pusher-bar, *i,* a step to the right, while the other bars remain at rest (*see* fig. 126).

VI.

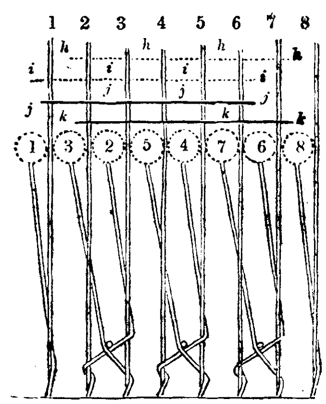


Fig. 124.

VII.

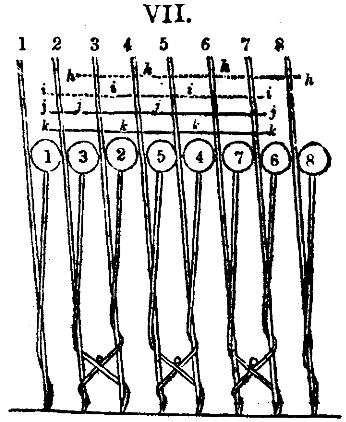


Fig. 125.

9. At the ninth movement the back pushers come forward alone—that is, without striking the bobbin-carriages, one-half of which stand upon the front, and the other upon the back bolt. The front bolt now moves one step to the left; the back bolt and the two back rows of pushers, *h*, *i*, move one step to the right; the other pushers and the guide-bar remain unmoved (*see* fig. 127).

10. The tenth movement drives the half of the bob-

VIII.

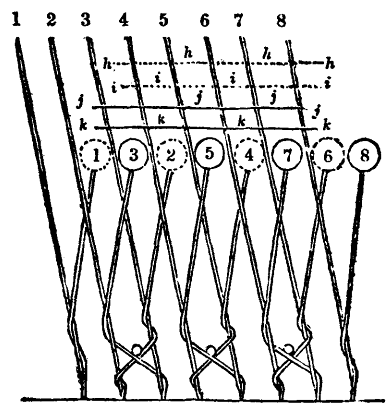


Fig. 126.

IX.

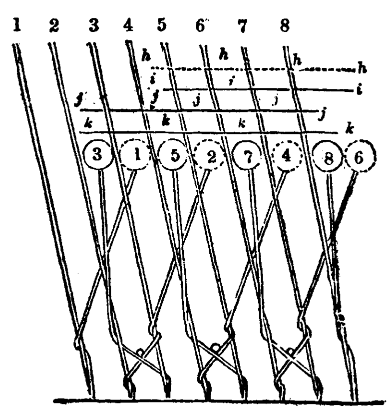


Fig. 127.

bins which are upon the front bolt from these to the back bolt, by the right-hand side of their warp-threads. The back upper pusher-bar, *h*, takes a step to the left, the back under pusher-bar, *i*, takes two steps to the left, the front bolt, which is empty, one step to the right, the guide-bar two steps to the right, while the back bolt bar and the two front pusher-bars remain in their places. The eighth, ninth, and tenth movements have again effected a crossing of the weft-threads given out by the bobbins (*see* fig. 116, *d'*, *d'*, *d'*, *d'*). At this moment the back point-bar, in like manner as the other point-bar formerly, withdraws its needles from the web, and lifts them up. Thereafter, by its depression, the needles are applied and pressed down upon the new fabric, so as to complete the mesh or row of holes.

After the tenth movement the roller which moves the bolts and bars is in the same position as it was at the beginning of the first movement. All the other parts are also in their primary situations, namely, the guide-bar, the pushers, and the bolts, as may be per

X.

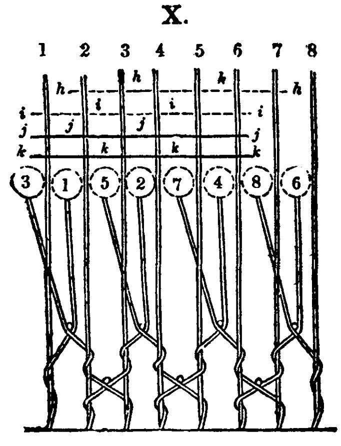


Fig. 128.

ceived by comparing figures 118 and 128. These ten movements being repeated, a second row of meshes is produced.

With respect to the carriages with the bobbins, they stand in one row, after the tenth movement, just as they did at the beginning: yet they have changed their places relative to each other; for that bobbin which was formerly the first in the range is no longer so. If we consider, in fig. 116, the course of the weft-threads, we shall remark the necessity that the bobbins of every thread, by going in the direction *c*, *c*, or *c'*, *c'*, after every crossing, must stand one step further to the right, and also in other gates, or betwixt other bolts. In this way, but towards the left hand, those bobbins must proceed which belong to the threads running in the direction *b*, *b*, *b'*, *b'*, &c. This march becomes on both sides a countermarch when the bobbin-carriage arrives at the selvage of the web; it then returns, and pursues its way backwards until it reaches the opposite border. In this manner a continual interchange of places occurs among the bobbins, and indeed this change happens every time at the fourth and ninth movement, when the bobbin-carriages are parted upon the two bolt-bars, and one of these bars is shogged to the right, and the other to the left.

The bobbins at the beginning of the fabric (*see* fig. 122) are marked with continuous numbers, but, for the sake of illustration, only eight bobbins are employed. If we follow all their changes of place during the ten movements, and mark those bobbins which are stationed upon the back bolt with an asterisk, we shall have the following diagram:—

	Position of the Bobbins.							
	*	*	*	*	*	*	*	*
At the commencement .	1	2	3	4	5	6	7	8
After the 1st movement .	1	2	3	4	5	6	7	8
	*	*	*	*	*	*	*	
„ 2nd „ .	1	2	3	4	5	6	7	8
	*	*		*		*		
„ 3rd „ .	1	2	3	4	5	6	7	8
	*							
	(1)	*		*		*		
„ 4th „ .	(3)	2	5	4	7	6	8	
	*							
„ 5th „ .	1	3	2	5	4	7	6	8
	*	*	*	*	*	*	*	*
„ 6th „ .	1	3	2	5	4	7	6	8
„ 7th „ .	1	3	2	5	4	7	6	8
	*		*		*		*	
„ 8th „ .	1	3	2	5	4	7	6	8
		*		*		*		*
„ 9th „ .	3	1	5	2	7	4	8	6
	*	*	*	*	*	*	*	*
„ 10th „ .	3	1	5	2	7	4	8	6

The two figures standing over each other in the fifth line show that here two bobbin-carriages stand opposite each other, of which the one is upon the front, and the other upon the back bolt bar.

We see from this diagram that, after the sixth and the tenth movements, the bobbins, although they again stand in one range upon the back bolt, have changed their places relative to each other. If we mark them once more with continuous numbers, we shall find such a change to take place during the ten movements which are requisite for the formation of the second row of meshes. Leaving to every bobbin the number originally assigned to it, and, pursuing these metamorphoses a step further, we have the following diagram:—

		Position of the Bobbins.	
1	Movement	1 2 3 4 5 6 7 8	
6	”	1 3 2 5 4 7 6 8	1st row of meshes.
10	”	3 1 5 2 7 4 8 6	
6	”	3 5 1 7 2 8 4 6	2nd ”
10	”	5 3 7 1 8 2 6 4	
6	”	5 7 3 8 1 6 2 4	3rd ”
10	”	7 5 8 3 6 1 4 2	
6	”	7 8 5 6 3 4 1 2	4th ”
10	”	8 7 6 5 4 3 2 1	
6	”	8 6 7 4 5 2 3 1	5th ”
10	”	6 8 4 7 2 5 1 3	
6	”	6 4 8 2 7 1 5 3	6th ”
10	”	4 6 2 8 1 7 3 5	
6	”	4 2 6 1 8 3 7 5	7th ”
10	”	2 4 1 6 3 8 5 7	
6	”	2 1 4 3 6 5 8 7	8th ”
10	”	1 2 3 4 5 6 7 8	

It is obvious that, after the completion of the fourth row of meshes, *that* bobbin which was originally the first has become the last, and the last has become the first; and that, after eight rows of meshes, every bobbin resumes its primary place. This restoration occurs, generally speaking, after as many rows of meshes as there are bobbins in the apparatus.

One of the essential peculiarities of the above-described machine is that the expanded warp-threads form a single vertical plane, and that the bobbins are usually in a single range, which is parted momentarily into two rows only at that instant when, from the change of place in the carriages, the crossing of the weft-threads is effected. The bobbin-net machines of this nature, which otherwise differ in many particulars from each other, constitute a peculiar class. A second great division comprehends the machines with double rows of bobbins, which have this essential character, that the bobbins are always arranged in two rows, which, during the weaving, stand sometimes upon the front, and sometimes upon the back bolt, opposite to each other; but occasionally they are both upon the front bolt, and finally both are assembled upon the back bolt. In the last two cases two carriages stand behind each other in the same gate of the bolt, and the length of the bolt must be proportionally increased. In the machines with double rows of bobbins the warp is also parted into two halves, each of which extends over the whole breadth, and both are so placed that their threads lie nearly behind each other, like one warp lying over its fellow yarns in a loom. If, in the following series,

b b b b b b

a a a a a a,

a represent the threads of the front warp, and *b* those of the back warp, we shall have an idea of their arrangement, one behind another, in a horizontal section. The main advantage of the double-tier construction is, that the intervals between the double warp may be as great as in the machine with single warp; and that consequently the bolts and bobbin-carriages may be made less thin and tender. The entwining of the warp-threads by the weft-threads is effected in such a manner that every warp-thread may be shoved, by means of a single guide-bar, both to the right and the left, in turns. Let us suppose, for example, that the bobbin-carriages have passed from the front to the rear through the warp, and that thereafter the thread, *a*, has been shogged one step to the right, or *b* one step to the left; the warp-threads will then have this arrangement,

b b b b b b

a a a a a a;

and, should the bobbins return now to the front, their threads must have been wound about the threads of the shogged warp. After the interlacement, the warp-threads will form only a single row,

a b a b a b a b a b a b,

in consequence of the reciprocal tension of the weft-threads, and the insertion of the needles of the point-bar, so as to preserve them at their proper distances.

The number of movements which are required to form a row of meshes with these double-tier machines varies according to their difference of construction. It may be done with fourteen, twelve, ten, nay even with only six, movements, when the mechanism is upon the most improved principle.

Bobbin-net lace is a thin semi-transparent web of fine cotton thread, arranged in hexagonal holes or meshes. It is produced by means of a warp, shed in two layers, as in a plain weaving-loom; only the threads are further apart. The weft, however, is applied in a very different way. It consists in an equal number of threads with the warp, which are made to revolve round every two threads of the warp, so that, after every such revolution of the weft-threads, the relative position of the two warp-threads lace factory of Derby, so justly celebrated in the Factory Commission Report, my readers are indebted for the present development of the lace manufacture. Mr. Morley's machine combines with the greatest possible simplicity many other valuable properties, especially that of going at very considerable speed, and producing solid and beautiful work.

Plate X., fig. 1, exhibits one of the end views of this lace-frame, which differs very little from the other end.

Plate X., fig. 2, is one-half of the front view, in which some of the framing has been left out in order to show the working apparatus behind it.

Plate IX., fig. 1, is a transverse section to display the internal operation of the machine; and in which, therefore, the driving-geer seen in Plate X. is not represented. This section is drawn upon double the scale of the other figures, to render the minute parts more distinguishable.

Plate IX., figs. 2, 3, 4, 5, 6, contain details of several parts of the machine, drawn in half of their real size.

With respect to fig. 1 of this plate, one of the end frames, A, A, of the machine, is shown; which frames are joined together upon each side by the rail, B, as seen in plate X., fig. 2.

B is an iron beam which connects together the tops of the frames, A. C is a roller upon which the warp-thread is wound, and may therefore be called the thread-beam. The length of this roller is two or three yards, according to the intended breadth of web. D is another similar roller, upon which the finished work is wound, and may therefore be called spindle-rod, with a feathered edge to fit that notch, and prevent them from turning round the rod. This spindle is put into an appropriate winding-frame, figs. 129 and 130, for filling the bobbins with thread prior to their introduction into the lace-machine.

Each of these tiny bobbins, *d, d′*, is inserted within a little iron frame, G, fig. 4, called the bobbin-carriage. The figure exhibits it, both in view and section, of half its true size. Into the circular hole of this carriage the bobbin is inserted, so that the groove-borders of its disc embrace the narrow edge, *e, e*, and are kept from falling out to the one side or the other by the pressure of a spring, *f*, which applies sufficient friction to prevent them revolving too easily, but still so little as to permit their giving out the thread when it is pulled with the very gentle force employed in the machine. The thread is led through the eye, *g*, at the top of the carriage, in order to be wound off in the formation of the lace.

The carriage G has a curvilinear groove *h, h*, turned out upon each of its faces or sides, the depth of which is seen in the section. These grooves fit the intervals between the teeth of the comb, or bars of the bolt, shown in plate IX., fig. 6, in which the carriages slide backwards and forwards. The carriages are driven by the impulse of a bar against one of the projecting catches or points, *i, i′*, which remain below the under surface of the bolt or comb.

The bobbins, with their carriages, which are equal in number to the weft-threads, have to pass through the narrow intervals between the equally numerous warp-threads. They are, with this view, arranged in a double line, in which the intervals of the double warp are only half as numerous as the threads.

In plate IX., fig. 1, two carriages, with their enclosed bobbins, G, G, are seen upon each side of the warp-thread, and they may be supposed to be the two end ones of two horizontal ranks or lines.

H and H′ are iron bars extending the whole length of the machine, to which are fixed two lines of curved brass plates, having their ends cast into or imbedded in pewter flanges, which serve for screwing them fast to the bars, H and H′. These curved parallel plates are called bolts, though they more closely resemble combs, with very thick strong teeth. These brass plates, marked, *k*, *k′*, in fig. 1, form therefore two rows of curved channels upon each side of the warp, and are half as numerous, in each bolt, as the carriages, G, G′, which ride between them.

The free ends of the teeth or bars in the opposite bolts stand so near to each other as to leave room merely for the proper motions of the warp-threads betwixt them. Hence the carriages, in their passage across, reach the back bolts before they have entirely quitted the front ones; so that the short break or interruption in their curvilinear pathway, at the line of the warp, does not interfere with the uniformity and smoothness of their movements.

A few of these bolts are shown of half their size in fig. 6, both in ground plan and in side view. The pewter bar in which one of their ends is cast is seen in the ground plan as broken off from the rest. These are placed, as we said, upon each side of the vertical warp-threads, with a distance between their comb-like tips of about half an inch, (*see k, k′*, fig. 1, plate IX.,) through which interval the warp-threads are stretched in parallel vertical lines. The curvature of the two bolts, taken together, forms the segment of a cylindrical surface. The two sets are placed right opposite, so that the two carriages, which always rest upon one bolt, may be shifted from the comb, *k*, to the opposite comb, *k′*, after passing through the intervals between the warp-threads.

The carriages are driven alternately from the one comb to the other by the two bars, *l* and *l′*, having their ends fixed to frames which vibrate round the centres, *m*, also the centres of curvature of the circular bolts. When, however, the driving-bar, *l* or *l′*, has pushed one of the lines of carriages nearly across the intervals of the warp, the foremost of their projecting catches or heels, *i, i*, is laid hold of by a plate, *n*, fixed upon the horizontal shaft, I, which thus pushes it quite through. Afterwards the second line of carriages, G′, is driven through by the bar, *o*, also fixed upon the shaft, I, which carries them across the interval by acting against their foremost projections, *i, i*. The same thing is performed by the shaft, I′, when the bar, *l′*, drives the two lines of bobbins in the opposite direction.

The beam, H, with the combs or bolts, *k′*, attached to it, can be shifted sideways a little. By this traverse motion the position of the comb, *k′*, is changed relatively to that of the comb, *k*, by one interval or tooth, so as to transfer the carriages to the next adjoining bolts. When this shifting is twice performed, the carriage, G′, is led to the right, and G to the left, as will afterwards be explained.

The particular line of the warp, marked *m*, plate IX., fig. 1, is that where the meshes of the lace are made while the bobbins are moving about to entwine the warp-threads together.

L, L′, are two bars, called the point-bars, which are suspended by the arms *p*, *p′*, from the shafts, *q* and *q′*, round whose axis they vibrate. They also turn at their joints with the suspending rods, so that each of the bars may be shifted, as is shown by the dotted lines upon one of them (fig. 1).

Upon each of these bars, L and L′, pewter flanges are screwed, into which a line of pointed needles are cast, as shown at *r*, *r*, fig. 5, plate IX. The needles of both bars lie in a horizontal plane, and in the intervals of each other, when the bars are placed as shown in fig. 1, plate IX.

After the bobbins have moved several times round about the warp-threads, and entwined their threads with them, one of the point-bars, L or L′, is moved with its points from the intervals of the warp, which lies in the spaces left by the corresponding needles of both bars, and, by receiving a downward motion, falls in between the warp-threads and the weft which has been twisted round it, and carries the latter up to make another line of meshes or holes in the lace, which has, in the mean time, wound for such a length upon the roller, D. Their point-bar remains now in its place, as seen in fig. 1, and, after some time, the other point-bar makes the same motion to produce a second line of holes; which, of course, lies between the former.

To give now an idea how the warp, consisting, as we have said, of two parts, guided separately by the two guide-bars, F, F′, is entwined together by the weft in passing gradually from the roller, C, to the roller, D, we shall suppose that both lines of bobbin-carriages, G and G′, are upon one side of the warp, and upon the bolts *k*.

1. The driving-bar, *l*, pushes the carriages, G, so as to drive the others, G′, through the intervals of both halves of the warp; which carriages are then caught by the plate, *n*, of the shaft, I, and carried completely through.

2. Now the bar, F, shifts with its part of the warp through one interval sideways, and the carriages, G, are pushed through, first, in part, by the driving-bar, *l*, and then completely by the plate, *o*, of the shaft, I.

3. The bar, F, shifts back to its former place, and the carriages, G, are pushed back by the driver, *l′*, to the bolts, *k*, and caught by the shaft, I, in the same way as before.

4. The guide-bar, F′, traverses through one interval in the opposite direction of what F did in No. 2, and the carriages, G′, are pushed through the warp by the driving-bar, *l′*, to the bolts, *k*.

5. The bar, F, shifts back to its former place, and the carriages, G′, pass through the warp again to the bolts, *k′*.

6. The bar, F, shifts as it did in No. 2, and the carriages, G, are also pushed through the warp to the bar, *k′*.

While the latter are passing the point-bar, L makes the motions above described, and carries the weft (which had been entwined round the warp by the motion of the carriages) up, to make a new line of holes.

7. The bar, F, shifts to its first place, and the bob-

bin-carriages, G, are pushed through the warp by the driver, *l'*, to the bolts, *k*.

8. The bar, F', shifts, as in No. 4, and the carriages, G', pass through the warp to the bolts, *k'*.

9. The bar, F', returns to its original place, and the carriages, G', pass again through the warp to the bolts, *k'*.

10. The bar, F, shifts again as in No. 2, and the carriages, G, are pushed through the threads to the bolts, *k'*.

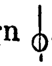
11. The bar, F', comes to its original place, and the carriages, G, pass through the warp to come again to the bolts, *k*.

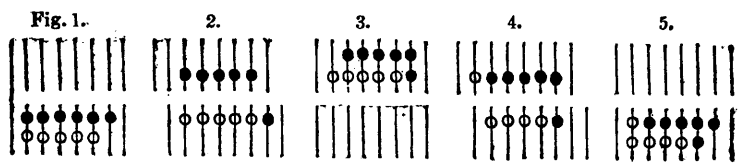
12. The bar, F', shifts or traverses once more, as in No. 4, and the carriages, G', are also pushed through the warp to the bolts, *k*. During the last movement, and before the guide-bar, F', comes to stand in its original place, as it was supposed at No. 1, the other point-bar, L', quits the holes formed round its needle-points by the point-bar, L, and, after being drawn down, falls between the warp and weft threads, and carries the interlacements of the latter up to form a new line of holes round the points of the bar, L; and now the same series of movements begins as detailed from No. 1 to No. 12.

While No. 9 is performing, that is, when the carriages, G, are about to be pushed through the warp by the driving-bar, *l*, to the bolts, *k'*, the bolt carrier-beam, H', is shifted or traverses an interval of two bolts, so as to make the carriages in the line, G', run upon the bolts which lie upon the right of those which they were formerly travelling upon.

Meanwhile, before the second line of carriages follows, as in No. 10, the beam, H′, has shifted to its former place, thus causing the carriages to come again upon the same bolts as before. Before these carriages, G, are again pushed to the bolts, *k*, the beam, H′, makes another shift or traverse like that previously made, after which the carriages, G, move to the bolts, *k*, lying to the left of those which they were travelling upon before, whilst the other line, G, after the beam, H′, has shifted to its original position, is pushed (in No. 12) to the bolts, *k*, lying to the right of those which they formerly were upon.

