

# The Invention of Roller Drawing in Cotton Spinning.

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In this paper I shall trace briefly the rise of the Roller Drawing system which has made possible the vast cotton spinning industry throughout the world, and which is intimately associated with the name of Sir Richard Arkwright. Few inventions have aroused greater controversy, prejudice and animosity in according credit where it is honourably due. The outstanding claimants are Lewis Paul (1738) and Richard Arkwright (1769). The Paul claim is countered by that on behalf of his associate, John Wyatt.

Our earliest record of roller drawing is to be found in the patent granted to Lewis Paul in 1738 (No. 562). The specification of this patent is witnessed by John Wyatt and another; it contains the following description of the invention or inventions:—

“ The said machine, engine, or invention will spin wooll or cotton into thread, yard or worsted, which, before it is placed therein, must first be prepared in manner following (to wit):—All those sorts of wooll or cotton which it is necessary to card must have each cardfull, batt, or roll joyned together, so as to make the mass become a kind of rope or thread of raw wooll. In that sort of wooll which it is necessary to combe, commonly called jarsey, a strict regard must be had to make the slivers of an equal thickness from end to end. The wooll or cotton being thus prepared, one end of the mass, rope, thread, or sliver, is put betwixt a pair of rowlers, cillinders, or cones, or some such movements, which, being turned round by their motion, draws in the raw mass of wooll or cotton to be spun, in proportion to the velocity given to such rowlers, cillinders or cones. As the prepared mass passes regularly through or betwixt these rowlers, cillinders or cones, a succession of other rowlers, cillinders, or cones, moving proportionately faster than the first, draw the rope, thread, or sliver, into any degree of fineness which may be required. Sometimes these successive rowlers, cillenders, or cones (but not the first), have another rotation besides that which diminishes the thread, yarn, or worsted, (vizt.): that they give it a small degree of twist betwixt each pair, by means of the thread itself passing through the axis and center of that rotation. In some other cases only the first pair of rowlers, cillenders, or cones are used, and then the bobbyn, spole, or quill upon which the thread, yarn or worsted

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is spun, is so contrived as to draw faster than the first rowlers, cillenders, or cones give, and in such proportion as the first mass, rope, or sliver is proposed to be diminished."

We have here a specification disclosing two constructions: the first describes the underlying principle of roller drawing, wherein two or more pairs of rollers are employed; the second construction calls for only two rollers to act as feeders to the spindle which, by twisting and winding faster than the rollers yield, produces a similar effect to that of roller drawing. Unfortunately no drawings were filed, thus much remains obscure.

Paul, assisted by Wyatt, either licensed or sold machines made under his patent to several parties. The names of Mr. Johnson, Spitalfields; Mr. Cave, Nottingham; Mr. Thomas Warren, Birmingham, are given, with others, by Robert Cole in his paper on Lewis Paul as operating engines in their respective towns. From Dyer's poem, "The Fleece," (see below) we learn that engines were operated in a mill situated in the Vale of Calder, Yorkshire. Daniel Bourne, Leominster, Herefordshire, would also appear from Cole to have employed Paul's engines in his mill.<sup>1</sup> In spite of these sources of income, Paul and Wyatt suffered imprisonment for debt, and parted company about 1743. Wyatt later on entered the service of Matthew Boulton, of Birmingham.

It was early impressed on the adventurers that the kind of stock cards then in use was unable to produce a feed of uniform and continuous sliver. In 1748 Paul was granted a patent (No. 636, August 30th) for a carding engine.<sup>2</sup> This patent was anticipated in some respects by that of Daniel Bourne, who obtained a patent on January 20th, 1748 (No. 628).

Paul was granted a third patent in 1758 (No. 724); to this specification excellent drawings are attached. These disclose a strong similarity to the second construction contained in his 1738 patent [p. 50], suggesting that the drawing roller principle was never employed, or, if employed, was a failure. Two pieces of evidence will enable one to form a conclusion on the point whether Paul ever operated the roller drawing system.<sup>3</sup> The first is contained in a poem, written by

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<sup>1</sup>Robert Cole mentions in his paper on Lewis Paul, appended to French's Life of Samuel Crompton, that he had in his possession various letters from Paul's customers, and mentions Bourn [sic] as among them.

In the "Gentleman's Magazine," Vol. XXIV., p. 482, 1754, Thursday, October 24th, is an interesting extract:—"Leominster. The Curious Cotton works, with the whole building wherein they stood, was consumed by fire, to the immense loss of Mr. Bourne, the artist who erected them, and the poor therein employed. Besides the loss of the partners who had shares in them, the single loss of Mr. Bourne is computed at £1,600."