On the ends of the machine, however, one carriage of the line G has gone, during these movements, to the line G′, while one of these carriages, on the line G′, has gone over to the line G; so that the carriages, viewed in a body, stand as before, though the individual carriages which were opposite to one another are now working, the one at the right side, and the other at the left. This interchange will be understood by reflecting that when the carriages G′ are first pushed through to the bolts *k*′, these having been previously shifted to the left, *that* carriage which is most to the left of the line G comes after the replacement of H′ into à gate of the combs *k*′. When no carriage is in the other line, it must remain there till it is pushed by the driving-bar, *l*′, along with the carriages into the line G′. This carriage has, therefore, now changed its position from the line G to the line G′. Upon the other end of the machine a similar change is performed reciprocally. Upon this end of the machine only one carriage is working in the last gate, or between the last interval of the bolts. This carriage, therefore, travels only when either the line G or G′ is pushed directly from the driving-bars, *l* or *l′*, but is otherwise at rest. This continues to take place till the beam, H′, shifts (traverses), and brings the line of carriages G one gate to the left, and G′ one gate to the right. The said carriage upon the right-hand side of the machine will now be shifted as the others in G, the line G′ having got two other carriages extending beyond those of the line G upon that end of the machine.

These movements will be better understood by means of the following diagram, which shows the position of the gates or bolts, , and the carriages of both lines, which are represented by the sign .



Successive Positions of Bobbins in the Gates of the Bolts.

Fig. 1. Before any change takes place with the beam H′.
2. At the operation No. 9.
3. At the operation No. 10.
4. At the operation No. 11.
5. At the following operation.

In explaining the train of mechanism in this lace-frame, the first thing is to show how the warp is gradually wound from the thread-beam, C, upon the other, or lace-beam, D.

M is a shaft, plate X., fig. 2, which is driven from the mill-shaft by a strap running over the usual fast-and-loose rigger-pulleys. From this shaft motion is communicated by wheel-work to the other main horizontal shaft, N, which extends through the whole length of the machine.

Near the end of the machine opposite to that represented in plate X., fig. 1, a cone, O, is fixed upon the shaft N (pl. IX. fig. 1), from which another cone, P, set in the reverse direction, is driven by a strap, which may be shifted, or made to traverse from the one end to the other of the said pair of cones, to change the velocity of the shaft upon which the cone, P, is fixed.

The end of this shaft bears a worm-screw, which drives a wheel, seen in dotted lines in fig. 1, plate IX., upon the shaft O, which also bears a worm-screw, that actuates a wheel attached to the shaft upon the end of the thread-beam, C.

R is the guide of the strap fixed upon the shaft S, which is connected by an arm, and the link-rod, T, to the arm of a bell-crank lever, U, which presses with its other arm upon the thread of the beam C, and thereby, with the decreasing diameter of the beam, shifts the strap towards the larger diameter of the cone, O, and to the smaller of the cone, P, so as to increase the speed of the roller, C, as its diameter decreases, or to equalize its surface velocity, that is, the rate of delivery of the warp.

Upon the shaft, N, close to the cone, O, there is a pulley, from which another pulley, V, is driven by means of a strap. The shaft of the pulley, V, drives, by means of two bevel-wheels, the upright shaft, W, on the upper end of which is another conical pulley, X, which drives by a strap the conical pulley, Y, on an upright shaft. Upon the end of this shaft there is a worm-screw, Z, which works in a wheel, seen partly in dotted lines, fig. 1. This wheel has upon its shaft a little pinion, which works in a wheel attached to the end of the roller, D. M′ is a lever, with a fork at its end, to guide the strap along the two cones, X and Y, and is connected by a rod, N′, with a lever, O′, which presses upon the lace wound upon the roller, D, and thereby guides the strap towards the smaller diameter of the cone, Y, and diminishes the number of revolutions of that roller as its diameter increases with the accession of lace.

Upon the shaft, N, there are likewise two eccentrics, *s*, upon each side, and one, *t*, in the middle of the machine, plate X., figs. 1 and 2, whose use will be presently described. There is, moreover, upon each end a pinion, *u*, driving the wheels, *v*, which have three times the number of teeth, and travel, therefore, with only one-third of the velocity of *u*.

Upon each of the short shafts of these two wheels, *v*, there are five eccentrics, *w*, *x*, *y*, *z*, and *z′*: *w* and *x* are upon both ends of the machine exactly the same, and consist of circular pulleys, having each one place of their circumference flattened. Upon their tops, lever arms, *c*, slide, whose fulcrum is fixed upon the framing, A, of the machine.

Other arms turning on the same fulcrum are connected by the rods, *d′*, with the arms, *e′*, fixed to the point-bars, L and L′, and may be adjusted with the arms lying upon the eccentrics, by means of screws, in order to bring the points of the two bars, L and L′, into the proper position, and into the same horizontal line. Each of these bars is therefore depressed at once, while the shaft, N, makes three turnings.

The next eccentric, *y*, upon the shaft of the wheel, *v*, is a circular plate, with three notches at equal distances, each notch being in length about one-twelfth of the circumference. Upon an arm, *f'*, which lies upon this plate, and therefore rises and falls as it slides over the circumference, or cut-out parts of the plate, *y*, presses the bell-crank lever, *g'*, and this with its other end against the guide-bar, F, which is thus shifted at three periods during one revolution of the wheel, *v*, and shifted back as many times by a spring working against the other end of the bar, F. Upon the other end of the machine there is a similar eccentric, with this difference, that the notches in the latter stand opposite to those in the eccentric *y*. Thus it serves to shift the bar, F, likewise three times to the side, which is then pushed back as many times by a spring, *h'*, working on the end represented in fig. 1, plate X.

The eccentric, *z*, is a circular plate with two notches, comprising, with the intervals, about one-fourth part of the circumference. Upon a lever or arm which slides upon it, and is made to sink when the notches pass (*see* fig. 1), stands the rod *i'*, which is connected by a bell-crank lever, *s'*, and thus shifts the beam, H', twice during each revolution of the wheel, *v*, or during three revolutions of the shaft, N. Upon the other end of the machine there is a similar plate, having only projections of a similar shape and size to the notches in the plate, *z*, in order to bring the beam, H', back when it has been moved by the eccentric of the other end.

z is a spiral arm, which works on one or other of two studs at the ends of the two-armed lever, *t*, shown in fig. 1, pl. IX. and fig. 2, pl. X, in dotted lines only, as full lines would have covered the other parts. This lever is suspended from the fulcrum, *u′*; and, being moved either the one way or the other by the arm, *z′*, is made to press with one of the set screws, *v′*, against one of the rods, *d′*; and whilst this is drawing down the point-bar, L or L′, it moves one of these bars with its points out of the holes of the lace.

w′, fig. 1, pl. X. is a horizontal shaft, extending through the whole length of the machine, and having at each end an arm (represented by dotted lines,) connected by a link with the end frame of the driving-bars, *l* and *l′*, fig. 2, plate X., and fig. 1, plate IX.

In the middle of the said shaft, *w′*, there is another arm, on whose end there is a roller working in the eccentric slot of the plate, *t* (*see* fig 2, plate X.), by which, therefore, the carriages with their bobbins are pushed from one bolt or comb to the other, and back again, during each revolution of the shaft, N.

The eccentrics, *s*, upon each end of the machine, move a bar, *x′*, up and down, the under end of which is guided by a lever, whose fulcrum is fixed to the frame-work, A, and slides with a friction-roller upon the said eccentric. The top end of each of these bars is toothed, and works in a toothed segment, *y′*, on one end of each of the shafts I and I′; thus giving motion to the locker-bars, *n* and *o*, which draw the carriages through the warp-threads.

Bobbin-filling.

For winding the threads upon the bobbins of the lace-frame an ingenious machine is employed, by means of which from 100 to 200 bobbins may be filled at once with equal uniformity and expedition. The thread is previously wound upon a cylinder or drum, somewhat like the parallel yarns upon a warp-beam; and from that drum the bobbins get their supply.

Fig. 129 is a side view, and fig. 130 a plan of this elegant machine. A is the drum filled with yarn in

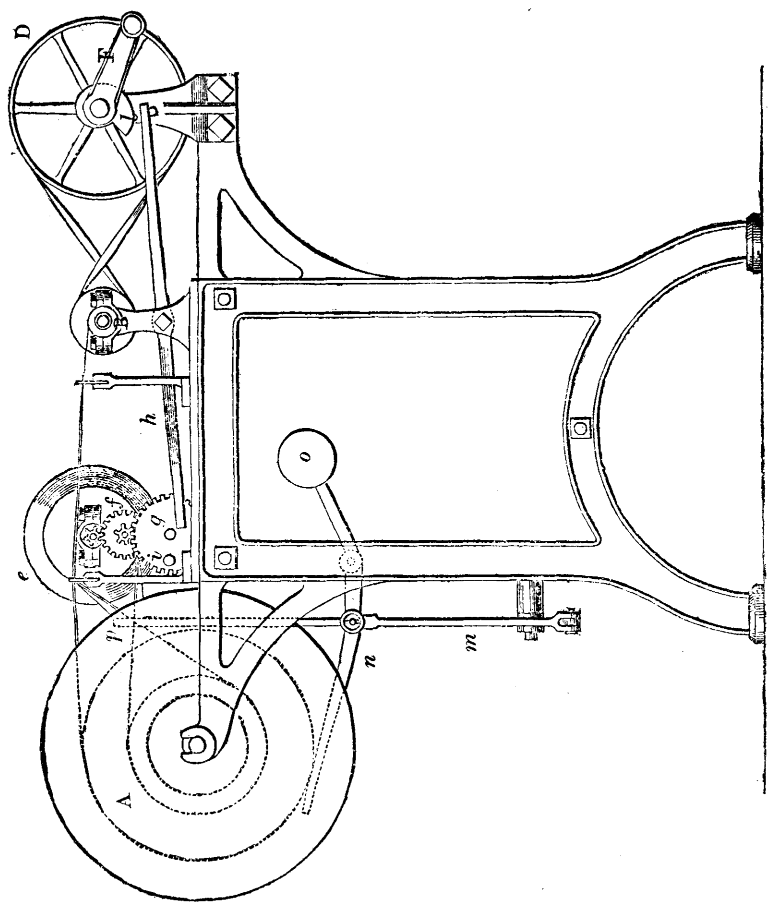


Fig. 129.——Bobbin-filling Machine. Side View.
Scale, about two inches to the foot.

parallel lines; B is a horizontal shaft, with a pulley, C, made fast to it, which is actuated by a strap from the pulley, D. The latter is fixed upon a shaft, E, which is turned by the handle, F.

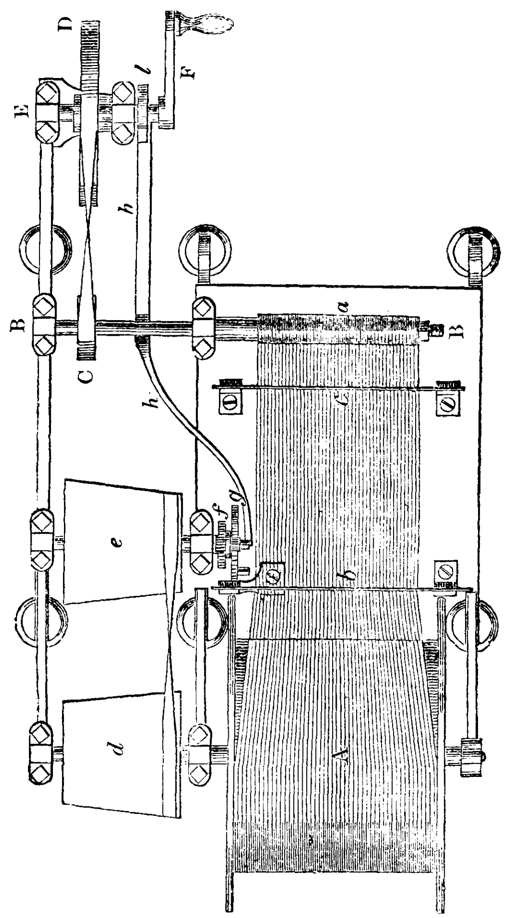


Fig. 130.—Bobbin-filling Machine. Ground Plan. Scale, about two inches to the foot.

One end of the shaft or spindle, B, projects beyond its bearings to serve as an axle, to receive the bobbins, *a*, *a*, slid upon it close to each other; the feathered edge formerly mentioned extending along the shaft, adapted to the notch in the side of the central hole of each bobbin, to prevent the rotation of the bobbins round the shaft.

b and *e* are two slips of brass-plate, pierced with a series of slits corresponding to the number of bobbins to be filled, and through which the threads are conducted from the drum, A, to be wound upon the bobbins by their rotation with the shaft, B. The winder, a young woman, instantly notices whenever a thread happens to break, because the train of them is led above a horizontal table, painted black. That the bobbins may be filled each time with the same quantity of thread, equal, upon an average, to 100 yards, the machine is so contrived as to throw itself out of geer, and stop, after the desired number of revolutions.

Upon the shaft of the drum, A, there is a conical pulley, *d*, from which another conical pulley, *e*, set the reverse way, is driven by a band. Upon the shaft of the latter pulley there is a pinion working in the little wheel, *f*, and thus actuating, by another pinion on its shaft, the wheel, *g*, near the circumference of which there is a stud, *i*, which, after each revolution of the wheel, *g*, depresses the lever, *h*. This, on rising, meets the catch, *l*, fixed upon the shaft, E, and stops that shaft after it has made a sufficient number of revolutions to fill the bobbins upon the spindle, B. Since the diameter of the drum, A, progressively diminishes as the threads are unwound from it, whereby it gives off less thread at each successive revolution, the speed of the little wheel must be proportionally diminished, in order to allow the successive sets of bobbins to be filled to the same degree as at first. This equation is produced by the gradual shifting of the band from the larger extremity of the cone, *d*, towards the smaller, and of course from the smaller extremity of *e* towards the larger. The band is guided, as usual, by a forked handle, seen in dotted lines, at *p*, fig. 129. It is attached to one end of a bell-crank lever; the other end being connected by a rod, *m*, with the lever, *n*, which is pressed by a counter-weight, *o*, against the thread upon the drum, A, thus rising and shifting the fork of the strap, in proportion as the threads are unwound from the said drum.

There are several terms peculiar to the lace manufacture. The gauge, or points, means the number of gates in one inch of the bolt, or slits in the comb; and indicates, of course, the number of bobbins in an inch of the double tier. Thus, gauge nine points means nine gates in one inch of the machine.

A rack is a certain length of work counted in the diagonal direction in which bobbin-net lace is woven: it contains 240 holes or meshes. This diagonal, like that of the parallelogram of forces, in mechanics, results from the vertical motion of the warp-threads in their constant progress from the warp-beam below to the lace-beam above, combined with the transverse horizontal motion, or march and counter-march of the weft-thread along with the bobbins. Well-made lace has the meshes elongated a little in the direction of the selvage.

The common gauge used is sixteen holes in the inch, up and down the machine, for ten bobbins transversely. Circular bolt machines, represented in plates IX. and X., produce, by steam-power, fully 360 racks each per week, working 18 hours per day, with a relay of superintendents.

It is the back bolt-bar only which shogs or traverses; it moves, with its carriages, one step or gate at a time, to the left and back again. The movements are as follows:—At the commencement the needle-points are supposed to be all in one line, and both tiers of carriages to be in the front comb or bolt.

1st *movement.* Front guide-bar shogged to the right with the front warp-threads, and the carriages are divided between the two combs or bolts, one half (about 600) in each.

2. Both tiers of carriages moved into the back comb; front guide-bar shogged to the left.

3. The carriages again parted equally between the two combs; back guide-bar shogged one step to the left, with the back warp-threads.

4. Carriages all moved into the front comb; back guide-bar to the right.

5. Carriages parted between the combs; front guide-bar to the left.

6. Carriages all into back comb; back guide-bar to the left.

7. Carriages parted; back bar to the right.

8. Carriages into front comb; front guide-bar to the right.

9. Carriages parted; front guide-bar to the left, and back comb to the left, with its tier of carriages.

10. Carriages all into the back comb; back bolt-bar to the right; guide-bar stationary.

11. Carriages parted; back comb shogged to the left, and back guide-bar also to the left.

12. Carriages all into front comb; back guide-bar to the right; back comb to the right.

The march and counter march of the bobbins, with the simultaneous movements of the warp-threads, may be rendered intelligible to every capacity by making a row of parallel slits in a couple of playing cards, to represent the gates of the two opposite bolts or combs, into which a series of buttons may be slid by their shanks, to represent the carriages. The two cards being laid down flat upon a table, with the two sets of slits fronting each other, the following six changes of position may be made, in correspondence with those of the lace machine :—

1. Move the back comb, or card, one slit to the left.

2. Shift all the buttons upon the back card, and shove the back card one step to the right,—its primitive position.

3. Part the buttons between the two cards; an odd one will now remain upon the back card, at the left end.

4. Move the back card one slit to the left, and then bring all the buttons into the front card.

5. Move the back card one slit to the right, its original position.

6. Both sets of buttons have advanced one step to the right, and there will remain an odd one upon the right end of the front cards, while one has come from the rear to the front at the left end, indicating the commencement of the counter-march.*

Many patents have been obtained for improvements in lace machinery, which have for their object to make breadths of lace with selvages,—that is, to make such divisions in the broad sheet of net as shall allow of its being separated into distinct strips, or narrow breadths as ribands, with perfect edges.

This object had been readily effected in Lever's, and in some other constructions of lace-making machinery; particularly the circular bolt of Mr. Morley, which

* See Mr. Morley's excellent observations upon the preceding account of bobbin-net in note A, at the end of this volume.

was used for that purpose by him immediately after its first invention; and it has been likewise regularly used ever since by the trade, to whom he most liberally left it open, though it was the greatest practical improvement ever made upon the original bobbin-net apparatus. At first, Mr. Morley's locker bars had only one plate or blade, constituting the machine now called the *Single-locker Circular Bolt.* In the year 1824 he added another plate to each of the locker-bars, which was a further improvement of importance as to the machines for making plain net, though it was an obstruction to the making of breadths upon them. This machine is now distinguished from the former by the title *Double-locker.* Croft's two patents of February and December, 1832, are for a method of making breadths, upon Mr. Morley's second improvement.

I shall select an outline of Mr. Croft's first plan, as being probably more intelligible to the general reader. His second plan is undoubtedly preferable in practice, but is not so well adapted for illustrating the method of manufacturing *quillings.*

Fig. 131 represents, in partial section, the operative parts of a circular bolt machine, with double-bladed locker-bars; and in which figure the present improved parts are added. *a* shows the situation of the front range of circular bolts or combs; *b* the back range; *c* and *d* are the double tier of bobbins and carriages, in one of which ranges there must be one bobbin more in number than in the other; *e* is the front driving-bar, *f* the back driving-bar, which, by vibrating, strike against the carriages, *c,* and *d,* and cause them to slide to and fro on the circular bolts, *a* and *b.* The front locker-bar, with its two blades, is shown at *g*, and the back locker-bar at *h*. These bars have reciprocating rotatory movements on their axes, for the purpose of causing their blades to strike against the tails of the bobbin-carriages, in order to pass them through the warp-threads in the middle.

The evolution and the mechanism for effecting these movements, and also the shogging or lateral movements of the circular bolts, are well understood as causing the threads from the bobbins to cross each other, and form the tops and bottoms of the meshes, and by twisting round the warp-threads proceeding from the roller, *i*, through the guides, *j*, *j*, to produce the sides of the meshes; the carriages being, by these means, made to move in zigzag directions, and to travel through the whole series of front combs or bolts in one direction, and of the back combs or bolts in the opposite direction.

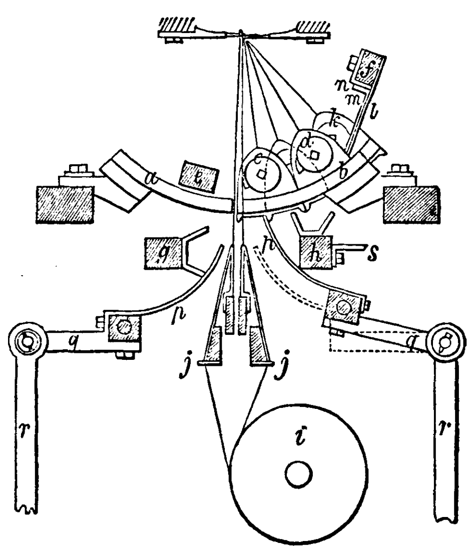


Fig. 131.—Croft's Machine for Bobbin-net Breadths with Selvages.

If these movements of the entire ranks or tiers of bobbins and carriages were uninterrupted, the bobbins would each, as they severally arrived by their zigzag course at the ends of the ranges of bolts or combs, pass over, and return along the opposite range, forming a finish to the meshes, or a perfect selvage at each of the outer edges of the broad sheet of net, by twisting the bobbin-threads round the outer warp-threads. If, however, one of these bobbins and carriages were removed from the front range of bolts or combs, so as to leave an opening in the series of bobbins, an interruption would take place in the formation of the meshes of the net at those places where the bobbin was wanting. If single bobbins were withdrawn from the range in several places, the same interruption would take place in the formation of the connecting meshes opposite to those blanks, and the broad sheet of net would be separated at those parts into strips or ribands, technically called "*breadths,*" as the bobbins, on their severally arriving at the end of the intended breadth, would become what are called "*turn-again bobbins*"; that is, they would pass over to the opposite range of bolts or combs, and travel in the reverse direction, forming selvages round the warp-threads at those parts of the sheet of net, and, consequently, separate it into strips.

As, however, it is necessary that the several narrow strips of lace so produced should be connected together, and made to form one broad sheet, additional bobbins, as *k*, called "*whipping bobbins,*" are placed in the back combs or bolts opposite to each of these spaces, in order to be occasionally brought into operation, merely to carry a single thread round the two selvages, for the purpose of whipping or lacing them together.

These whipping-bobbins, *k*, are required to be held back when the range or tier of bobbins, *d*, are driven by the bar, *f*, toward the middle; to allow of which a horizontal plate, seen edgewise at *l*, affixed to the front of the bar, has saw-gates or openings cut in it opposite to each whipping-carriage; so that when the bar, *f*, with plate, *l*, advances to drive the bobbin-carriages, *d*, the whipping-bobbins, *k*, remain stationary in the back parts of the combs or bolts; but when it is required to bring these whipping-carriages forward also, then the saw-gates or openings in the plate, *l*, are covered by a sliding piece, *m*, formed as a comb, which is attached to a bar, *n*, in front of the driving-bar, *f*, and is moved, when required, by what is termed a shogging apparatus, at the end of the machine.

The double-bladed lockers could not be made to work the ordinary bobbins, without bringing forward the whipping bobbins, *k*, with them, and entangling those carriages in the warp-threads at the time of shogging the bolts or combs: neither will a locker, with double blades, allow the turn-again carriages to remain behind when it is necessary to perform transfer; consequently such machines have not been found capable of producing broad sheets of lace divided into breadths. This difficulty is overcome by the employment of forked arms, or levers, *p*, *p*, called pickers, which are employed for pushing back the carriages of the turn-again and whipping bobbins preparatory to shogging the bolts or combs.

The series of pickers, *p*, are fixed upon horizontal bars, *q*, *q*, which turn upon pivots, hanging in bent levers, *r, r,* the lower ends or longer arms of these levers being acted upon by a cam-wheel, or some other suitable contrivance, at such times as it may be necessary to raise and throw back the pickers, as shown by dotted lines.

By thus raising the picker, *p, p,* the turn-again, and also the whipping-carriages, are driven back in the bolts or combs, after the double-bladed locker-bars have acted upon them; and at the same time that the pickers rise up, the sliding plate, *m,* on the top of the bar, *l,* moves laterally, for the purpose of throwing open the recesses or saw-gates, into which the whipping-bobbin carriages are thereby allowed to retreat.

As soon as the outermost blade of the locker has passed clear of the teeth of the carriages, the pickers fall from their elevated position, and allow the turn-again carriage to be operated upon in the usual manner. Attached to the back locker-bar, *h,* is an extra blade, *s,* the object of which is to present itself against the tooth of the whipping-carriages after the pickers have retreated, and thereby prevent it from falling, by its own gravity, between the warp-threads at the time of shogging.

BOOK IV.

PRESENT CONDITION AND STATISTICS OF THE COTTON MANUFACTURE.

CHAPTER I.

Cotton Manufacture of the United Kingdom.

It is a truth well established at the present day, that trade tends to distribute itself in various countries in the joint ratio of their natural resources, and the industry of their inhabitants, without much regard to diplomatic considerations. Political catastrophes, such as civil and foreign wars, are accidents which may derange this distribution for awhile, but whenever they cease to act, the nations begin again to develop their peculiar faculties, and to convert them into substantial elements of prosperity. Great mistakes have long prevailed concerning the causes of the predominance of British manufactures; some having ascribed it (as the French prohibitionists still do) to our navigation laws, some to our commercial treaties, and others to our vast colonial possessions. These causes undoubtedly contributed somewhat to the encouragement of our nascent industry, but to no very great extent; and they are now nearly inoperative. It is to our coal, iron, rivers, seaports, canals, highways, capital, and the skill employed in agriculture, and the arts; or the natural resources of our peaceful island, turned to good account—that our large share in the trade of the world is to be ascribed.

The spirit of the age tends towards commercial liberty, wherever fiscal regulations allow it to follow its own course. Even the new German confederacy, however impolitic in some respects, may be regarded as the first and great measure of enfranchisement by removing custom-house trammels from its internal trade.

England has for several years adopted the liberal system; not for the purpose, as has been said, of a decoy, under which she may invade foreign markets, but in obedience to the force of circumstances. Her patent monopoly expired with the war, in consequence of the rival industry of other nations. The famous treaty of Meduen, which converted Portugal into an English colony, exists no more; free intercourse is now permitted between that country and every other; and this diplomatic event, which would have excited a great sensation in Europe fifty years ago, has passed over in our days almost unperceived, as the natural and inevitable result of the progress of opinion. Cromwell's celebrated Navigation Act has been rendered nearly non-effective by the assimilation, in many cases, of the French, American, and German shipping with the British. Even the recent ministerial inquest of France, at which the friends of free trade and the partisans of prohibition came into close conflict, shows not only the stubbornness of the tortuous roots shot forth under commercial restriction, but the barrenness of the whole protective system, and will unquestionably lead to its modification at no distant date.

In the "*Philosophy of Manufactures*," having devoted Chapter III. of Book I. to the *Topography* *and Statistics* of the factory system,—including the four great divisions of the textile manufactures,—the cotton, woollen, linen, and silk, I may refer my readers to the causes there assigned why one district is chiefly occupied with manufactures, and another with agriculture; why one selects cotton, another wool, and a third linen, as the main object of its industry.

The actual amount of the cotton manufactures of the United Kingdom has been estimated upon different principles, and with considerably different results.

From the multiplied observations which I have had occasion to make in spinning factories, I think the produce of each spindle, on an average, of mules, throstles, and self-actors, may be fairly taken at 20 hanks of the average counts of 40's. or half a pound weight of yarn, per week of 69 hours. This is 25 per cent. under the produce of Mr. Orrell's, and most of the modern mills; and 50 per cent. under that of Sharp and Roberts' self-actors. But I consider it a fair average of weight, taking into account the smaller produce of the finer spinning-mills.

The quantity of cotton delivered and used last year, ending in May 1836, for home consumption, may be fairly assumed in round numbers at 330 millions of pounds, or very nearly one million of bags, most of which exceed 300 pounds in weight. In fact, Messrs. George Holt and Co., the eminent cotton brokers, of Liverpool, in their annual statement, rate the average weight of the bags at about 335 pounds. In 300 working days, or 50 weeks of six days, 25 pounds will be spun per spindle. Hence, after deducting one-tenth for waste, 300 millions divided by 25 = 12 millions, will represent the number of spindles at present at work in the United Kingdom. I believe this statement to be not far from the truth.

If we reckon each stretch of a mule to be 58 inches, and three stretches of 40's to be made in one minute, equal to 14½ feet, then 870 feet will be spun per hour; 870 yards, or a hank and 30 yards, in three hours; and nearly four hanks in the day; which amount to about 24 hanks a-week. But in the best modern mills, a stretch of from 30's to 40's weft is made in less than 20 seconds. We are, therefore, safe to assume 12 millions as the actual number of spindles in activity; since in 60's, and in still higher counts, only two stretches are made in a minute, and in counts above 140's only one stretch. In the finest numbers, a minute and a half, or even two minutes, are employed in completing a stretch.

Suppose a stretch for 120's to take one minute, then only five hanks would be spun in a week by each spindle; or 120 hanks, weighing one pound, in 24 weeks, which is very nearly half a year. At this rate no less than 150 millions of spindles would be required to spin the 330 millions * of pounds of cotton-wool last year delivered out for consumption. I have seen 170's spun at the rate of a stretch per minute; but in only one mill at Manchester, conducted by a truly scientific spinner.

Dr. Cleland, in his elaborate "*Statistics of Glasgow*," enumerates the mule and throstle-spindles at work in Lanarkshire, in 1831; the former

* Allowing in round numbers 10 per cent. of waste.

being 591,288, the latter 48,900; which numbers are nearly as twelve to one. It is probable that the same proportion may be applicable to the whole spinning-mills of Scotland. But in those of England it will not hold, on account of the great demand for throstle-yarn for the fustian and velveteen fabrics.

It appears from the minute survey made by Mr. Crompton, in 1812, that from four to five millions of spindles were then going upon his mule principle. Mr. Kennedy estimated the number of mule-spindles in 1829, at about seven millions*. It is to be regretted that the factory inspectors had not been instructed to enrich the statistics of the cotton manufacture with a register of the numbers of mule and throstle-spindles at work in each factory under their superintendence. This information would be very valuable to the spinning trade itself, and would, I am sure, be most readily afforded by its members. It would exhibit the condition of the business more accurately than any other document, and would be peculiarly instructive in reference to the nature of children's employment. At the throstle-frames, young persons under 17 or 18 are seldom or never employed.

The quantity of cotton-wool delivered for the home consumption of Great Britain, in 1829, was 745,200 bags = 223,560,000 lbs., which is to that in 1835, in the ratio of 7 millions of spindles to 10 millions and 300,000. In 1829 the average weight of a bag is stated by Messrs. Holt at only 280 lbs.; so that the economy of package has increased since that time in the proportion of 335 to 280, or 12 parts upon 100.

* Memoir of Samuel Crompton, p. 7.

If we assume the number of mule-spindles to be to that of throstle-spindles as 8 to 1, we shall have $10\frac{1}{2}$ millions of mule-spindles, and $1\frac{1}{2}$ millions of throstle-spindles, as the total spinning power of the United Kingdom at the present time, March 1836.

The following estimate for 1817 was published by Mr. Kennedy, in the third volume of the "*Memoirs of the Manchester Society.*"

	Pounds.
Quantity of raw cotton consumed or converted into yarn, in Great Britain and Ireland, was	110,000,000*
Loss in spinning estimated $1\frac{1}{2}$ oz. per lb.	10,312,500
Quantity of yarn produced . . .	99,687,500
Number of hanks (supposing the average to be 40's to the pound) .	3,987,500,000
Number of spindles employed (each spindle being supposed to produce two hanks per day, and 300 working days in the year)	6,645,833
Number of persons employed in spinning (supposing each to produce 120 hanks per day)	110,763
Number of horses' power employed (supposing $4\frac{1}{2}$ oz. of coal to produce 1 hank of No. 40, and 180 lbs. of coal per day equal to one horse's power) .	20,768

* By the official returns of the Custom-house, 124,912,968 lbs. were imported; 8,155,442 lbs. exported; and 116,757,526 lbs. retained for consumption. This year was one of great manufacturing depression. The muslin weavers were in a state little short of starvation.

Were we to adapt Mr. Kennedy's proportions to the present increased consumption of cotton wool, which is about three times the quantity then assigned by him, we should be led to estimate the spindles at 19,937,499, and the cotton-spinning operatives at 332,289,—a number far above the truth. But if we admit that *fully* three hanks of 40's are *now* spun *per diem*, instead of two, as in 1829, which, from the facts above adduced, we are well warranted to do, then the number of spindles will be reduced from Mr. Kennedy's estimate to about 12 millions, as directly deduced in my first statement. His number of spinning operatives would need to be reduced in a greater proportion than one-third. The returns of the factory inspectors last year gave the number of operatives, of all descriptions, engaged in cotton mills, as 229,382, to which, if we add 20,618, as the increase since, we shall raise their present number to 250,000. But of these undoubtedly 60,000, at least, are engaged in tending the power-looms and dressing-machines subservient to them; so that the number of operatives engaged in spinning, and in the processes preparatory to it, cannot exceed 190,000; and is more probably, about 180,000.

The cotton-mill operatives in Scotland form one-seventh of the whole number thus employed in the United Kingdom. But as much of the yarn spun in Scotland is for the muslin weavers, its average fineness is so far above 40's, as to have induced an eminent statistical writer * to regard 50's as the pro-

* John W. Cowell, Esq., in Supplementary Report of the Factory Commission, p. 119 *z*.

bable mean grist of cotton-yarns spun in the United Kingdom.

There is a remarkable document, entitled "List I. in the Tables extracted from the Returns to the Lancashire Forms of Inquiry, by Mr. S. Stanway, comprehending 151 Mills, from which complete Returns were made," according to the tabular forms issued at Manchester on the 17th and 20th of May, and 20th of June, 1833, under the direction of the Factory Commissioners. This very instructive table is reprinted in the Appendix to the first volume of this work, page 334.

The sum of average counts in the first page of the original folio table is . .	1,697,89
" Second . .	1,670,71
" Third . .	1,824,00
" Fourth . .	1,663,15
" Fifth . .	597,68
	7,453,43.

Now if this number be divided by 149, which is the number of mills corresponding to the said sum of average counts, the quotient will be 50·0, showing that 50's are the true mean counts of English mills. Only 38 of these 149 mills are in Manchester, and many of these 38 spin low counts; so that if we take into account the finer yarns of the Scotch mills, I think there can be little doubt that the average counts of the British yarns is nearer 50's. than 40's. Were we to take 50's for the average, and were we to suppose 20 hanks to be spun by each spindle in a week of 69 hours, (which is, however, much above its productive power,) then in 50 weeks, or an average working year, only 20 pounds would be spun by each spindle. But if we divide 300 millions of pounds by 20, the quotient, 15 millions, would in this case represent the number of spindles requisite to work up the quantity of cotton consumed last year in the factories of the United Kingdom. I conceive, therefore, that there is no exaggeration in estimating our actual number of spindles at 12 millions.

If we reckon the average weight of a piece (36 yards long) of power-loom cloth, for printing, to be $6\frac{1}{2}$ lbs., and $5\frac{1}{2}$ pieces to be woven upon each loom per week, then 1,000 looms will require 35,750 lbs. of yarn, which is very nearly the product of the 45,860 spindles at work in Mr. Orrell's factory. Hence from 45 to 50 spindles, spinning from 36's to 38's, are equivalent to supply one power-loom with yarn. 1,100 power-looms, with all their subsidiary spinning and dressing-machinery, require (from the data of that mill) a power of 250 horses to drive them. Allowing two horses' power for 30 looms, and one horse's power for their dressing-machine, 110 horses' power will be absorbed by 1,100 calico looms; and the remaining power of 140 horses will be expended upon the spinning and reeling apparatus of the factory. If there be 110,000 power-looms at present in activity in the United Kingdom, as is most probable, they will require fifty times their number of spindles, or 5,500,000, to supply them with yarn; and both together will require the power of 25,000 horses to impel them. The remaining 6,500,000 spindles are employed in spinning yarns for the hand-weavers, frame-work knitters, bobbin-net lace manufacturers, of this kingdom, and for exportation. Of these spindles seven-eighths may be accounted mule, and one-eighth throstle. 500 hand-mule spindles require (including preparation) the power of one horse; and 150 throstle ones require also one horse, upon an average of the common and the Danforth construction. Hence 5,687,500 mule-spindles will require the power of 11,375 horses; and 812,500 throstle-spindles the power of 5,417 horses. Thus the total power at work in the spinning and weaving departments of the cotton manufacture would seem to be equal to that of 41,792 horses, upon the steam estimate of Mr. Watt; or more probably, on account of the great friction of the older spinning machines, 45,000.

A year ago, when the cotton manufacture was not so extensive as it is at present by about one-tenth, the number of operatives employed in its factories was, by the parliamentary returns, 229,382; it must now amount to nearly 250,000, or to about 11 individuals for the power of two horses. This proportion will, of course, be different in different mills: in some fine spinning mills there may be 10 or more individuals to a horse's power; and in coarse spinning and weaving mills, perhaps only four.

Mr. Burn, in his much esteemed "*Commercial Glance of the Cotton Trade*," estimates the average consumption of cotton wool in Great Britain, during the year 1835, at 17,750 bags weekly, and for the last week in December, 18,000 bags; which, at the rate of 342½ lbs. per bag, would be 6,165,000 lbs. "Allowing 1¾ oz. per lb. for loss by waste in spinning, the yarn produced would be 5,490,703 lbs. To spin this yarn, supposing each spindle to produce on the average 8½ oz. per week, there would be required

11,152,000 spindles. Hence it would appear, from the usual mode of calculating the capital required for cotton spinning, viz., for building, power, and machinery, at 17*s*. 6*d*. per spindle,—the capital sunk in this branch of the cotton manufacture in Great Britain amounts to £9,758,864."

From the progressive increase since the end of the year 1835, up to the present time, March 1836, we may estimate the value of the sunk capital at considerably upwards of ten millions sterling. When a power-loom factory is combined with a spinning-mill, so as to weave up the yarn produced, the sunk capital becomes more than doubled. Thus in Mr. Orrell's mill, which may be regarded as a good model establishment of this kind, if its 45,860 spindles, at 17*s*. 6*d*. each, be reckoned at £40,000, then other £44,000, at least, must be allowed for 1,100 power-looms, and their subsidiary dressing-machines, &c.

Hence 110,000 power-looms, with their appropriate spinning machinery, at the rate of £84 per loom, may be estimated at £9,240,000. The remaining 6,500,000 spindles (to make up the total 12 millions) represent a capital of £5,687,500. These two sums added together will give a total fixed capital of £14,927,500, or 15 millions sterling, engaged in the cotton factories of Great Britain, exclusive of those occupied with the bobbin-net lace manufacture.

CHAPTER II.

Statistics of the Bobbin-Net Trade.

For the following elaborate and instructive statistics of the bobbin-net trade, my readers are indebted to Mr. William Felkin, of Nottingham :—

August, **1833.**

Capital employed in Spinning and Doubling the Yarn.

Fixed capital in 35 spinning and 24 doubling factories—724,000 spinning, 296,700 doubling spindles	£715,000	
Floating capital in spinners and doublers' stock, and necessary sundries	200,000	
	915,000	
Deduct 1-6th, employed for foreign bobbin-net trade	155,000	
Total capital employed in spinning and doubling for English bobbin-net trade . .		£760,000

Capital employed in Bobbin-net Making.

Fixed capital in 25 factories, principally for power machines		85,000	
Fixed capital in 1,100 power machines, averaging 11 quarters wide		170,000	
Fixed capital in 3,900 hand machines, averaging 9 quarters wide		267,000	
Floating capital in stock on hand, power owners	£150,000		
Floating capital in stock on hand, hand owners	250,000		
		400,000	
			922,000
Capital in embroidering, preparing, and stock . .			250,000
Total capital employed in the trade . . .			£1,932,000

The following Number of Hands are employed.

In spinning—adults, 4,800; children, 5,500 .	10,300	
In doubling—adults, 1,300; children, 2,000 .	3,300	
	13,600	
Deduct 1-6th employed for foreign demand .	2,300	
		11,300
In power net making—adults, 1,500; youths, 1,000; children, 500; women and girls in mending, 2,000 .		5,000
In hand-machine working—small machine owners, 1,000; journeymen and apprentices, 4,000; winders, 4,000; menders, 4,000		13,000
Mending, pearling, drawing, finishing, &c. . . .		30,000
In embroidering, at present very uncertain, probably about		100,000
Total of hands employed		159,300

Value of the Raw Material when imported, and of the Goods manufactured therefrom.

Amount of Sea Island cotton annually used, 2,387,000 lbs., value before the late advance, £179,000, but now worth £224,000. This is manufactured into yarn, weighing 1,532,000 lbs., value £766,000. But of this quantity 262,000 lbs. are sent abroad, leaving 1,270,000 lbs., value before the advance £635,000, and since the advance worth £680,000. This yarn (inclusive of about £10,000 worth of thrown silk) is worked up into

5,645,000	yards of hand lever quilling net, averaging (fine 11-point, at 1*s.* 3*d.* per square yard)	£352,815
2,207,000	yards of hand circular quilling net, averaging (fine 11-point, at 1*s.* 3*d.* per square yard)	137,935
6,622,000	yards of hand circular plain net, averaging (fine 12-point, at 1*s.* 6*d.* per square yard)	496,650
4,580,000	yards of hand rotatory plain net, averaging (common 11-point, at 1*s.* per square yard)	229,000
10,905,000	yards of power plain net, averaging (common 11-point, at 1*s.* per sq. yd.)	545,250
562,000	yards of fancy net, at 2*s.* 6*d.* . . .	70,250
250,000	yards of silk net, at 1*s.* 6*d.* . .	18,750
Total sq. yds. 30,771,000	Annual produce of English bobbin-net, of the present value of . .	£1,850,650

Two years ago there was much fine yarn on hand, and many mills were then standing, or only worked three or four days a-week: all these and many others are in full occupation, their production being regularly absorbed by the actual demand; for there are now no stocks of fine yarns here or on the Continent; and while an advance has taken place in coarse yarns, equal to the rise in the price of cotton wool, none has taken place in fine yarns in this market. This state of things is not likely to continue very long; the machine owners may therefore expect an advance in fine yarns; and in that case, as it is certain that there are no stocks of plain nets on hand, it is not improbable that an advance may be obtained on that branch of our production. Either the prices of quillings must be raised, or the majority of the machines making them must stand still, under any advance of cotton yarn.

By comparing this calculation with that of 1831, when 23,400,000 square yards, the then annual produce, were worth £1,891,875, it will be seen, that while there is a difference in favour of the machine owners and workmen, in the smaller proportion of quillings to plain nets now made, and in the advantageous use of much new and improved machinery, yet, on the other hand, they are producing 7,000,000 of square yards per annum more than at that time, for about the same amount of wages and profits; the number of cotton now used being on the average as fine, and its price as high, as at the period when that calculation was made. The average fall in the price of bobbin-net has been 20 per cent.