<sup>2</sup>WYATT MSS. Letter from Paul to Wyatt. Jan. 7th, 1739. "By this time I hope you have completed the carding machine according to the instructions I left. . . ."

There are further documents relating to this subject which show that Wyatt had some share in the invention.

<sup>3</sup>There is a document dated June 9th, 1735, from "Mill," which deals specifically with the roller drawing principle. Who or what was "Mill" I have not been able to fathom.

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John Dyer, entitled "The Fleece," published in 1757, or one year before Paul obtained the final patent referred to. Dyer says in Book III., lines 79—85:—

" But patient art,  
That on experience works, from hour to hour,  
Sagacious, has a spiral engine form'd,  
Which, on an hundred spoles, an hundred threads,  
With one huge wheel, by lapse of water, twines,  
Few hands requiring; easy-tended work,  
That copiously supplies the greedy loom."

[Dyer's footnote: " Paul's engine for cotton and fine wool." ]

Further on in the same book, lines 291-302:—

" We next are shewn,  
A circular machine, of new design,  
In conic shape: it draws and spins a thread  
Without the tedious toil of needless hands.  
A wheel, invisible, beneath the floor,  
To ev'ry member of th' harmonious frame  
Gives necessary motion. One, intent,  
O'erlooks the work: the carded wool, he says,  
Is smoothly lapp'd around those cylinders,  
Which, gently turning, yield it to yon cirque  
Of upright spindles, which, with rapid whirl,  
Spin out, in long extent, an even twine."

[Dyer's footnote: " A circular machine,—a most curious machine, invented by Mr. Paul. It is at present contrived to spin cotton; but it may be made to spin fine carded wool." ]

Dyer gives us an excellent description of Paul's second construction contained in his 1738 patent, and of his invention patented in 1758 (pls. xv and xvi). He fixes the engines by his footnotes as being Paul's patents. Throughout the poem we do not read of the roller drawing system.

The second piece of evidence is an expert's opinion. John Wyatt, when he died, left his family a note which reads: " The inclosed yarn, spun by the Spinning Engine (without hands) about the year 1741."

That yarn would have been spun on the machines operated in 1741 under the 1738 patent. It was submitted about fifty years afterwards to Mr. John Kennedy, of Manchester, a recognised authority on the subject, who said: " From examining the yarn, I think it would not be said by competent judges, that it was spun by a similar machine to that of Mr. Arkwright's, for, the fabric or thread is very different from the early productions of Mr. Arkwright, and is, I

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think, evidently spun by a different machine, the ingenuity of which we cannot appreciate as the model alluded to is unfortunately lost.”<sup>4</sup>

That is the most conclusive evidence I have been able to discover throwing any reliable light on the special system used by Paul in his spinning engines, and it does not justify the claim made on his behalf of anticipating Arkwright’s system.

Paul died in 1759, and was buried in St. Mary’s Parish Church, Paddington.

The right of Lewis Paul to the inventions set out in his 1738 patent has been questioned by Edward Baines in his “History of the Cotton Manufacture” (1835). Robert Cole, F.S.A., read a paper (already referred to) before the British Association at Leeds in 1858, in which he quotes, *in extenso*, from Paul’s papers which had come into his possession (since then they have unfortunately been burnt). He endeavours to justify Paul as the true inventor of the cotton spinning system, but, like many others, he avoids specifically mentioning the real issue, that of roller drawing, the only system employed for cotton drawing. His paper clearly shows the relationship which existed between Paul and Wyatt, mainly financial, but he fails to be of real assistance to us in our quest.

The Birmingham Reference Library is fortunate in the possession of a collection called the “Wyatt MSS.” These are a series of documents and letters between Wyatt and Paul, Wyatt and his brother, and others, but from our standpoint they are uninteresting. Those between 1730 and 1738 are too often acrimonious, mainly quarrelling over finance. The documents are mostly in John Wyatt’s handwriting and, unfortunately, few are dated.<sup>5</sup> They appear to have been written at varying periods, and at some time Wyatt appears to have endeavoured to fix approximate dates to them, but the nearest he could get was: “that it must have been after they went to London.” His early documents are crude, but his later ones excite little but admiration. There are many referring to roller drawing and the system of spindle drawing. I give one on roller drawing as an example. It is undated, but placed among the 1738 series. Omitting the first part which deals with the preparation of the cotton:—

The principle parts necessary to every Bobbin comes to the regular diminishing of the above preparation which is done by means of cylinders, rollers, or cones, the convex part of whose surfaces are in some cases made smooth in others rough, indented, or covered with leather, cloth, shagg, or sometimes with hair or bristle brushes, or with points of metal set in wood, or being fixed in leather first, and afterwards wrapped about the cylinders. Which makes it in some measure resemble the face of the common cards

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<sup>4</sup>John Kennedy’s paper, “The Rise and Progress of the Cotton Trade.”—*Mem. Manchester Lit. and Phil. Soc.*, 1819, vol. III., p. 137.