It is probable that about £550,000, or little more than one-third of what was paid in 1831, may have been paid for English embroidery during the last twelve months. Since our statement in 1831, the embroidery put on bobbin-net, both at home and abroad, has been of a much less expensive quality than heretofore, as well as at greatly reduced wages, which will account for part of the great diminution here stated, and decreased demand explains the rest. Foreign embroidery on bobbin-net is annually on the increase, and likely to continue so.

Of late, three-fourths of our production has been exported, and chiefly in the plain state. The American trade, which has much increased, is supplied entirely in the white. Quillings are sent to the north of Europe in the white, as are also the principal part of the wide nets sent to those markets. A large quantity of wide net is sent into Belgium and into France, in the unbleached state. We have almost entirely ceased to export quillings into France, as they make an immense quantity themselves. Recently, increased impediments have been thrown in the way of the introduction of bobbin-net into France, as also of the English yarns—the latter to satisfy the French spinners, the former the makers of nets. The demand for quillings from Germany has also materially declined, and many houses are giving up dealing in the article. The extensive frauds which have been practised in putting quillings up in this market for foreign trade, both as to the lengths often being short and of inferior quality in the inside of the cards, combined with the excessive fluctuations in price, have disgusted and impoverished foreign buyers, and it is very probable may have tended to produce the present difficulty in sales.

English Bobbin-net Machinery.

Hand levers—5 and 6-quarter, 500; 7-quarter, 200; 8-quarter, 300; 10-quarter, 300; 12-quarter, 50; 16-quarter, 30; 20-quarter, 20	1,400	
Hand rotatory—10-quarter, 100; 12-quarter, 300 .	400	
Hand circular—5 and 6-quarter, 100; 7-quarter, 300; 8-quarter, 400; 9-quarter, 100; 10-quarter, 300; 12-quarter, 150	1,350	
Hand traverse, pusher, and straight bolt, averaging 5-quarter	750	
Total hand machines . .		3,900
Power, 5, 6, and 7-quarter, 90; 8-quarter, 350; 10-quarter, 280; 12-quarter, 350; 16-quarter, 30 . .		1,100
Total number of machines . . .		5,000

The wages paid in fine spinning are—for adults, from 8*s.* to 40*s.*, and perhaps may average 17*s.* per week; children from 2*s.* 6*d.* to 7*s.*, averaging about 5*s.* In doubling, adults from 8*s.* to 30*s.*, averaging about 12*s.*; children, from 2*s.* 6*d.* to 7*s.*, averaging about 4*s.* 6*d.*

In bobbin-net making, men, 18*s.*; apprentices, 10*s.*; boys, 5*s.* In mending, winding, threading, &c., children, 4*s.*; women, 8*s.* In embroidering, children, 1*s.* to 2*s.*; women, 3*s.* to 5*s.* per week, working twelve to fourteen hours. During the last two years an extraordinary depression has taken place in the demand, and wages paid, for embroidery, chiefly arising from competition with Belgic and Saxon embroidered goods. Wages are lower in those countries than they have been here, though our good hands were reduced to 2*s.* 6*d.* or 3*s.* a-week, for women's wages. Many have left the business in despair, and a considerable reaction has taken place, so that hands are now scarce at the rate above quoted. It is very difficult to ascertain with any exactitude the number at present employed. The health of lace embroiderers is frequently impaired, owing to their always sitting and leaning forwards over a frame when at work. Any predisposition to pulmonary disease or indigestion is brought into activity, and slight distortion of the body is common amongst them. Females are employed from a very early age, and the hours of working are much too long. The pernicious effects of this sedentary labour must inevitably be felt in future years; however, being domestic and voluntary employ, it would seem impossible to interfere.

It was observed in my former paper,* that wages were reduced in 1830 and 1831, say 25 per cent., or from 24*s.* to 18*s.* a-week; and that machines had increased in the same time 1-8th in number, or from 4,000 to 4,500, and 1-6th in capacity of production. It was also then stated to be deserving the serious notice of all proprietors of existing

* First Report of Factory Commissions, C, 1, page 186.

machines, that new ones were introducing into the trade, of such power of production as must still more than ever depreciate the value of their property, have a direct tendency to sink the small owners into journeymen, and either greatly increase the labour or depreciate the wages of the workmen. The machines that have since been built, if worked by three men, in six hour shifts, or eighteen hours per day, would each turn off 20,000 square yards of good net per annum. The result then predicted has actually occurred; the wages per rack have been much lowered, although the weekly earnings are about the same now as in 1831. The inferior machines are single-handed, and the journeymen are working either wider or speedier machines than heretofore, so as to produce probably a fourth more net for the same wages. The verification of the then anticipated fall in the saleable value of narrow hand machines, is given by Mr. Felkin, but omitted here. It is proper to remark, that the system of bleaching by the piece still continues to exert a very prejudicial influence over the value of all machinery engaged in this trade.

This reference to the difficulties and depression of the small machine owners and journeymen, arising from home and foreign competition, naturally presents a favourable opportunity for again urging upon these classes the importance of regular weekly savings, while they have sufficient left in the price of their nets, or of their labour, to admit of putting something by that may form a fund for their future supply in the hour of need. Moderate labour and independence, they themselves will allow, are infinitely preferable to excessive exertion and poverty, and are cheaply purchased by present economy and foresight. In the absence of these principles in extensive operation, no class of persons is more open to further depression, or has greater reason to dread it. The wear and tear, both of body and mind, produced by excessive labour in bobbin-net machines, will be found far greater than it is in a stocking-frame, or than is generally imagined. It is a fact, that diseases of the chest are even now much more prevalent than formerly amongst hand-machine workmen. The richest, most powerful, and most natural fund on which the workman or machine owner can draw, and which will enable him successfully to avert these evils, is that which he creates himself by his own savings; and enables him to command the price of his goods or his labour, not controlled by his necessities, but influenced by a prudent regard to his own welfare and that of his family.

Foreign Bobbin-net Machinery.

Calais . .	600	8-quarter 11-point hand circular, quillings: 100 of these built this year and last.	
„ . .	60	7-quarter 11-point hand levers.	
„ . .	45	various widths, old machines, pusher, traverse, &c.	
Boulogne .	30	hand circular, chiefly 8-quarter, quillings.	
St. Omers .	30	hand machines, plain nets.	
Douay . .	145	part power, part hand machines, plain net.	
Lille . .	120	chiefly 8-quarter, 10-quarter, 12-quarter power, plain net.	
Ghent . .	35	power 12-quarter.	
St. Quentin	90	chiefly hand plain nets.	
„	60	8-quarter, 10-quarter, 12-quarter power, plain nets chiefly.	
Caen . .	35	hand quilling chiefly.	
Paris . .	10	hand machines chiefly.	
Lyons . .	50	hand machines chiefly.	
„ . .	340	scattered through the villages in the north of France, chiefly hand machines.	
Switzerland	50	nearly all hand machines.	These five states, if we may judge from their efforts to obtain model machines, are preparing to make our article very extensively.
Saxony .	70	ditto ditto	
Austria .	60	power and hand machines.	
Russia and Prussia .	20	probably, and both hand and power.	
Total	1,850	machines.	

In 1823 there were not 35 machines in Calais, and not 100 upon the Continent altogether. 3*d*. a-rack covers labour and expenses in working 8-quarter 11-point quilling machines, at Calais; and 2*d.* a-rack covers all expenses in making 12-quarter power net, excepting the cost of the moving power. Forgers are paid on the average by machine builders 24*s.* a-week; filers, 16*s.*; setters-up, £16 for getting an 8-quarter 11-point quilling machine to work. These machines are producing about as follows:—

		sq. yds.	at	£.
220	5, 6, and 7-quarter, old machines, of various kinds, mostly plain, about 11-points . . .	330,000	1*s.* 0*d.*	16,500
100	6-quarter levers, averaging 11-points, plain . .	200,000	1*s.* 0*d.*	10,000
120	7-quarter levers, averaging 11-points, plain . .	350,000	1*s.* 0*d.*	17,500
100	8-quarter levers, averaging 11-points, half plain .	200,000	1*s.* 0*d.*	10,000
100	8-quarter levers, averaging 11-points, half quillings .	200,000	1*s.* 3*d.*	12,500
1,020	8-quarter circular, 11 points, almost all quillings .	6,124,000	1*s.* 3*d.*	382,750
290	averaging 10-quarter power, 11-points, nearly all plain	2,420,000	1*s.* 0*d.*	121,000
1,950	machines, making at present . . .	9,824,000	Square yards of net, value at English price	570,250

These machines probably use per annum, 130,000 lbs. of French spun yarn, No. 140 to 170 principally; and 265,000 lbs. of English spun yarn, of which a small quantity is of other numbers, both above and below 180, but the great bulk is of that number. The value of the English yarn is about £140,000, or delivered in France, about £170,000.

Bobbin-net is often bleached and dressed, in France, by the same person, who makes one charge for both operations; say 25 centimes the *aune*, equal to about $1\frac{3}{4}$*d.* the English yard, for all widths.

In an able address presented to the French Chamber of Deputies, in March, this year, and drawn up by a gentleman who has been engaged during the last 35 years in the French lace trade, and who is also now a bobbin-net machine owner, it was stated, in advocating the necessity for a grant of free entry of our fine yarns, at a 20 per cent. duty, and of course a stricter prohibition of English bobbin-nets, that the price of their first machines had fallen from £600 each to £120, and, in many instances, to the price of old iron; but that there were then 1,500 good bobbin-net machines at work in France; and that bobbin-net of the value of £1,000,000 is annually used in France, of which £500,000 is of English, and £500,000 is of French manufacture.

The total result of the operations of the whole of the bobbin-net trade, during this year, may be stated as follows:—6,850 machines use 3,000,000 lbs. of raw cotton, value £225,000, which, after it has been spun and doubled into 1,665,000 lbs. of yarn, is worth £833,000. This material is worked up into 40,595,000 square yards of bobbin-net, worth, in the markets where it is produced, £2,565,000 in its plain state. It is probable that nearly 1-6th of all the plain nets made are embroidered at home, and that rather more than that quantity is embroidered abroad, enhancing the market value by £1,300,000, and making the total value £3,865,000.

The author has been induced to bestow the requisite time and labour upon the compilation of the remaining part of this statement, from the conviction, that the more light is thrown upon this, as well as every other branch of business, the more cautiously and safely will capital be introduced into it, and the less risk will there be of those excessive fluctuations which we have often experienced in the value of machinery; and in the proportion between demand and supply, as well as, in the end, of the working classes suffering by unnecessary depression in their wages. Nothing has more tended to overload this trade with machinery, depress wages, and destroy profits and capital, than the extraordinary elevations and depressions in prices of bobbin-net, and which may generally be traced to ignorance on the part of both buyer and seller as to how high or how low sales may be forced in this market. The experience of no former period has exhibited this feature in our trade more clearly than that of the past year.

During this interval we have had a rise in many articles of 25 per cent. without any extraordinary demand, and a fall of 30 per cent. on the average of the whole production, without any superabundant supply. Machines are far less valuable than ever before; a more than usual amount of new ones have been constructed, and are now in process of construction; and the prices of bobbin-net have been lower than at any previous epoch of the trade.

Mr. Felkin has published a table, which gives as accurate an account of the public sales of machinery, during the last nine years, as his sources of information would allow; and as he has bestowed some pains to render it tolerably complete, it will probably be found sufficiently accurate to justify, when combined with the account he has obtained of the prices for which the majority of the machines were sold, the rate of depreciation stated to have recently occurred in the value of the great bulk of machinery now in the trade. In reference to this and all other similar calculations, any pretension to absolute accuracy is of course disclaimed: the correctness of general deductions, in these cases, depends upon the bearing of the sum total of the facts adduced, and not upon any minute particulars.

A list of hosiery and other frames, sold during the same period, is also given by him, as likely to prove interesting on grounds independent of the principal inquiry.

In the year 1824, and the spring of 1825, speculation in machinery prevailed to such an extent, that levers sold for

£90, circular for £80, and pusher and traverse warps for £50 to £70 per quarter of machine in width. But in the subsequent depression, during the first six months of 1826, levers fell to £18 to £20 a-quarter; circulars, to £15 to £18; and pushers and traverse warps, to £10 to £15. From January to March the working hours were restricted to 12, 10, and 8 per day. Bobbin-net improved in price in 1827, and again fell in 1828; in November of which year a restriction commenced, which continued for 12 months, limiting the time of work to about 12 hours a-day. In the latter end of 1828, levers machines sold for £12, circulars for £15, traverse warps for £3 to £4, and pushers for £6 each per quarter. In 1828-9, 535 machines appear to have been publicly offered for sale; in 1830-1, 206 only were offered. In 1828, many machines were built, but few in 1829, and more in 1830, chiefly 8-quarter and rotary. In 1831 many 10-quarter hand rotaries were built. The prices of bobbin-net rallied in 1829, and continued tolerably steady through 1830 and part of 1831. Towards the end of 1831 they fell materially. In the spring of 1832 some articles attained an unnatural height as compared with others, and in the autumn prices began to give way generally. They seem to have reached their lowest point for the present about Christmas, 1832, having then been sold, in many cases, under prime cost; for the rise which has taken place in cotton yarn, (in itself a singular circumstance, while many machines are making less work,) to be accounted for in good part by increased foreign demand, has been more than equivalent to the reduction to which the workmen have unhappily been compelled to submit. Levers machines will now only bring, when offered for sale, about £4 to £6 a-quarter in 6-quarter to 8-quarter, and circulars are nearly the like value. Eight circular machines, averaging 8-quarter 11-point, and which cost the parties, in 1825, £5,000, were sold lately for £300. Pushers, which were sold temporarily in 1829 for £20 to £25 a-quarter, will not now realize more than £3 to £4 a-quarter; and traverse warps are sold for £2 or £3 a machine. Rotary machines, when brought into the market, sell for £12 to £15 a-quarter, 8-quarter to 12-quarter wide. Setting the private sales, which are continual, and often considerable, against such part of the above amount of 1,843 machines publicly offered, as may have consisted of re-sold machines, and which would far more than make up the difference, it would result that, since the panic of 1825-6, one-third of all the machinery in the trade has passed out of the hands of the original owners. In the year 1832 there appear to have been only 213 machines brought into the market; but many more have exchanged owners through being mortgaged and taken possession of by creditors; and still more would have been offered of the inferior kinds, but from a conviction of the impossibility of realizing anything approaching to their supposed intrinsic value. Many such machines are single handed, or not worked at all. Where worked, the produce is selling at so low a rate, as to leave scarcely any thing beyond the price of the cotton.

It has been stated that the depreciation has been mainly upon the hand machines, up to nine quarter in width. It was calculated, two years ago, that there were 3,500 hand machines of all widths in the trade; the then current market value (not cost or maker's actual price) was about £390,000. The extreme present market value of them would be probably nearly as follows, viz. :—

1,350 levers	£71,500	Total £185,000; leaving a difference, compared with their value in September 1831, of £205,000, or more than one half.
100 rotary	£16,500	
1,300 circulars	£86,500	
750 pushers, traverse warps,	£10,500	

And this loss must fall, if no re-action take place, upon the present holders of these machines. The improbability of any such permanent improvement in the demand or bobbin-net, compared with the supply, as would materially raise the selling-price of these machines, or their working value, will appear from the fact, that during the last two years there have been built in this country, for home employment, about 300, 10 and 12-quarter hand rotary; 100 power, 12-quarter chiefly; 50, 12-quarter hand circulars; and 50 levers, 12 to 20-quarters; making an increase, since 1831, of 500 machines, averaging 12 quarters in width, of great speed and excellent construction. The outlay of English capital, in new bobbin-net machinery, in 1832 and 1833, has been at least £100,000. During the same time, it is probable that 200 new machines have been got to work abroad which cost £40,000. If my information be correct, not only many machines are building for the English trade, but capital is flowing even more rapidly into the foreign manufacture. The very extensive export of models, working drawings, and every part composing the insides of machines,—such as bolts, bobbins, carriages, points, &c.,—is strongly corroborative of this important fact.

W. FELKIN.

Nottingham.

Bobbin-net Frames in 1835.

Nottingham . . .	582	
Rest of county . . .	1,538	
		2,120
Leicestershire		385
Derbyshire		282
Mansfield and Chesterfield . .		132
West of England and Isle of Wight		793
		3,712
At stand . .		165
At work . .		3,547

At work . . 3,547; Hands employed, 5,868; Power Factories, 29 or 30; Hand Factories, probably 40.

Goods produced, and Value and Number of each kind of Machine.

	Square Yards.	£.	Machines.
By Rotary Frames . .	15,827,848 . .	662,255 . .	1,585
Lever " . .	8,327,240 . .	476,959 . .	1,225
Circular " . .	2,627,137 . .	141,864 . .	420
Pusher (Grecian) .	811,650 . .	41,574 . .	165
Traverse Warp . .	325,188 . .	54,198 . .	152
	27,919,063	£1,376,850	3,547

Machines employed in making Plain Net . .	1,425
" " Quillings . .	1,122
" " Fancys . . .	998
	3,545 (an error of 2 somewhere.)

Width of Net produced by Machines.

4-Quarter . . .	8	11-Quarter	172
5 "	51	12 "	816
6 "	366	13 "	29
7 " . . .	262	14 "	9
8 "	1,084	15 "	3
9 "	168	16 "	31
10 " . .	546	20 "	2
	2,485		1,062
			2,485
			3,547

271,000	lbs. yarn, No. 130 to 170, inclusive.
350,000	" " 180
250,000	" " 190
220,000	" " 200
60,000	" " 210
9,000	" " 220
1,160,000	*Net* value, £604,616.

640,000	used in Nottinghamshire,
100,000	" Leicestershire,
100,000	" Derbyshire,
320,000	" West of England.
1,160,000	

The last tabular statement was recently drawn up by Mr. Felkin, with his usual zeal, at the request of the Board of Trade, and through the favour of Mr. Porter it is here laid before my readers.

We shall conclude these general statistics of our cotton manufactures with a sketch of the topography of its various fabrics.

The chief seats of our muslin manufacture are Paisley, Glasgow, and Bolton; each place producing an article in some respects peculiar. The variety called jaconets, both coarse and fine, but always stout, as well as checked and striped muslins, and other articles of the heavier sort, are made in Bolton and its neighbourhood. Book muslins, as also those called mull and line, of lighter fabric than the Lancashire, are made at Glasgow. Paisley is celebrated for its sewed and tamboured muslins, which give domestic employment to great numbers of young women in the West of Scotland. Mechanical tambouring was attempted nearly thirty years ago at Glasgow, by means of a most ingenious machine invented by Mr. John Duncan, but it has never been found so profitable as to be pushed to any considerable extent, owing to the abundance and dexterity of the hand tambourers.

Figured muslins, called fancy goods, were first woven in the loom at Paisley, which having been previously the chief seat of the silk gauze manufacture, had trained a race of most ingenious artisans, distinguished for a spirit of study and research which would have done honour to men in the most exalted stations. They immediately transferred to cottons the elegant patterns which they had been accustomed to give to silks, and thus rendered their native town for many years the sole possessor of this beautiful branch of the trade. And even at the present day, though many of the principal manufacturers of Paisley have removed their warehouses to the more general emporium of Glasgow, yet they continue to draw their supply of goods from their former townsmen. This fact, joined to the circumstance of the fine muslin yarn being chiefly brought from Manchester to Paisley, shows how a manufacture, which depends on the skill of a colony of workmen, gets fixed and rooted, as it were, among them, in spite of many motives and efforts to transplant it. Thus also the Manchester spinners o fhigh numbers have never been rivalled by those of Glasgow, whatever pains the proprietors of the mills in the latter place may have bestowed in getting their machines made in the best manner, and after the most improved patterns.

The thicker cotton goods have also their favourite localities. Dimities continue to be exclusively manufactured in the North of England, though they have been often attempted, but in vain, by the Scotch. The finer qualities of these goods are made at Warrington, the coarser in the West Riding of Yorkshire. Preston and Chorley still retain Balasore handkerchiefs to themselves. Ginghams, however, which were long monopolized by Lancashire, have for several years been partially extended to Glasgow. On the other hand, Pullicat handkerchiefs—a style of goods first introduced at Glasgow in 1785, and manufactured exclusively there to a great extent for many years—were eventually introduced into Lancashire, but have never attained the same magnitude as in their birth-place.

Blue and white checks and stripes for the tropical markets are woven chiefly at Carlisle; though some are also made in Lancashire, and the county of Fife.

The manufacture of cotton cambric sprung up also from the mule-frame, and became characterized by two styles,—cambric for ladies' robes, either white or printed, and cambric resembling the fine linen cambric of France, for which it was designed to be a substitute: Lancashire is the sole seat of the first style, which it fabricates to an immense amount; Glasgow is the seat of the second style, and which is of much more limited demand. Either place has endeavoured, but in vain, to compete with its rival in this analogous production.

Effects of Improvements in Machinery upon the Prices of Products.

In the year 1782, Arkwright's cotton twist of No. 60 exceeded the price of the raw material by 20*s*. a lb., or, in other words, he charged 1*l*. sterling for spinning one pound weight of cotton into such yarn. In 1830 the charge for spinning one pound of such cotton yarn by the mule was only 1*s*. 6*d*. If we take into account the depreciation of the value of money since 1782, the decrease will be from 20*s*. down to 9*d*., that is in the proportion nearly of 27 to 1.

The number of mule-spindles going in 1812, appeared by actual survey to be 4,200,000, producing a quantity of cotton yarn equal at least to what could be spun in the same time by 4,200,000 persons working diligently with our household wheel.

In Great Britain all these spindles were conducted by 70,000 persons, working at average wages of 20*d.* a-day each; being one-sixtieth the number of persons necessary to manage as many spindles in India. But on account of more expensive apparatus and various contingencies, let us assume the ratio of 40 to 1. Then 40 Indian spinners at 2*d.* a-day, receiving altogether 6*s.* 8*d.*, will produce no more yarn than one British spinner at 1*s.* 8*d.*, being one-fourth of the wages. If we take into account also how many yards of good calico one person will turn off by a power-loom in the time that the Indian tanty would turn off only one, we may well understand how the cotton fabrics of Great Britain may eventually clothe not only her subjects in Hindostan, but the immense population of Eastern Asia, and its multitudinous isles.

The progressive fall in the prices of cotton yarns during the short space of 18 years is exhibited in the following Table, presented by John Kennedy, Esq., of Manchester, to a Committee of Parliament in 1830.

Hanks per day per spindle.			Price of Cotton and waste per lb.		Labour per pound, average 20*d.* per day, in		Cost per pound.	
Description of Yarn.	1812.	1830.	1812.	1830.	1812.	1830.	1812.	1830.
No.			*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*
40	2.	2.75	1 6	0 7	1 0	0 7½	2 6	1 2½
60	1.5	2.5	2 0	0 10	1 6	1 0½	3 6	1 10½
80	1.5	2.0	2 2	0 11¼	2 2	1 7½	4 4	2 6¾
100	1.4	1.8	2 4	1 1¾	2 10	2 2½	5 2	3 4¾
120	1.25	1.65	2 6	1 4	3 6	2 8	6 0	4 0
150	1.00	1.33	2 10	1 8	6 6	4 11	9 4	6 7
200	0.75	0.9	3 4	3 0	16 8	11 6	20 0	14 6
250	0.05	0.06	4 0	3 8	31 0	24 6	35 0	28 2

Indian prices remained the same at both periods.

Prices of Cotton Yarns per Hank.

English Prices.			Indian Prices.
	1812.	1830.	1812 and 1830.
No.	*d.*	*d.*	*d.*
40	$1\frac{1}{2}$	$0\frac{3}{4}$	$2\frac{1}{8}$
60	$1\frac{3}{8}$	$0\frac{3}{4}$	$2\frac{3}{8}$
80	$1\frac{5}{16}$	$0\frac{3}{4}$	$2\frac{3}{4}$
100	$1\frac{1}{4}$	$0\frac{13}{16}$	3
120	$1\frac{3}{16}$	$0\frac{13}{1}$	$3\frac{1}{4}$
150	$1\frac{1}{2}$	1	$4\frac{1}{16}$
200	$2\frac{3}{8}$	$1\frac{3}{4}$	$5\frac{3}{8}$
250	$3\frac{3}{8}$	$2\frac{3}{4}$	8

" It is upon the basis of spinning that the great abridgments of labour, and the consequent cheapness of the cotton manufacture, have been chiefly founded, and by which this country will be able to meet competition in the eastern markets, either in yarns or in cloth, of which they form the principal constituent value. Very important discoveries and improvements have doubtless been made in weaving, dyeing, printing, and bleaching, and particularly for certain operations and descriptions of cloth; but, taken in the gross, the amount will bear but an inferior proportion to the economy introduced by spinning, upon which both invention and exertion have been upon the rack for the last 30 years, and a real capital vested in building and machinery of 10,000,000*l.* sterling. The consequence of these improvements has been, that by the last returns, from 4,000,000 to 5,000,000 lbs. of cotton yarn have been exported to India in one year, while in 1812 only a few samples were sent."*

* Mr. Kennedy *ut supra.*

The fall of price is much more remarkable with regard to calicoes than to yarns. Of this fact Mr. Everett has afforded striking evidence in the following statement of cotton goods which he shipped in American traders from England to Canton during the years 1820-1, and down to 1828 inclusive. The total quantity was 226,571 pieces, value £207,784.

Depreciation of the Cost of Cotton Long Cloths since 1820.

1821	from 2½	to 5	per cent.	1826	from 30	to 35	per cent.
1822	5	7½		1827	35	40	
1823	10	15		1828	40	45	
1824	20	25		1829	45	50	
1825	12½	15		1830	47½	50*	

Thus nearly a double quantity of long cloths might be bought in 1830 for the same money as in 1820; and thus a double number of persons might be enabled to purchase and wear them.

By the increased exports of our manufactures, as their prices fall, we are enabled to obtain a vastly greater proportion of the productions of foreign nations than we did 20 years ago, as the following statement of *imports* at two such intervals will show:—

				1810.		Home Consumption. Jan. 1836.
Sheep's wool		lbs.		10,914,137		43,185,993
Cotton wool	{home consumption.}	do.		90,000,000		333,000,000
Sugar	do.	cwts.		3,489,312†		4,466,000
Coffee	do.	lbs.		5,308,096		22,326,000
Wine	do.	galls.	in whole	6,805,276	in whole	6,640,519 9,033,000
Tea	do.	lbs.	do.	22,000,000	do.	36,606,000 41,194,000
Pepper	do.	do.	do.	1,117,000		3,345,000

* Commons' Report on Indian Affairs, 1830.

† A great deal was consumed in the distilleries this year.

Prices of Upland Georgian Cotton Water-twist, No. 20, $\frac{9}{8}$ *Shirtings, and* $\frac{3}{4}$ *Velveteens.*

Years.	Cotton.	Water Twist.		$\frac{9}{8}$ Shirtings per piece.				$\frac{3}{4}$ Velveteens per lb.	
			Diff. to Cotton.			Diff. to Cotton.			Diff. to Cotton.
	d.	*d.*	*d.*	*s.*	*d.*	*s.*	*d.*	*d.*	*d.*
1827	$6\frac{1}{2}$	12	$5\frac{1}{2}$	.	.	.	.	.	.
1828	$6\frac{3}{8}$	$11\frac{1}{8}$	$4\frac{3}{4}$	.	.	.	.	$21\frac{7}{8}$	$15\frac{1}{2}$
1829	$5\frac{7}{8}$	$11\frac{1}{8}$	$5\frac{1}{4}$	.	.	.	.	$18\frac{1}{2}$	$12\frac{5}{8}$
1830	$6\frac{7}{8}$	$11\frac{1}{2}$	$4\frac{5}{8}$	13	5	7	$4\frac{1}{2}$	$18\frac{7}{8}$	12
1831	$5\frac{7}{8}$	$10\frac{5}{8}$	$4\frac{3}{4}$	13	0	7	$10\frac{1}{2}$	$19\frac{1}{4}$	$13\frac{3}{8}$
1832	$6\frac{5}{8}$	$10\frac{7}{8}$	$4\frac{1}{4}$	13	0	7	$2\frac{1}{2}$	$17\frac{5}{8}$	11
1833	$7\frac{5}{8}$	$11\frac{3}{8}$	$3\frac{3}{4}$	13	1	6	4	$17\frac{1}{8}$	$9\frac{1}{2}$

The loss of cotton of that quality in waste amounted to one-eighth, or 2 oz. per lb. The above Table was given in to the Committee on Manufactures by Joshua Milne, Esq., of Crompton, near Oldham. He has four mills, employs about 770 hands, several of whom are in families earning from 40*s.* to 50*s.* per week, and has lately disposed of power-looms for £255, which cost him £1,400, and replaced them by others of an improved construction. In his manufacture he allows 5 per cent. for interest of money, and 10 per cent. annually expended on repairs of the machinery, but 33 per cent. on the cards, which must be renewed every three years. He admits, that as he is working more cheaply now than formerly, in consequence of improved machinery, the difference between the price of raw and manufactured cotton is not a correct criterion of his rate of profit. The new looms cost only £800, and did better work than the old, which cost £1,400. This is a particular case, and could not be applied to the rest of the apparatus in the mill. The old looms were for fustians, and had been originally ill constructed for their work. "There is some machinery," adds he, "which it is better to burn than to use."*

Table of the Average Price of Cotton compared with Twist Sold.

The column "Difference" may be considered as denoting the progress of machinery in the cotton manufacture during the last thirty years. As the first number in this column is 20·2*d.*, and the last 5·37*d.*, it would seem to follow that cotton-spinning machinery is now nearly four times as efficient as it was thirty years ago. This conclusion is not, however, quite accurate, at least for the numbers given since 1825; as, from that period, the prices of yarn have been frequently insufficient to pay the cost of production, owing to the universal introduction of power-looms. This paradoxical result has been brought about in the following way:—Previous to the general use of power-looms, hand-loom weavers were the principal purchasers of cotton-yarn; but when the power-loom was extensively introduced, the manufacturing of cloth, by its assistance, did not form a separate business, as in the hand-loom trade, but was carried on under the same roof with the spinning of cotton, the manufacturers of yarn having added a power-loom department to that of their spinning machinery. The hand-loom weavers could not, of course, work against the competition of the steam-looms, or if they did struggle to earn a scanty subsistence from their business, they could do so only by giving a far lower price for the yarn they made use of than before; the consequence was, that there were

* Supp. Report Factory Commiss. p. 185.

hardly any buyers of yarn in the market, and the price was reduced so low that the profits of the spinners of it were almost annihilated; many of them were brought to bankruptcy, and, of late years, those coarse cotton-spinners only have driven a profitable trade, who have annexed power-looms to their spinning establishments. This explanation is necessary in reference to the present Table. The factory to which it refers is solely for spinning. This does not prove that the cotton business in general has been profitless for the last few years, but simply that the mode of conducting it profitably has changed, and that those who have stuck to the old method of proceeding have suffered severely.

At this moment (May 1836) the demand for yarn in the foreign (chiefly German and Russian) markets is so brisk, as to render power-weaving an unprofitable business relatively to spinning. Such are the vicissitudes of trade!

Average PRICE of COTTON compared with TWIST Sold.

——	Cotton per lb.	Twist sold per lb.	Average Number.	Difference.
From December 1802 to December 1805	19.6	39.8	25.9	20.2
— — 1805 — — 1806	19.08	36.18	25.	17.1
— — 1806 — — 1807	21.54	36.70	25.78	15.16
— — 1807 — — 1808	24.83	38.	24.61	13.17
— — 1808 — — 1809	26.83	41.91	24.37	15.08
— July 1809 — — 1809	20.73	37.01	24.69	16.28
— December 1809 — July 1810	20.93	40.79	22.97	19.86
— July 1810 — December 1810	19.75	38.51	22.96	18.76
— December 1810 — July 1811	17.96	34.40	23.09	16.44
— July 1811 — December 1811	17.43	28.71	23.59	11.28
— December 1811 — July 1812	17.81	29.72	23.15	11.91
— July 1812 — December 1812	18.24	29.09	24.45	10.85
— December 1812 — July 1813	24.75	35.46	25.22	10.71
— July 1813 — December 1813	25.12	35.08	25.52	9.96
— December 1813 — July 1814	33.52	46.92	25.06	13.40
— July 1814 — December 1814	31.67	45.40	26.	13.73
— December 1814 — July 1815	25.72	37.48	23.65	11.76
— July 1815 — December 1815	26.53	38.44	25.	11.91
— December 1815 — July 1816	20.47	37.74	25.4	17.27
— July 1816 — December 1816	20.73	33.8	25.3	13.07
— December 1816 — July 1817	22.3	34.65	25.7	12.35
— July 1817 — December 1817	20.44	33.6	25.46	13.16
— December 1817 — July 1818	20.46	34.55	25.6	14.09
— July 1818 — December 1818	21.13	32.95	23.4	11.82
— December 1818 — July 1819	14.49	30.85	24.53	16.36
— July 1819 — December 1819	13.65	27.53	24.95	13.88
— December 1819 — July 1820	14.44	26.03	25.70	11.59
— July 1820 — December 1820	11.62	21.40	25.18	9.78
— December 1820 — July 1821	9.82	20.11	25.73	10.29
— July 1821 — December 1821	9.91	19.45	25.53	9.54
— December 1821 — July 1822	9.23	19.27	25.54	10.04
— July 1822 — December 1822	8.34	19.14	25.6	10.8
— December 1822 — July 1823	7.8	19.23	25.6	11.43
— July 1823 — December 1823	8.24	19.63	25.34	11.39
— December 1823 — July 1824	8.81	19.41	25.9	10.6
— July 1824 — December 1824	8.78	19.09	26.1	10.31
— December 1824 — July 1825	14.	22.34	26.2	8.26
— July 1825 — December 1825	13.06	19.11	29.1	6.05
— December 1825 — July 1826	7.6	16.5	27.73	8.9
— July 1826 — December 1826	6.82	15.17	30.	8.35
— December 1826 — July 1827	6.95	14.97	30.95	8.02
— July 1827 — December 1827	7.34	14.77	30.	7.43
— December 1827 — July 1828	6.26	13.	27.41	6.74
— July 1828 — December 1828	6.64	13.3	28.33	6.66
— December 1828 — July 1829	6.23	12.96	28.23	6.73
— July 1829 — December 1829	6.34	13.43	29.69	7.09
— December 1829 — July 1830	7.01	13.28	27.85	6.27
— July 1830 — December 1830	6.82	12.72	26.77	5.90
— December 1830 — July 1831	6.65	12.82	28.58	6.17
— July 1831 — December 1831	6.82	12.37	27.40	5.55
— December 1831 — July 1832	6.97	12.76	29.43	5.79
— July 1832 — December 1832	7.24	12.61	29.52	5.37

Furnished by Samuel Greg and Co., not from their own mills, but they can vouch for its being accurate.

PRICES OF MANCHESTER COTTON TWIST, abridged from Mr. W. F. REUSS's excellent TABULAR VIEW of the COTTON MANUFACTURE of GREAT BRITAIN.

	1828.		1829.		1830.		1831.		1832.		1833.		1834.		1835.	
	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.
	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*	per lb. *d.*
Mule No. 20, Best Second	. .	. .	. .	. .	10¾	. .	11	10½	10½	10½	·11¼	14½	12¼	14	14	15¼
No. 40, Ordinary	11½	13	12¾	12½	12½	12¾	11¾	11	11½	11¾	12¼	14¾	12½	15	15	17
Good Second	12	13¼	13	12⅞	12¾	13¼	12½	11¼	12	12¼	12¼	15	13	15	15¼	17⅛
Best Ditto	12½	14	13½	13¼	13¼	13¾	13	11¾	12½	13	13	15¾	13½	15½	15¾	18
Extra Best Ditto	14	14½	14¼	14¼	14	14½	14¼	13	13¾	14	14	16¾	14¾	16½	17	19¼
No. 50, Ordinary	14	15¼	14¼	14¼	14½	15¼	14¼	12¼	13½	13¼	13½	16½	14½	16¾	16½	19
Good Second	14¾	15¼	15	14⅝	14⅝	15½	14¾	12½	13¾	13¾	13¾	16¼	14¾	17	16¾	19¼
Extra Best Ditto	16½	17	16	16¼	15⅝	16¼	16	14¼	15½	15½	15¾	18½	17	18¾	20¼	22½
No. 60, Good Second	16½	17½	17¼	16¾	16¼	17¼	17	14¼	15¼	15½	15¾	18½	17¾	20	19	22¼
Best Ditto	17	18	18¼	17¼	17¼	17¾	17¼	16	16¼	16	16	19	18¼	20	19¾	22¾
Extra Best Ditto	18½	19	19¼	19½	19¼	19¾	19¼	19	19	19	18¾	22¾	20½	23	24	26
Prima	23½	23½	22½	21½	22	22	22	21	20½	20½	20¼	23½	22	25¼	27¼	27¾
Water Twist, No. 20, Ordinary	9¾	10¼	10½	10½	10¼	11	10¼	9	10	9¾	10	12½	11	13½	13½	14
Good Second	10	10¾	10¾	10¾	10½	11¼	10¾	9½	10¼	10¼	10½	14¼	12	13¾	14	15
Best Ditto	10½	11	10⅞	10⅞	10⅝	11½	11¼	9½	10¼	10½	11	14	12¼	14¼	14¾	15⅜
Extra Best Ditto	. .	11¾	11	11¼	11	11½	11⅞	10	11	11	11	14¼	12¼	14¼	15	16
No. 30, Ordinary	12	12¼	12¾	12¾	12¾	12¾	11¼	10½	11½	11¾	11¾	14½	12½	15	15¼	16½
Good Second	12¼	12¼	13	13¼	12⅞	13¼	12¾	10¾	12	12	12¼	15	13	15¼	15¾	18
Best Ditto	12½	13¼	13¼	13½	13¾	14	13	11½	12¾	12¼	12½	15½	13½	15½	16¼	18¼
Extra Best Ditto	15½	14¾	13¾	14	14½	14½	14¼	13	13¾	13¼	13¼	16	14¾	16¼	17½	19¾
No. 40, Good Second	16½	16½	16	16	16	16¾	16¼	14½	15	16	15¾	. .	18	19	20	23
Best Ditto	17½	18	17½	17½	18	18½	17¼	16	16¾	17	17	19¼	18¾	19¼	21	24
Extra Best Ditto	19	19	18½	18¼	18¼	18½	17½	16¾	17¾	17¼	17½	19¼	19	20	21¾	24¾
Medio, No 50	16	16½	16	16	16	17	16½	15½	16	16¼	16½	18	16½	18¼	19¾	22¼
,, 40	18½	19	19	18	17	18	17	15½	16½	16½	18	20½	. .	. .	24½	28¼

1828. The demand for yarn at the beginning of this year promised to be favourable, but, from the multiplication of power-looms, the price of calico fell, generally speaking, so low as to afford little remuneration to the manufacturers. In the last months of the year particularly, from the diminished vent, it became lower than at any former period.

1829. The depression which prevailed at the conclusion of last year in the cotton cloth trade continued, without interruption, during the first six months of the present year. Considerable bankruptcies occurred, which, in conjunction with the disputes which arose between the mill-owners and the operatives about wages, occasioned a long suspension of the course of business. The cotton twist trade, however, was far from being unsatisfactory as to price.

1830. The influence of the Belgian revolution on the commercial world, as well as the differences revived towards the end of this year between the manufacturers and their workmen, obstructed not a little the demand for all sorts of cotton goods. The trade, however, indicated a steady tendency to increase, especially at the beginning of the year; but towards its close the purchasers were seized with a panic on account of the unsettled state of Continental politics.

1831. The demand of cotton yarn and fabrics for exportation was upon the increase at fair prices. These became unfavourably affected in December by the new Act of Parliament for restricting the hours of labour in factories, to which circumstance some of the manufacturers fell a sacrifice.

1832. The business of the factory districts being no longer disturbed by trades' unions, strikes, and quarrels, the manufacture of cotton in all its branches advanced in a constant and satisfactory manner; the export of twist, in particular, was greatly increased, although complaints were made by the mill-owners of the little difference in price between the raw and manufactured article.

1833. This year is the commencement of a new era in the trade of England, in consequence of the Slave Emancipation Act, the new Bank Charter, and the opening up of the trade to China. These important measures, dictated by the liberal spirit of the age, soon began to display their propitious influence in every department of British industry. Their primary effect was to excite extensive speculations in cotton wool and cotton yarn.

1834. The beneficial influence of the philanthropic acts of the British Parliament in 1833 upon the prosperity of the country were very conspicuous in 1834, especially in reference to the textile manufactures. The fabrication of cotton goods became not only more extensive, but assumed a more substantial and healthful character. All the hands were in full employment during the course of the year. As the prices of cotton wool remained steady during the first nine months, the spinner derived the full advantage of the improved demand for his goods. The factory operatives now ceased to complain either of low wages or of the hours of work, having full occupation, with bread and other necessaries of life at moderate rates, in spite of the corn laws. Commercial enterprise gave itself up the more confidently to the allurement of the times, as no interruption to its success had lately occurred.

1835. The increased facilities of trade, and the large demand for cotton twist in the China market, the extent of which is yet unknown, along with the quickly-advancing consumption of the old customers in every country, the continuance of peace, and the soundness of credit, gave to the cotton trade of Great Britain this year a prodigious impulse. The anticipation of a very large demand exciting fears of a short supply of the raw material caused a panic in the cotton-wool market, which reacted upon the yarns, and raised their prices towards the conclusion of the spring months, without the aid of speculation. At the end of the month of May, Georgia and Louisiana cotton wools stood 2*d.*, Sea Island and Egyptian 3½*d.* to 4*d.*, and Brazil 3*d.* higher than in January, cotton twist rising in a similar proportion. The alarms of the trade were by this time appeased, and the fears of a short supply of cotton wool seemed to be unfounded.

According to Mr. W. F. Reuss, the production of cotton yarn in Great Britain, in the year 1835, was as follows:—

	lbs.
Cotton wool spun	315,997,442
Waste in spinning	34,562,220
Total yarn made in England and Scotland	281,435,222
Scotland alone	32,520,691
Total yarn spun in England . . .	248,914,531

Being nearly eight times the production of Scotland.

Employment of the said Yarn.