<sup>5</sup>The arrangement of the Wyatt MSS. has been well done, but it seems to me that as Wyatt’s handwriting and spelling improved year by year, an expert in handwriting would place some of the undated documents differently.

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at present in use. In some cases the wool is drawn by means of several pairs of these cylinders, etc., one pair moving in its circular surface as much faster than the other as the wool given is made less without twist at all, as for example if the sliver or rolls joined as above, were required to be drawn to a size no greater than one sixth part of what they were before, then must the velocity of the circular surface of each pair of cylinders be in proportion to each other as 1 to 6. In some cases a small matter of twist is given betwixt those pairs of cylinders which is done by making the pair move quickest (which are fixed in ring or hollow cylinder) move at the same time through whose centers of motion the thread itself moves. When cylinders are fixed in a ring the ring itself may be kept in the circular direction by means of pulleys so fixed that the outward rims may be directed by them. When the cylinders are fixed in a hollow cylinder then the outside of the cylinder itself being put through holes or the like keeps the cylinder in motion. In other cases only one pair of cylinders, etc., is made use on and then the bobbin, spool or quill upon which the thread or yarn is wrapt as it is spun is made to exceed a certain arm or guide that places the thread regularly on the spool, quill or bobbin in greater degree as the thread is to be made less than the quantity of wool given to the cylinders. N.B.—Whether the revolutions of the bobbin exceed the revolutions of the arms or whether the revolutions of the arms exceed the revolutions of the bobbins the effect is nearly the same.”

That document is so like the patent specification in its wording as to suggest that it was drawn up as the instructions for its preparation. That Wyatt intended others to know his position in regard to the patent would appear from an undated document: “A Description of Mr. Paul’s Invention for Spinning,” at the end of which he uses the words, “We Petitioned His Majesty’s Royal Patent,” etc.

Unfortunately, throughout the Wyatt MSS. there is no evidence whether Paul or Wyatt, or both, were the inventors of the roller drawing principle. Wyatt writes as much of the spindle drawing method as of the roller drawing system. All evidence goes to show that Paul and Wyatt never carried the roller drawing idea beyond the experimental stage. That they launched the spindle drawing engine is to be found in an important admission by Wyatt, though one document is endorsed, in pencil, 1760, it may have been written about 1738. It is headed and written by Wyatt.

### “THOUGHTS ORIGINALLY MR. PAUL’S.”

1. The joyning of the Roles.
2. Their passing through cillinders.
3. The calculation of the wheels by which means the Bobbyn draws faster than these cylinders I presume was picked up somewhere before I knew him.

### “THOUGHTS ORIGINALLY MINE.”

1. The Horizontalls and Tracer.
2. Conick Whorves.

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3. The making the Spindle twice the Length of the Bobbyn, with the Ring flys and manner of raising the Bobbyn.
4. With the Wheel Pipe which serves all the Bobbyns or any Bobbyn.
5. An Original design of this long Spindle and Short Bobbyn was to work with only one wheel, whorve, or Pulley, which turned the Spindle only. The Role being Drawn, to the size of the Thred without twist. This method if the Roles can be made quit regular seems to be about the highest perfection the thing is capable of, in this case the Bobbyn is brought about by the strength of the thred only. Therefore to proportion the friction of this Bobbyn to the strength of the thred is some difficulty. (This not being rightly hit upon at first; Master Paul was impatient with it. It was then altered to the wheel and Pipe.) The bobyns in this case must have a contrivance to prevent its going faster than the Spindle in case of irregularity in the engine or any suden stops. I think the best means I have yet thought on for this is a spring fixed upon one end, and near the outside of the Bobbin the other end Bearing very gently against the Spindle at such an Angle as if the Bobbin should offer to out go the spindle the end spring may bind so hard against the spindle as to stop it soon.
- 6.
7. Or the cones and conick wheels in various cases.
8. In the new work made at Mr. Bartletts the maner of driving the spindles by wheel and strap Impraceing the whorves on both sides.
9. The manner of laying the Thred upon the Bobbin by Thred instead of an Iron Screw which was Mr. P——s original method.
10. A means to take off the friction of the axis of the two great wheels and prevent the Gudgeons get in so soon (?loose) by the interposition of two friction wheels to bear against each other and against the shafts of the great wheels.