Exported in twist . .	82,457,885	
„ thread . .	1,842,124	
„ goods (manufactured)	97,822,722	
Sent to Scotland and Ireland from England	5,359,000	
Miscellaneous articles, waste, &c.	11,500,000	
Retained for home wear, and stock	49,932,800	
		248,914,531

Exports of Cotton Twist in 1835, by Mr. Reuss.

	lbs.		lbs.
Africa	15,189	Mexico	668,886
Belgium	14,645,506	Naples and Sicily	2,246,927
Brazils	194,778	New Holland	4,060
British West Indies	3,459	Prussia	10,791
British N. America	153,597	Portugal	272,717
Chili and Peru	7,320	Russia	21,478,499
Columbia	1,200	Sweden and Norway	925,309
Denmark	14,800	Spain	1,788
France	75,145	Sardinia, Tuscany, &c.	2,298,541
Gibraltar	37,944	Trieste and Austria	1,777,805
Hanover and Hanse Towns	29,306,538	Turkey & the Levant	*1,667,441
India and China	5,305,512	United States of America	131,060
Malta and the Ionian Isles	417,046		
Mauritius and Java	237,726	Total	82,457,885

* Egypt, 558,630 of that quantity.

Lace-Thread Price List of T. Houldsworth, Esq., M.P.

No.	Price per lb. s.	d.	No.	Price per lb. s.	d.
80	3	6	170	10	7
90	3	10	180	12	0
100	4	3	190	14	0
110	4	11	200	16	0
120	5	8	210	18	6
130	6	5	220	21	3
140	7	3	230	25	0
150	8	2	240	29	6
160	9	2	250	35	0

The price above No. 250 must be fixed by special agreement. The thread is delivered in Manchester, and is thenceforward at the risk of the purchaser.

Dates and Amounts of Excise Duties laid at different Times, from the earliest Period, on Cotton Goods made in Great Britain. Duties commenced 20th July, 1712.

	Per Yard.	
Calicoes printed, stained, painted, or dyed . .	3*d.*	yard wide.
From 2d Aug. 1714—Additional duty of the like amount, total	6*d.*	„
„ 17th Aug. 1774—Stuffs wholly made of cotton spun in Great Britain, called "British Manufactory"	3*d.*	„

„ 5th April, 1779—5 per cent. additional duty on the former duty.

„ 5th April, 1782—A second 5 per cent. as before.

„ 25th July, 1782—A third 5 per cent. as before.

„ 1st Oct. 1784—Duties on cottons, stuffs, and cotton and linen mixed, bleached or dyed, not being linen gauzes sprigged with cotton, viz., under 3*s.* per yard in value, 1*d.* per yard, and 15 per cent. thereon. At 3*s.* per yard in value, or upwards, 2*d.* per yard, and 15 per cent thereon.

„ 1st Aug. 1785—The above repealed, and new duties, viz.:—

	d.	
Linens printed, painted, &c., of greater value than 1*s.* 4*d.* and not more than 2*s.* 6*d.* .	$1\frac{1}{2}$	per. sq. yd.
Do. 2*s.* 6*d.*	$3\frac{1}{4}\frac{8}{10}$	„
Mixed or cotton stuffs, do. 1*s.* 8*d.*, and not more than 3*s.*	$2\frac{1}{4}\frac{2}{10}$	„
Do. 3*s.*	$4\frac{1}{2}\frac{4}{10}$	„
British muslins, do. 1*s.* 8*d.*, not more than 3*s.*	$2\frac{1}{4}\frac{2}{10}$	„
Do. 3*s.*	$4\frac{1}{2}\frac{4}{10}$	„

„ 10th May, 1787—The whole of the above repealed, and new duties in lieu thereof, viz.:—

British manufactory and British muslin .	$3\frac{1}{2}$	„
Linens and stuffs	$3\frac{1}{2}$	„

These rates continued until the repeal of the duty, 1st of March, 1831.

Duties on Cotton Wool at different Periods.

COTTON WOOL IMPORTED.

Years.	lbs.	Years.	lbs.
1697 .	1,976,359	1730 .	1,545,472
1701 .	1,985,868	1741 .	1,645,031
1710 .	715,008	1751 .	2,976,610
1720 .	1,972,805	1764 .	3,870,392

Inspector-General's Office, 21st Jan., 1834.

RATES OF DUTY ON COTTON WOOL IMPORTED.

	Previous to 1798 . . .	Free.
1798.	Imported by the E. I. Company	£4 per cent. ad valorem.
	From the British Colonies or Plantations . . .	8s. 9d. per 100 lbs.
	From Turkey and the United States of America . .	6s. 6d. "
	From any other place . .	12s. 6d. "
1801.	. . . . . .	Free.
1802.	Imported by the E. I. Company	£4. 16s. per cent. ad val.
	From Turkey and the United States of America . .	7s. 10d. per 100 lbs.
	From the British Colonies and Plantations . . .	10s. 6d. "
	From any other place . .	15s. "
1803.	From the East Indies, Turkey, the United States of America, and any British Colony or Plantation . . .	16s. 8d. "
	From any other place . .	£1. 5s. "
1805.	E. I. Company, Turkey, United States of America, and any British Colony or Possession	16s. 10½d. "
	From any other place . .	25s. 3¾d. "
1809.	All sorts	16s. 11d. "
1815.	All sorts	8s. 7d. "
1819.	From any British Colony or Plantation in America, and imported directly from thence	6s. 3d. "
	Otherwise imported . .	8s. 7d. "
1820.	Of any British Colony or Plantation in America, and imported directly from thence .	6s. 3d. "
	Otherwise imported . .	£6. per cent. ad valorem.
1821.	Of any British Colony or Plantation in America, and imported directly from thence .	Free.
	Otherwise imported . .	£6. per cent. ad valorem.
1826.	Of any British Colony or Plantation in America, or of Malta, and imported directly from thence	Free.
	Otherwise imported . .	£6. per cent. ad valorem.

1828.	Imported from any British Possession	4*d.* per cwt.
	From any other place . .	£6. per cent. ad valorem.
1831.	The produce of, and imported from, any British Possession	4*d.* per cwt.
	Of any foreign country, or imported therefrom . .	5*s.* 10*d.* „
1833.	The produce of, and imported from, any British Possession	4*d.* per cwt.
	The produce of any foreign country, or imported therefrom	2*s.* 11*d.* „

Inspector-General's Office, 21st Jan., 1834.
(Signed) W. Irving.

The following Tables, compiled by Dr. Mitchell from the Reports of the Factory Commissioners, exhibit the rates of wages for cotton-spinning in the two great factory districts of England and Scotland.

Tables of the Wages and Ages of the Operatives in the Cotton Manufacture.

LANCASHIRE.				
Age.	Males.		Females.	
	Number employed.	Average Weekly Wages.	Number employed.	Average Weekly Wages.
		s. *d.*		*s.* *d.*
Below 11	246	2 3½	155	2 4¾
From 11 to 16	1,169	4 1¾	1,123	4 3
16 — 21	736	10 2½	1,240	7 3½
21 — 26	612	17 2½	780	8 5
26 — 31	355	20 4½	295	8 7¾
31 — 36	215	22 8½	100	8 9½
36 — 41	168	21 7¼	81	9 8¼
41 — 46	98	20 3½	38	9 3½
46 — 51	88	16 7¼	23	8 10
51 — 56	41	16 4	4	8 4½
56 — 61	28	13 6½	3	6 4
61 — 66	8	13 7	1	6 0
66 — 71	4	10 10	1	6 0
71 — 76	1	10 0	—	—
76 — 81	1	8 8	—	—
	3,770		3,844	

GLASGOW.				
Age.	Males.		Females.	
	Number employed.	Average Weekly Wages.	Number employed.	Average Weekly Wages.
		s. d.		s. d.
Below 11	283	1 11¾	256	1 10¼
From 11 to 16	1,519	4 7	2,162	3 8¾
16 — 21	881	9 7	2,452	6 2
21 — 26	541	18 6	1,252	7 2¼
26 — 31	358	19 11¼	674	7 1
31 — 36	331	20 9	255	7 4½
36 — 41	279	19 8½	218	6 7¾
41 — 46	159	19 6	92	6 6
46 — 51	117	19 2	41	6 10
51 — 56	69	17 9¾	18	6 1½
56 — 61	45	16 1¼	16	6 0
61 — 66	17	17 7	7	5 5
66 — 71	15	15 9½	2	4 0
71 — 76	11	10 11	—	—
76 — 81	5	9 6	—	—
81 — 86	0	0 0	—	—
86 — 91	1	8 0	—	—
	4,631		7,445	

Actual Prices paid for Spinning Mules of different Sizes.

A spinner spinning—

			s. d.
No. 170, on mules of 336 spindles and under, is paid			2 0 per lb.
Do.	do.	348 to 384 do.	1 11½
Do.	do.	396 do.	1 10½
Do.	do.	600 spindles is paid	
		at Messrs. M'Connell's, Manchester	1 4½
		at Messrs. Houldsworth's, do.	1 8½
		at Messrs. Carruthers', do.	1 6½

A spinner spinning—

No. 200, on mules of 336 spindles and under . .			3 6
Do.	do.	348 do.	3 5
Do.	do.	396 do.	3 4
Do.	do.	600 do.	
		at Messrs. M'Connell's . . .	2 5
		at Messrs. Houldsworth's . .	2 5
		at Messrs. Carruthers' . . .	2 8¾

Thus the advantages of large mules over small will give a difference of four to five per cent. in cost of production, but of seven to eight in rate of spinners' wages.

It has been stated to be doubtful whether the large mules, employed as above in fine spinning, can ever be applied to coarse spinning, owing to the greater rapidity of the motion in mules for coarse spinning, and the weight of them. An experienced manufacturer resolves this doubt by saying, that, with the knowledge possessed by modern mechanics of diminishing friction, and with the superior accuracy of their work, a spinner can manage two mules of 600 spindles for coarse spinning with as much ease to himself, and with no less, or more rapidity of the machinery, than he did two mules of 300 spindles each ten years ago. "I have not seen mules of 600 spindles for coarse work yet fitted up; but I have myself fitted up a pair of mules for my master, of 512 spindles each, for coarse work, and they answer so well that I see that I could easily and certainly add 100 spindles to them."*

Estimate of cost of a fire-proof mill of 24 windows long (exclusive of engine-house), 9 feet bays, 42 feet wide, and 7 stories high, with a steam-engine of 100-horse power, to turn 24,000 spindles, spinning No. 40; 12,000 throstle spindles, spinning No. 30; with all necessary preparations for the same.

Suppose the mill 75 yards long (including engine-house), 13 yards wide, and 7 stories high, containing 6,825 square yards of flooring, cost about 50*s.* per square yard, and include mill, mill-gearing, steam-pipes, steam-engine boilers, boiler-house, gas-house, gas apparatus, and other appendages to complete the mill; 6,825 yards, at 50*s.*, cost . . . £17,062

* Rowbotham in Factory Commission Report, Part I., Bolton, p. 133.

A fire-proof warehouse of 10 windows long, 5 stories high, 30 feet wide, for cotton cellar, waste place, counting-house, twist rooms, reeling rooms, making-up and taking-in rooms, &c., will contain about 1,500 square yards flooring, at 30*s*. £2,250

A mill of the above dimensions will contain, and an engine of the above power will turn, the following spinning machinery and preparation, and will produce weekly the following weight of yarn:—

12,000 throstle spindles, at $22\frac{1}{2}$ hanks, or three quarters of a pound, per spindle of No. 30.	lbs. 9,000	at 200 spindles per horse	= 60 horses.
24,000 mule spindles, at 18 hanks, or three quarters of a pound, per spindle of No. 40.	lbs. 10,800	at 600 spindles per horse	= 40 horses.
	19,800		100

Machinery.

One willow		£ 80
Three scutchers	£ 60	180
Three lap machines	60	180
One hundred cards, forty-inch, and covered with cards	50	5,000
Three card grinding machines	30	90
Twelve drawing frames, four heads each	40	480
Twelve slubbing frames	67	804
Forty-eight fine frames	81	3,888
Twelve thousand throstle spindles, in eighty throstles, of one hundred and fifty each, at 9*s*. per spindle		5,400
Twenty-four thousand mule spindles, in forty pairs of three hundred spindles per mule, at 5*s*. per spindle		6,000
		22,102
Cost of mill		17,062
Cost of warehouse		2,250
		£41,414
Cop and bobbin reels	£300	
Mechanics' shops, lathes, vices, and tools	200	
Counting-house	100	
Cotton and twist warehouses, waste places, &c., fitted up	100	
		700
Carried forward		£42,114

Brought forward		£42,114
Cans	300	
Straps	400	
Bobbins for slubbing and jack-frames and mules	410	
Bobbins for throstles	60	
Doffin tins	100	
Skewers	50	
Skips	100	
Banding, list, buckles, &c.	100	
Roller leather, and rollers covering	250	
Making up presses, counters, weights, and scales	100	
Horse, cart, gear, stable	150	
		2,020
		44,134
Purchase of land and procuring a supply of water for engine		3,000
Total cost		£47,134

In a mill of the before-mentioned dimensions, and seven stories high, the different stories would probably be occupied as follows:—

One and a half story for 100 cards, of 40 inches, and preparation; say 6 feet per engine.

Half story for scutching, and cleaning, binns, and mixing.

One story for 80 throstles of 150 each, equal to 12,000, at 5½ feet per pair.

Four stories for 10 pairs of mules of 300 spindles per mule in each room, equal to 24,000.

Warehouse.

Cellar for cotton and waste.
Ground floor, counting-house, and twist rooms.
Third story, making-up and store rooms.
Fourth and fifth stories, reelers, &c.

The above estimate is made up by a very competent person engaged in the construction of machinery, and who has a mill of his own. But such estimates generally fall much below the actual outlay. The owners of mills would give their separate valuations at a much higher rate *.

* Holland Hoole, Esq., in Factory Commission Report, Part I., Manchester, p. 96.

The great differences in the average rates of wages paid by different mill-owners in Manchester for spinning the same quality and fineness of yarn with similar mule-jennies is one of the most remarkable, and, at first sight, most puzzling circumstances in the factory system. Thus we find that the average rates of weekly wages, or net earnings, in 69 hours of each individual employed, in the following fine spinning-mills, are as follow:—

Name of Firm.	Fineness of Yarn or Counts spun.	Average Fineness.	Total of Operatives.	Average Earnings in one week of 69 hours, of each individual of all ages.
M Connell & Co. .	100 to 240	170	1,545	131·03 pence.
T. Houldsworth, M.P.	130 to 230	180	1,201	122·72
A. and G. Murray .	90 to 200	145	841	141·96
T. R. and T. Ogden .	150 to 220	176	712	125·
Benjamin Gray . .	100 to 200	130	391	113·5
Benjamin Sandford .	140 to 210	175	382	112·94
Thomas Plant . . .	140 to 210	175	343	112·34
J. and W. Bellhouse	130 to 210	170	211	148·46
S. M. Moore	150 to 210	180	189	129·49
Hugh Shaw and Co.	150 to 210	180	182	111·8
William Carruthers	150 to 210	180	143	146·24

The average net weekly earnings of all the adult mule-spinners, in the coarse and fine mills of Manchester, is 325·64 pence, or fully 27*s*. That of the men spinners alone in the fine mills varies from 30*s*. to 40*s*., which, with the wages of two children as assistants, at an average of 5*s*. each, will make up an excellent income for a working man's family, one very different indeed from the 12*s*. or 14*s*. earned by a like family in the agricultural districts of England.

But the extraordinary phenomenon in the above table is the difference of wages paid in similar mills of the same town for work of like quality. Thus, in three mills which spin the average count of 180 hanks of yarn in a pound weight, or nearly 90 miles' length out of one pound of cotton, the average wages to the workmen are 122·72 pence, 129·49 pence, and 111·8 pence. The latter two, which differ so much, are moreover of the same extent, or employ nearly the same number of hands.

These differences are well known to the operatives in Manchester from the constant intercourse which subsists between them, and yet they create no jealousies either among them or the masters, because the spinners are paid according to a general table, called the *Manchester List of Prices,* agreed upon and fixed for a certain period, according to the number of spindles in a mule, and the fineness of the yarn.* The more spindles there are in a mule, the more yarn can a spinner turn off, and, though his earnings relatively to each spindle may be less, his weekly wages for like labour on his pair of mules becomes greater, while the cost of spinning to the master is diminished. Thus operative, owner of the mill, the commerce of the country, and mankind at large, all simultaneously profit by this factory progression.

The causes of the above differences are very complex. Some mills, like Mr. Houldsworth's, which, according to the principle of fineness of yarn, ought to pay fully the average wages, pay less in consequence of the number of machines employed in it for doubling the fine yarn into thread for making lace. Now these doubling machines are superintended by young persons, who work, of course, at much lower wages than

* See Philos. of Manufactures, page 319.

skilful adult spinners. Again, factories which have mules containing most spindles employ the largest proportion of juvenile piecers and scavengers, and, of course, pay a less average rate of wages among the whole operatives. Some mills, also, which are filled with modern machinery of the best kind, but not with very large mules, enable the spinner to turn off a proportionably greater quantity of work, and to earn proportionably higher wages,—a result most advantageous to the mill-owner, as it makes his sunk capital so much the more productive. Hence, in these circumstances, the higher average rate of wages he pays, the more prosperous he is. On the contrary, when a manufacturer works his mill with very long mules, such as contain from 800 to 1,000 spindles, he needs fewer spinners at high, and more piecers at low wages, and will therefore pay a lower average rate, which will be in this case the cause and measure of his prosperity. When a long mule is constructed in the best possible manner, a prudent operative may choose to take work on it at a rate per pound of yarn under the *printed list prices*, because he can even then earn a very large weekly sum. Under such a variety of circumstances the average rate of wages paid by the mill-owner may undergo considerable variation, without any person in the trade having just reason to blame either master or servant.

The following is the result of an average of several men's work at different periods. There are 111 spinners at present employed in the mill, each earning, on an average per week, 33*s*. 3*d*. In the same factory 917 persons are employed in card-rooms, doubling, reeling, and piecing; *their* net earnings average 7*s*. 1*d*. per week.

Particulars of Fine Cotton-Spinners' Wages at different Periods, spinning No. 180 and No. 200; from the Wages-book of Thomas Houldsworth, Esq., M.P., Manchester.

Years.	Work turned off by one Spinner per week.		Wages per week.			Hours of work per week.	Prices from Greenwich Hospital Records.		Quantities which a week's net earnings would purch.	
	lbs.	Nos.	Gross.	Piecers.	Net.		Flour per sack.*	Flesh per lb.	lbs. Flour	lbs. Flesh.
			s. d.	s. d.	s. d.		s. d.	d. d.		
1804	12	180	60 0	27 6	32 6	74 sup.	83 0	6 to 7	117	62½
,,	9	200	67 6	31 0	36 6	74	83 0	6 to 7	124	73
1814	18	180	72 0	27 6	44 6	74	70 6	8	175	67
,,	13½	200	90 0	30 0	60 0	74	70 6	8	239	90
1833	22½	180	54 8	21 0	33 8	69	45 0	6	210	67
,,	19	200	65 3	22 6	42 9	68	45 0	6	267	85

* The sack of flour is taken at 280 lbs.

Rates of Wages per Week at the different Periods in the same Mill.

	1806.	1811.	1815.	1818.	1824.	1833.
Card-room.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Males . .	15 0	15 0	15 6	15 0	15 0	15 0
,,	17 0	17 0	18 6	18 0	17 9	17 9
,,	35 0	35 0	40 0	40 0	40 0	30 0
Females .	9 0	9 0	10 0	9 0	9 0	9 0
Reelers ,,	19 to 30	15 0	15 0	15 0	15 0	12 0
Doublers ,,	12 0	10 6	10 6	9 6	9 6	8 6

Piecers' wages, with the exception of those of big piecers, who constitute one-third of the whole, have not varied sixpence per week within the last twenty years. Mechanics' wages, such as blacksmiths, turners, filers, machine-makers, and fitters-up, are now from 27*s*. to 31*s*. per week. Within the last twenty years they have been as high as from 28*s*. to 35*s*.;

but then they worked from half an hour to an hour per day longer.

Although a great deal more work is now done in certain factories than formerly, it is done with fewer hands; and, though a factory be increased in extent, the money wages paid in it may be the same as before. Mr. K. Finlay states that, about the beginning of the present century, the profit upon a piece of cotton goods to the manufacturer was as much as the price of the goods altogether is at present.

It will be seen from the authentic Table of the Wages earned in Cotton Factories (*see* Appendix to Vol. I., pages 347, 348, and 349), that there never was a time when the prudent operative was better off than at present, considering the quality and price of provisions, the extreme cheapness of clothing, and the number of charitable institutions that minister to his wants, and those of his children. And, notwithstanding the clamour and lamentation about the moral and physical evils concomitant on our manufacturing aggrandizement, it is certain that the condition of the work-people thirty-five years ago was greatly inferior in most respects to the present. "At that time," says a very competent judge, "the spinners were not held to any regular hours of work; they frequently spent two or three days in the week in idleness and drinking, letting the children in their service linger for them at the public houses till they were disposed to go to their work; to which, when they did return, they would sometimes work desperately, night and day, to clear off their tavern score, and get more money to spend in dissipation." Such practices are now unknown, and would, in fact, be no longer endured by any manufacturer.