“ I may say the whole contrivance of that work whether it prove better or worse is all my own. Two things I already apprehend might have been Better viz If the wheels had had their Rims Bent in thickness and been so contrived as to have Born against each other instead of y[e] two friction wheels above.”

In view of the foregoing admissions we may reasonably assume that both Paul and Wyatt contributed to the invention of the roller drawing principle. It was merely an enunciation of a principle in the patent and not a description of any combination.<sup>6</sup>

After Wyatt entered the service of Matthew Boulton he made many inventions. The celebrated weighbridge, in use throughout the world, is his. His researches into friction annihilators produced the roller bearing, now so common.

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<sup>6</sup>Wyatt endeavoured to improve the spindle and bobbin in order to make automatic winding. Arkwright's spindle and flier is most crude, necessitating stopping the frame working to allow of readjustment of the thread. Neither appears to have known of the Saxony spindle, or of Leonardo da Vinci's (circa 1500 A.D.) beautiful automatic self-raising spindle and flier so clearly drawn in his "Codex Atlanticus."

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Road construction, bridge building, hydrostatics, canals, water power engines, and many other schemes received his attention.

John Wyatt died in 1766, and was buried in St. Philip's Churchyard, Birmingham.<sup>7</sup> Many of the leading men of Birmingham, including Mr. Boulton, attended the funeral.

ARKWRIGHT'S INVENTIONS.

In 1769, Richard Arkwright patented the roller drawing principle and working combination which exists to-day.

Arkwright was a barber by trade.<sup>8</sup> He was the youngest child of Thomas and Ellen Arkwright (née Hodgekinson), a beautiful woman. They had seven children, two boys and five girls, and not thirteen as is commonly stated. The eldest son joined Prince Charles Edward when he made his descent on England *via* Preston in 1745. I have been unable to trace his further career. The five daughters married men connected more or less with the cotton industry. Mrs. Arkwright was left a widow a few years after Richard's birth in 1732 and in poor circumstances. Having little or no financial support she went to live with one of her married daughters in Manchester, and Richard was apprenticed to a barber at Kirkham, near Preston. After serving his indentures, Arkwright went to Bolton-le-Moors, Lancs., where he practised his trade. About 1766 he became interested in the cotton spinning problem, which had become acute through John Kay's invention of the "fly shuttle" in 1733, and that of his son Robert's invention of the "drop box" in 1760, causing a famine in the supply of warp and weft. While pursuing his invention he maintained the closest secrecy by building his machine in Manchester, probably under the protection of his relatives. In the spring of 1768 he exhibited his perfected machine in the back room of the Old Grammar School at Preston, whither he went to obtain financial support from among his parents' friends. The only help came from John Smalley, a wine merchant and painter, who sold out his business, it is said for about £1,600, and joined Arkwright, but on what terms I have not been able to discover. The repayment of this debt would appear to have happened by John Smalley building the cotton mill at Holywell, Flintshire, in 1777.<sup>9</sup> With this limited capital the adven-

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<sup>7</sup>Opposite the Blue Coat School door, and close to the railings in St. Philip's Churchyard (now the Cathedral), Birmingham, is an upright gravestone. It reads: "In Memory of John Wyatt, who departed his life November the 29th, 1766. Aged 66 years. Likewise of Marabella, his wife, who died February the 4th, 1776. Aged 54 years." Marabella was Wyatt's second wife.

<sup>8</sup>The information relating to the Arkwright family has been obtained from the Willersley MSS. kindly loaned to me by Mr. F. C. Arkwright.

<sup>9</sup>An interesting account is given of John Smalley and his Holywell Cotton Mill by Thomas Pennant in his "History of the Parishes of Whiteford and Holywell," 1796, page 214 *et seq.*

John Smalley was buried in Whiteford Churchyard; at the N.W. end of the Church is a big altar tombstone: "Here rests the remains of John Smalley, late of Preston, in Lancashire, he died at Holywell on the 28th day of January, 1789, aged 53 years, he established the cotton manufactory in the year 1777."

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turers departed to Nottingham and started a mill in Woolpack Lane. Their operations would probably have been commenced about June, 1768, as they left Preston after the Burgoyne election, which took place in March or April of that year. At this election, Arkwright was so shabbily dressed that his friends purchased a new suit in order that he might appear, to vote as one of Preston's Freemen, respectably clothed.