Number of Hands, and their Occupation, in a Cotton Spinning Mill for Fine Numbers, with 52 Pairs of Mules.

	Men.	Women.	Boys.	Girls.
Cash-keeper . . .	1			
Clerks or book-keepers .	2			
Cotton taker-in, and assistant .	2			
Two head carders, one under do.	3			
Grinders . . .	4			
Cylinder-strippers . .	2			
Top-card-strippers . .	12			
Brushers . . .	3			
Card-tenters . .	..	..	13	
Spreaders . . .	..	..	14	
Drawing-frame-tenters . .	..	28		
Jack-tenters . . .	..	13		
Stretchers 14, back-tenters 14 .	..	14	..	14
Roving-sorters . . .	..	3		
Two roller-coverers, 1 ledge-tenter	3			
Mechanics . . .	6			
Engineers . . .	2			
Batters and pickers, about 90, all grown-up women .	..	90		
Spinners . . .	103			
Piecers . . .	..	..	306	97
Wrapper . . .	..	1		
Reelers, about . . .	..	15		
Cop-rackers . . .	..	..	3	
Yarn-examiner . . .	1			
Overlookers . . .	2			
Watchman . . .	1			
	147 336	164	336	111 164
Males .	483	Fem	ales .	275
758 Hands altogether.				

NOTE A,

TO PAGE 391, VOL. II.

HAVING transmitted to my kind friends, Messrs. Boden and Morley, of Derby, the proof sheets of my chapter on bobbin-net, I received the following communication in return, which, coming too late to enable me to correct the press in the body of the book, is here presented *verbatim* to my readers. Certain of the errors which I have inadvertently committed were occasioned by my following a great London authority upon this intricate subject. I have much pleasure in publishing these friendly animadversions, not only on account of their intrinsic truth and value, but as demonstrating the liberal spirit and intelligence of English manufacturers.

"You say (page 339) 'The first machine for making lace from a stocking frame was constructed in 1777, which has been claimed both by Mr. Frost and by Holmes, a poor workman of Nottingham. This was, ere long, superseded by the point-net machine, the ingenious invention of Mr. John Lindley, sen., &c.'* As this account refers to circumstances with which I am not fully acquainted, I am unable to give you a complete and correct history of them; but I am persuaded there is some inaccuracy in your account, which I will endeavour to point out by giving you my ideas of the circumstances, which I received from persons in the trade much older than myself. Various kinds of network were made from the stocking frame prior to the time you name, none of which, however, much resembled lace-net until the invention of a fabric called square net, for which Mr. Robert Frost had a patent. This was soon

* This account was copied, I believe, from Glover's History of Derbyshire.

superseded by the invention of point-net, the most perfect description of net-work ever produced from the stocking frame. This is generally supposed to have been an invention of a poor man of the name of Holmes. This invention, however, only went to show, that by a new and particular mode of arrangement of the loop upon the stocking-frame a beautiful kind of net-work could be made, but how this was to be accomplished with facility was still wanting. This was effected by the addition or appendage to the stocking frame called the point-net machine, and which appears to have been the result of the united ingenuity of several individuals. Two persons of the names of Flint and Morris are supposed to have assisted, but what share they had in it is difficult to determine, but a person of the name of Taylor, a maker of stocking frames, had a patent for it. It, therefore, could not be the sole invention of Mr. John Lindley, as your account implies.

"Page 350. You enumerate twelve different systems of bobbin-net machinery; this is incorrect; there are only six that deserve that distinction. 1st. Heathcoat's patent machine. 2d. Brown's traverse warp. 3d. Morley's straight bolt. 4th. Clarke's pusher principle, single tier. 5th. Lever's machine, single tier. 6th. Morley's circular bolt. All the others are mere variations in the construction of some of their parts. For instance, 'the improved double tier, or Brailey's,' and 'the Old Loughborough improved, with pumping tackle,' are slight variations of Heathcoat's patent machine, and, like it, are now laid aside. 'The single tier, on Stevenson's principle,' is the lever machine lying horizontally, as you have before described, page 344. 'The circular comb, or Hervey's,' is nothing more than a slight difference in the construction of the bolt on which the carriage rides in the circular bolt machine. 'The improved levers' have nothing new in their system or principle. 'The traverse warp rotatory, or Lindley and Lacey's,' may have *some* claim to distinction from the rest, as it is a combination of two of the different systems or principles: viz., 'Brown's traverse warp,' and 'Lever's machine, single tier;' but is now entirely out of use.

"Page 351. You will perceive you have contradicted what has been said in page 345, 'Mr. Morley's circular bolt is the only machine which has been found capable of working successfully by mechanical power,' which is quite correct.

"Page 367. Beginning with 'the number of movements, &c.,' substitute the following; viz.

"The number of movements which are required to form a row of meshes in the double-tier machine are six; that is, the whole of the carriages pass from one bolt bar to the other six times, during which passages the different divisions of bobbin and warp threads change their relative positions twelve times, as is hereafter explained.

"Page 371. In the paragraph beginning 'The carriage G, &c.,' substitute this for the last sentence. The carriages are driven by the pressure of the bars, *l*, *l*, placed above the bolt or comb until the catches or points *i*, *i'*, are taken hold of by the locker plates *n*, *n'*, and carried forward.

"I think the sentence page 367 should be inserted page 374, just preceding the one commencing with 'To give now an idea, &c.'

"For page 377, beginning 'However, before the 2d line, &c.,' down to 'Fig. 5, at the following operation,' page 378, substitute the following: While No. 10 is performing, and before the carriages G are again pushed to the bolt *k*, the beam H′ makes another shift or traverse back to its former position; this places the line G one step to the right of its former position, whilst the line G′ reoccupies its first position. While No. 11 is performing, the beam H′ shifts one step to the left, as was performed in No. 9, which places the line G′ one step to the left of what they before occupied, and two steps to the left of the position which the line G now occupies. Whilst No. 12 is performing, the beam H′ returns to its original position, and remains until the same is again required. This interchange or traversing of the carriages with their bobbins, which is the most difficult thing to explain, and a most important principle in the lace machine, will be best understood by a careful attention to the following diagram and explanation. Where the sign represents the bolts, the sign  the back line of carriages, and the sign  represents the front line of carriages ; H is the front beam or bolt-bar, and H′ the back beam or bolt-bar. It must be borne in mind that the front bolt-bar H remains always fixed and stationary, and that there must be an odd carriage.

"No. 1 represents the carriages in the front bar, the odd carriage being on the left. The back line of carriages are first moved on to the back bar H′, the odd carriage, as seen in No. 1, having been left behind, there being no carriage opposite to it to drive it over; the carriages then stand as in No. 2 ; the bar H′ then shifts to the left, as shown in No. 3 ; the front carriages now go over into the back bolt-bar, which is represented by No. 4 ; the bar H′ now shifts to the right, No. 5 ; the front carriages are then driven over to the front bar, which leaves the odd carriage on the back bar on the right, for the same reason as before described, and the carriages stand as in No. 6. The bar H′ now shifts to the left, and the carriages stand as in No. 7,—(observe the odd carriage is now on the back bar to the left.) The back carriages now come over to the front bar, and stand as in No. 8. The back bolt-bar H′ shifts to the right as No. 9, which completes the traverse. The whole of the bobbins and carriages have now changed their position, as will be seen by comparing No. 9 with No. 1. The

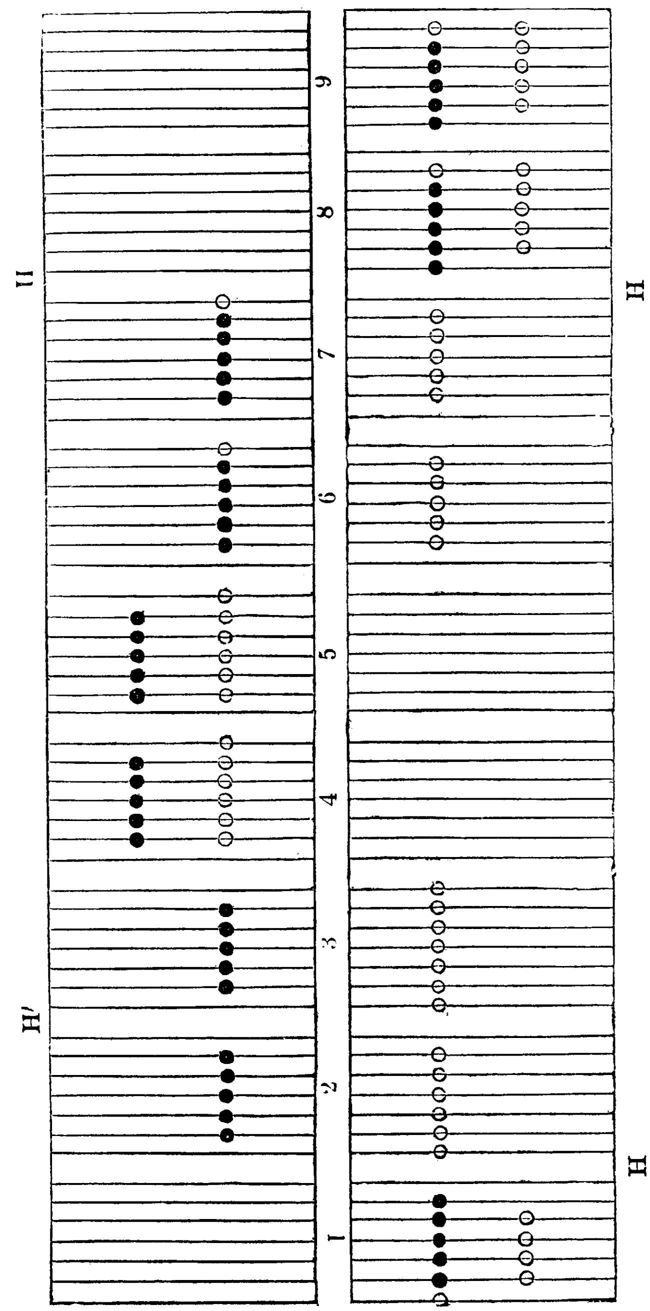


Fig. 132.—Scheme of Bobbin Movements in making a Mesh of Lace.

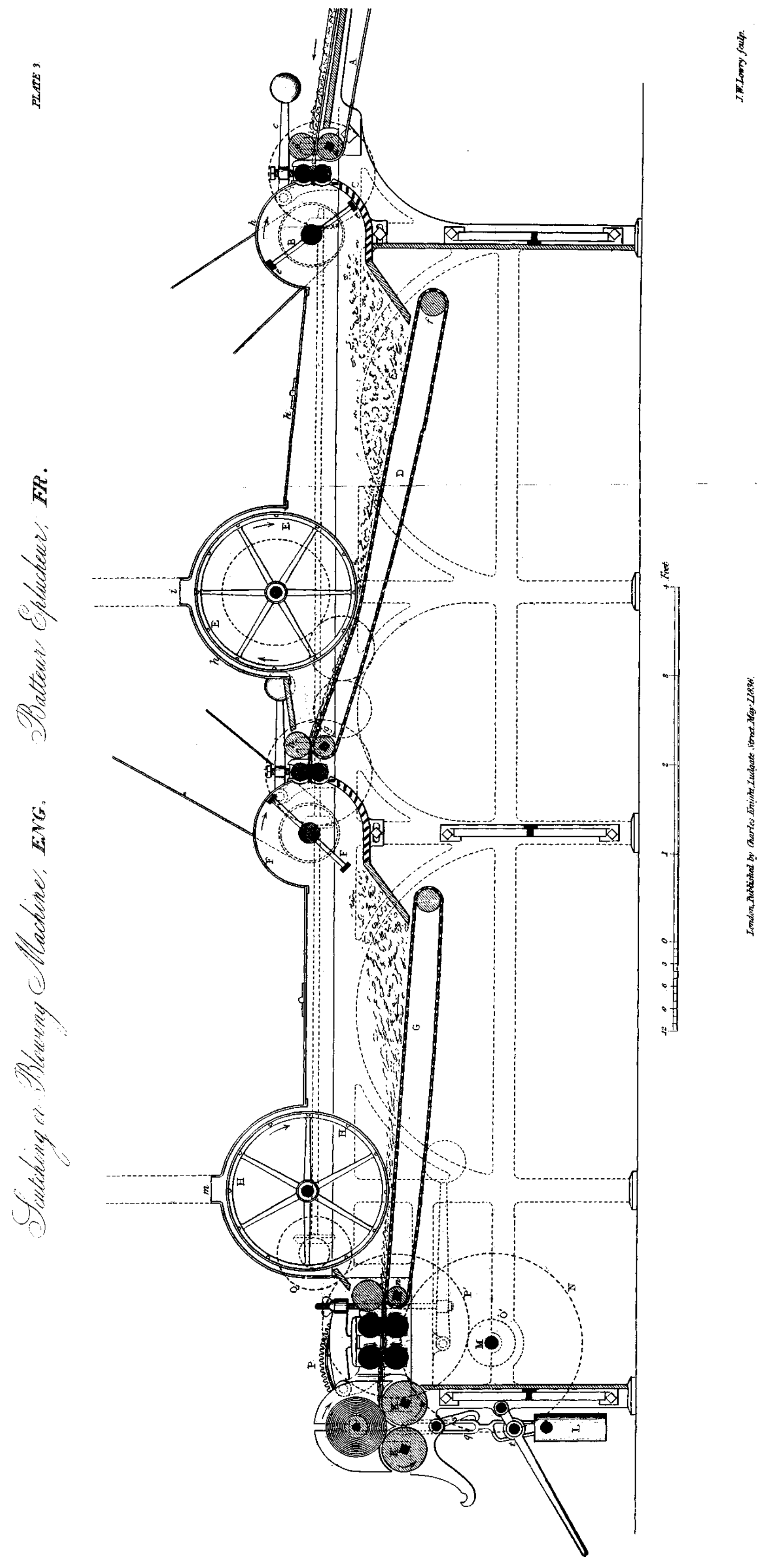
odd carriage in No. 1 ϕ has advanced one step to the right, and become one of the front line; one of the back line ϕ has advanced one step to the left, and has become the odd carriage; and one of the front ones ϕ has gone over to the back line on the right. The bobbins and carriages throughout the whole width of the machine have thus crossed each other's course, and completed the mesh of net.

"Page 382, after the words 'against one of the rods *d′*,' substitute this, 'and moves one of the bars L, L′, with its points out of the lace before it descends.'

"Page 389. 'A rack is a certain length of work counted perpendicularly, and contains 240 meshes or holes. Well-made lace has the meshes a little elongated in the direction of the selvage.' The other part of this paragraph I think better omitted."

THE END.

London: Printed by William Clowes and Sons, Stamford-street.



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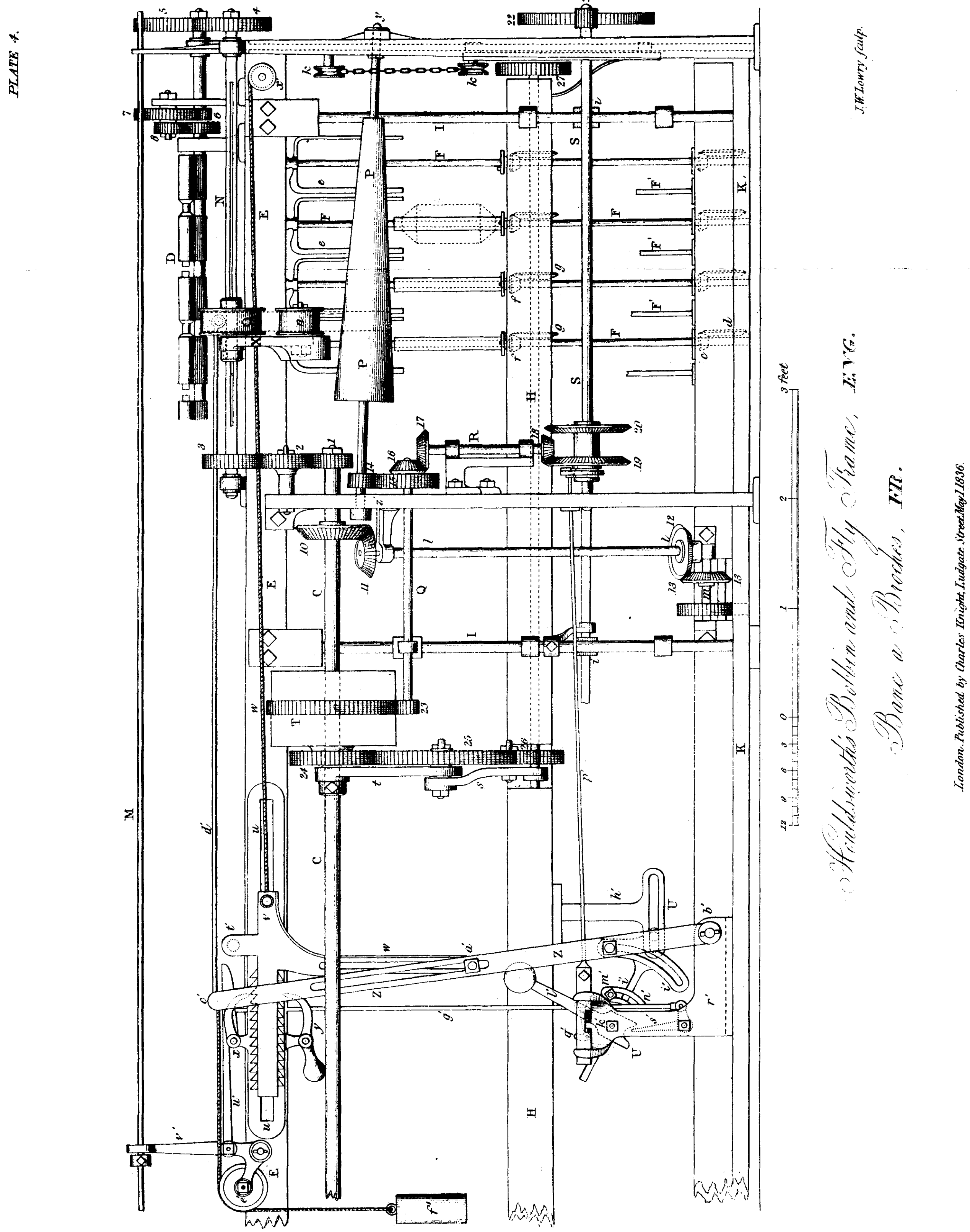

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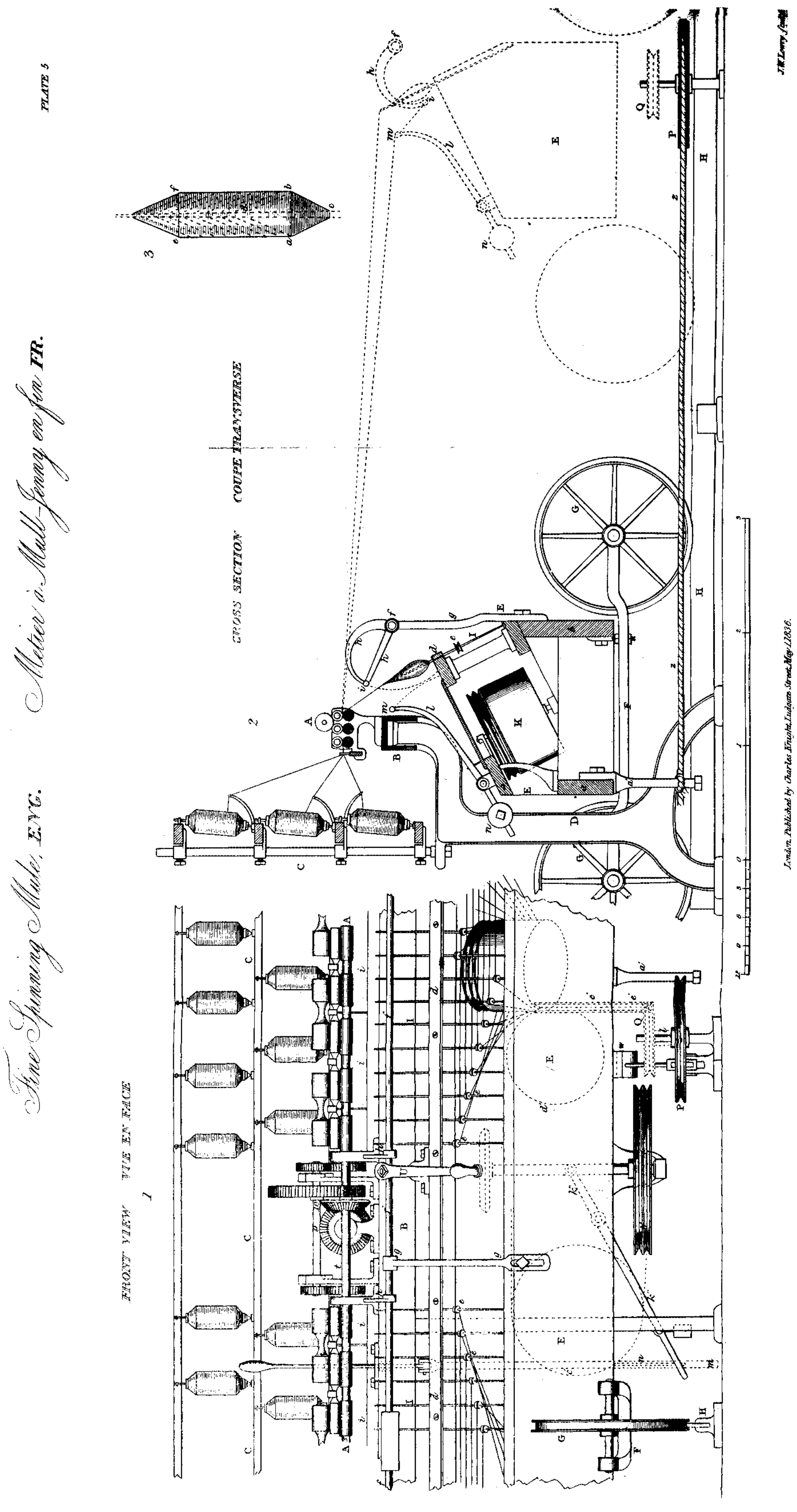

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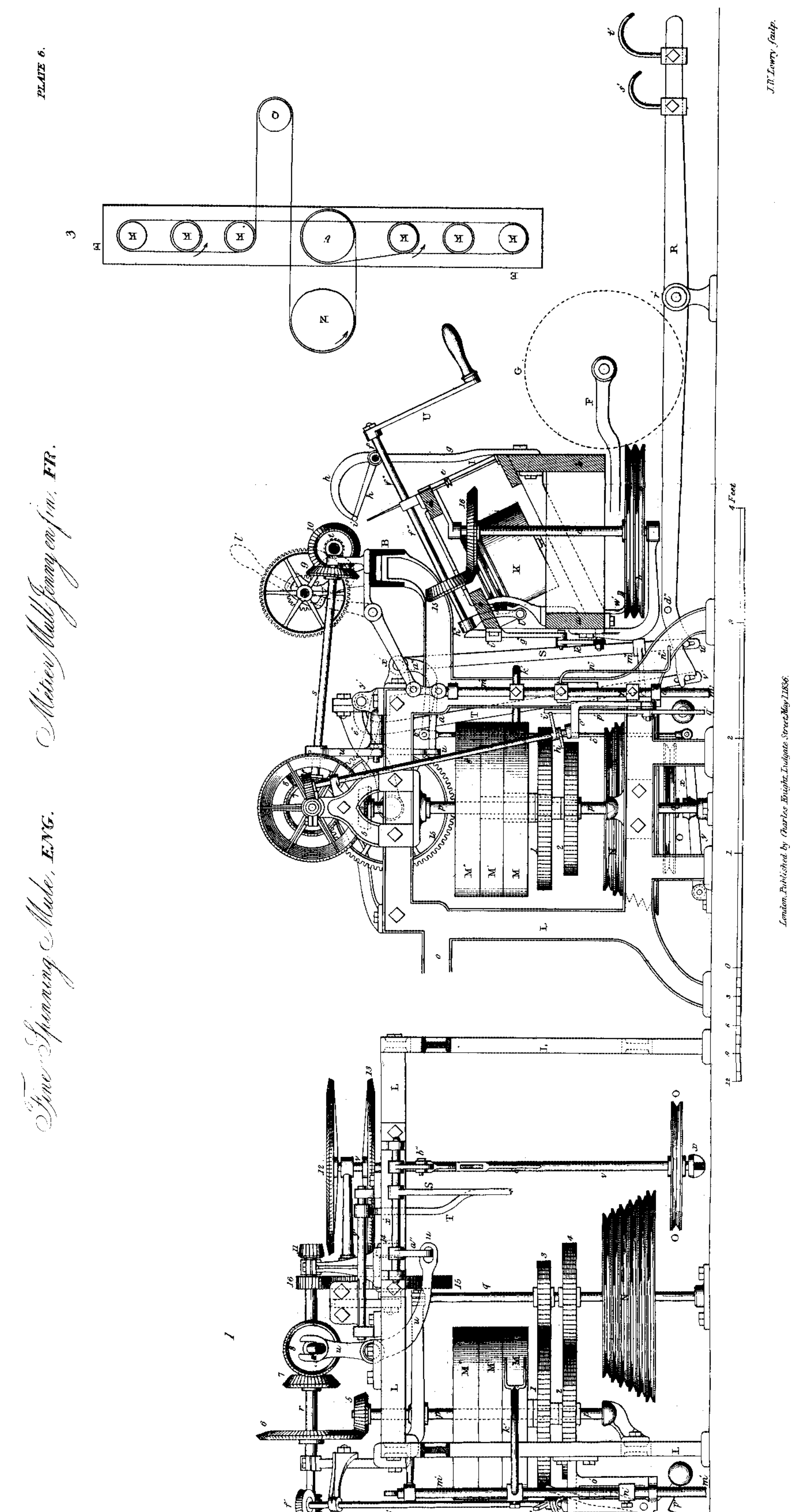

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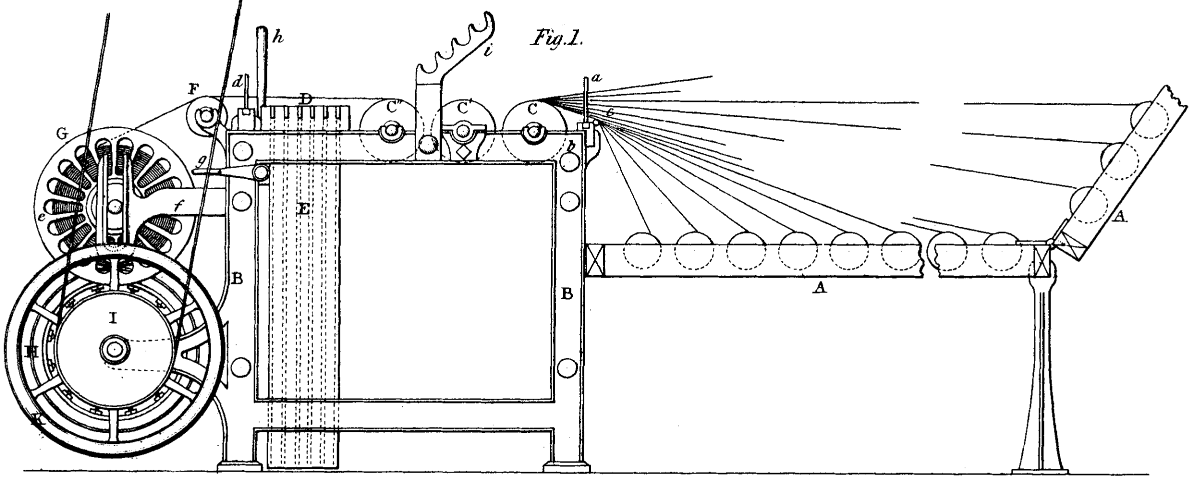
SECTION

Fig. 1.



PLAN

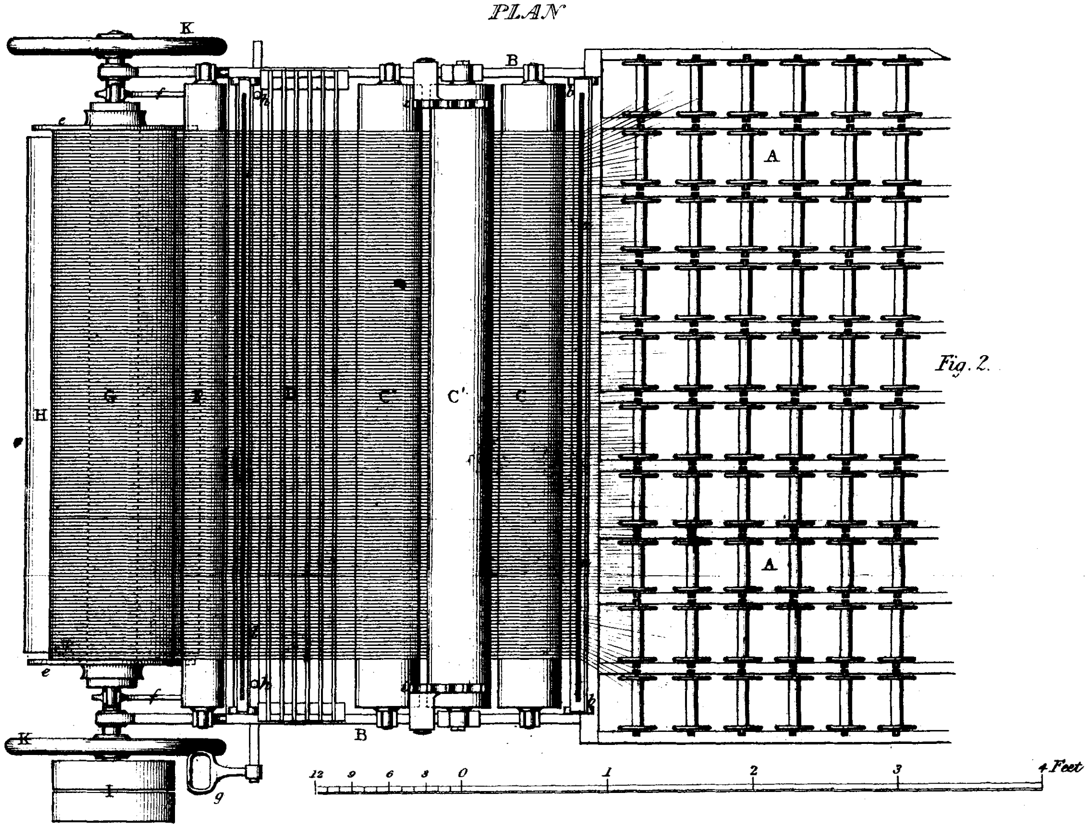


Fig. 2.

Warping Frame, ENG. *Métier à Ourdir*, FR.

J. W. Lowry sculp.

London. Published by Charles Knight, Ludgate Street. May 1. 1836.

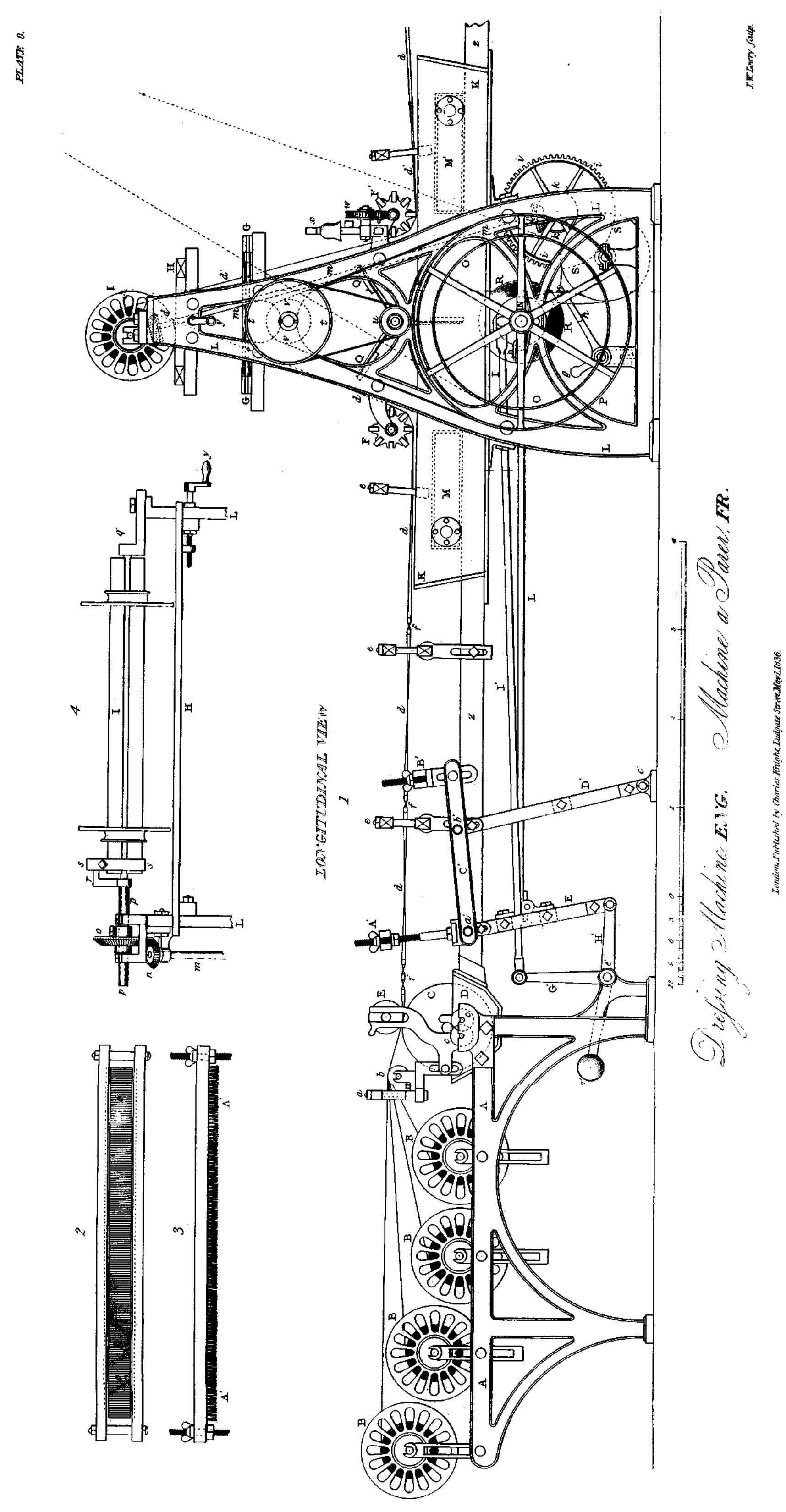


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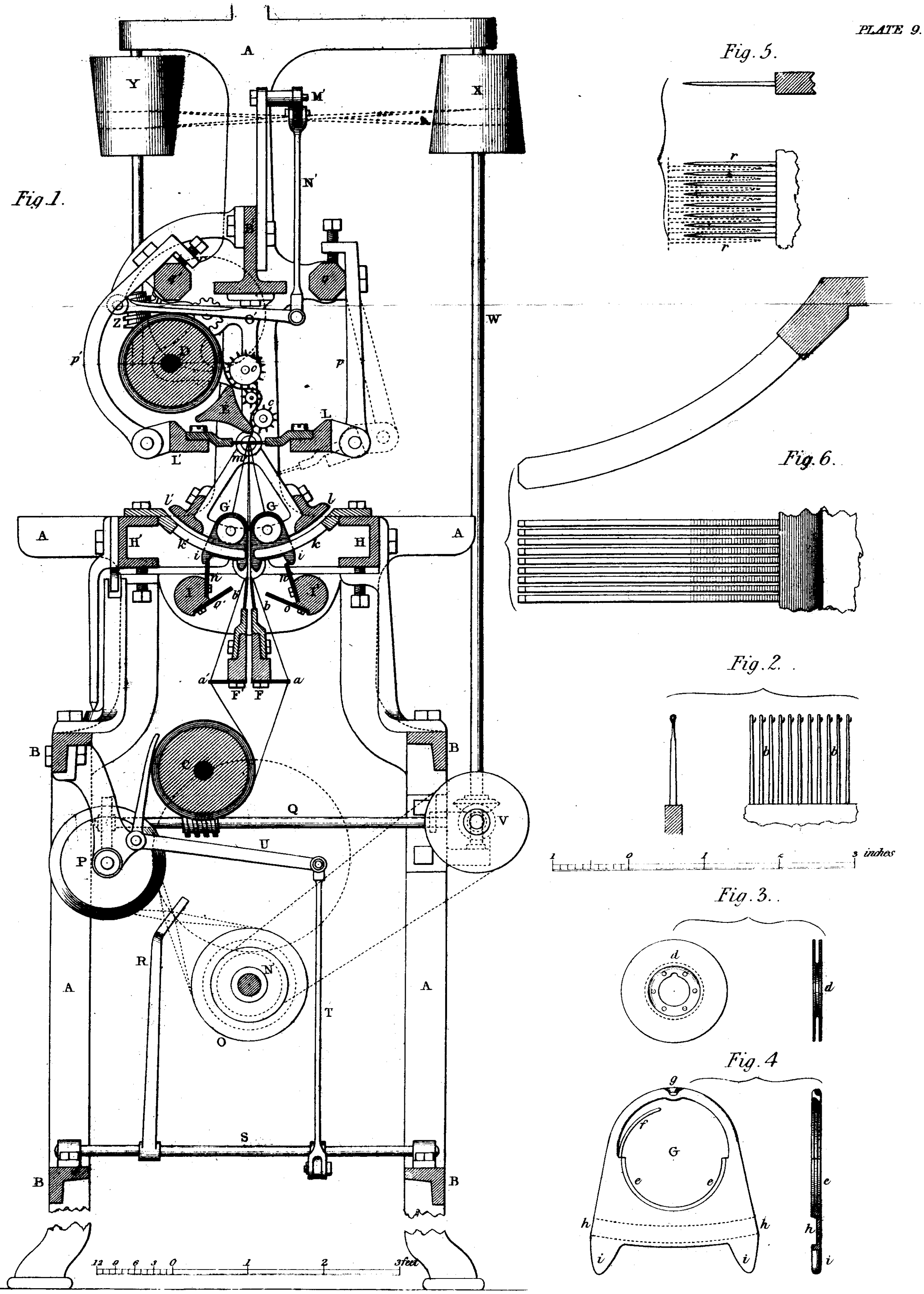
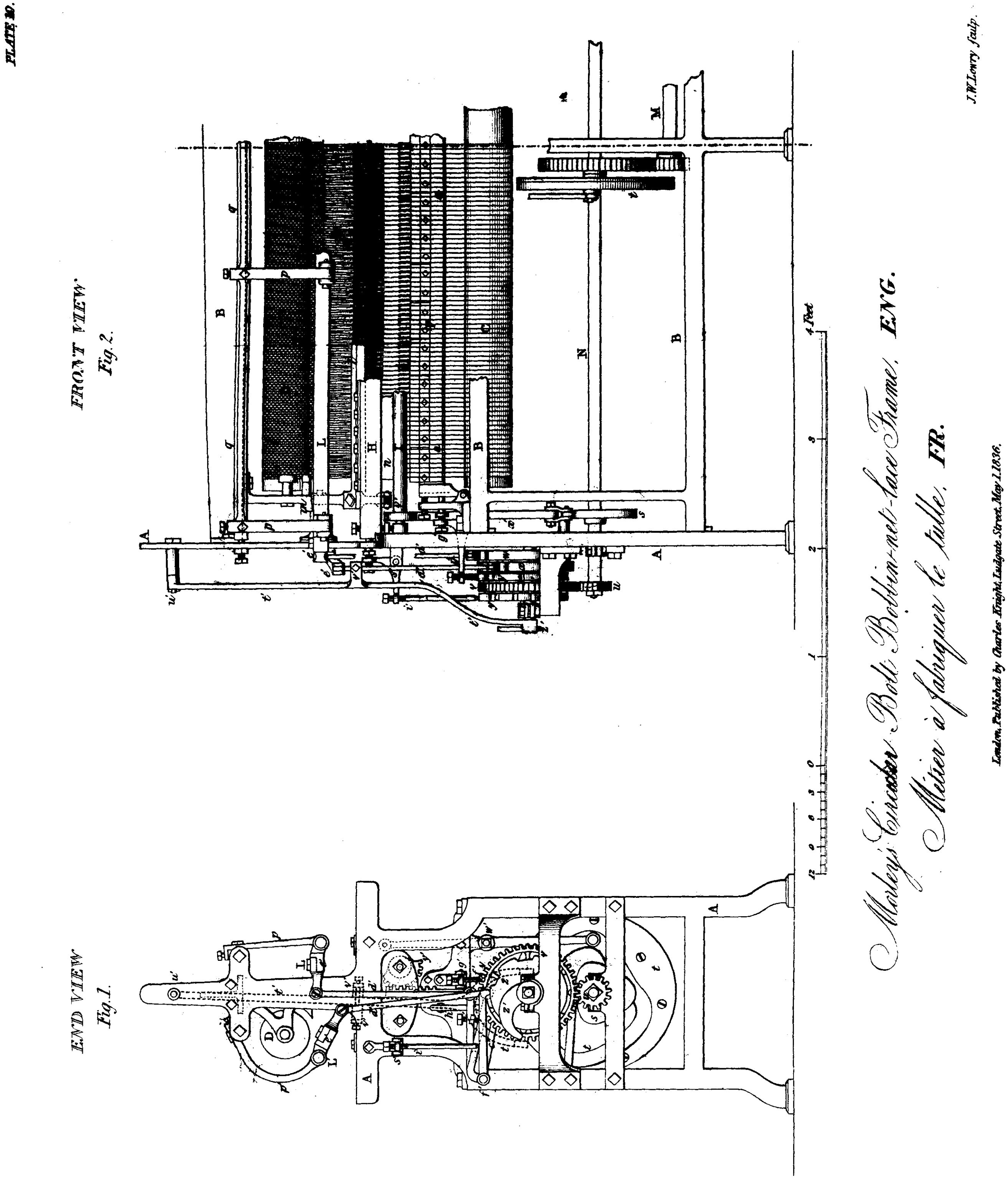
PLATE 9.

Morley's Circular Bolt Bobbin-net Lace Frame, **SECTION.**
Métier à fabriquer le tulle, **COUPE.**





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