What with the equipping of the Woolpack Lane Mill and the high price of cotton, the small capital did not suffice without assistance from their bankers, Messrs. Wright. These funds were exhausted during the last days of 1768 or the early days of 1769, and Arkwright was in deep waters, financially.

It is apposite I should detail, at this stage, the true story of the quarrel between Arkwright and his wife,<sup>10</sup> which occurred at this time, as it has been told with so many variations.<sup>11</sup>

Thomas Arkwright, Richard's father, had a brother named John,<sup>12</sup> who was married and lived in Preston, but had no children. When he died he left his widow in possession of a handsome fortune; after her death it was divided amongst numerous relatives; Richard's share came to more than £400. This sum he invested in the joint names of his wife and himself. In his financial trouble Richard turned to his wife and appealed to her to agree to the money being invested in the mill; but she, having no confidence in his schemes, refused. He pleaded hard, but she remained adamant. They separated their marital relations for life, yet remained friends, and neither would say, or allow others to say, an unkind word of the other. During the earlier separation, Mrs. Arkwright cared for the children, Richard making her an allowance which was within two years increased to £500 per annum. She lived with her married daughter and survived her husband about twenty years.<sup>13</sup>

It was at this critical period in Arkwright's financial affairs that his bankers, Messrs. Wright, rendered eminent services to the infant cotton industry by introducing Arkwright to Mr. Samuel Need, who was in partnership with Jedediah Strutt, the inventor of the Derby Rib Stocking Loom. Both were successful men of business with ample capital. Need mentioned the matter to his partner, who inspected the mill with the result that a partnership, called Arkwright,

<sup>10</sup>This version was given me by the late Hon. Frederick Strutt.

<sup>11</sup>"A Compendious History of the Cotton Manufacture with a disapproval of the claim of Sir Richard Arkwright to the invention of its ingenious machinery," by Richard Guest, 1823, contains evidence bearing out this story.

<sup>12</sup>John Arkwright was churchwarden of St. Peter's Parish Church, Preston, at the time of Richard Arkwright's baptism in 1732, and signs the register.

<sup>13</sup>Arkwright married twice. His first wife was Patience Holt, a Presbyterian, whom he married at Bolton according to the rites of that faith, in 1755. By her he had one son, Richard, baptised at Bolton, Jan. 18th, 1756, by the Rev. Philip Holland, Presbyterian Minister. Patience died October, 1756, and was buried in Bolton Parish Churchyard. His second wife, Margaret Biggins, of Pennington, Leigh, he married by special license at Leigh Parish Church, March 24th, 1761, by whom he had one daughter. (Willersley MSS.)



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Need and Strutt, was arranged between the parties. Need retired soon afterwards and confined himself to the partnership in the hosiery business with Strutt. Then began the celebrated association between Arkwright and Strutt which ran for the agreed term of twelve years. Their first act was to secure protection for the machine. This was granted by patent July 3rd, 1769 (No. 931), and in the clearness of the specification I am inclined to see the wise guidance of Strutt. The story of the building of the Cromford Mill, the pioneer of the factory system has been so often told, I need not pursue that theme.

It is important that we should review Arkwright's invention in detail in order that we may compare it with Paul's patent. Arkwright, following the admirable drawings (Pl. xvii.) affixed to the specification, says:—

“ A, the cogg wheel and shaft, which receive their motion from a horse; B, the drum or wheel which turns C, a belt of leather, and gives motion to the whole machine; D, a lead weight which keeps F, the small drum, steady to E, the forcing wheel; G, the shaft of wood which gives motion to the wheel H, and continues it to I, four pair of rollers (the form of which are drawn in the margin), which act by tooth and pinion, made of brass and steel nutt, fixt in two iron plates K. That part of the roller which the cotton runs through is covered with wood, the top roller with leather, and the bottom one fluted, which lets the cotton, etc. through it, and by one pair of rollers moving quicker than the other, draws it finer for twisting, which is performed by the spindles T. K, the two iron plates described above; L, four large bobbins with cotton rovings on, conducted between rollers at the back; M, the four threads carried to the bobbins and spindles, by four small wires fixt across the frame in the slip of wood V; N, iron leavers with small lead weights, hanging to the rollers by pulleys, which keep the rollers close to each other; O, a cross piece of wood to which the leavers are fixed; P, the bobbins and spindles; Q, flyers made of wood, with small wires on the side which lead the thread to the bobbins; R, small worsted bands, put about the whirl of the bobbins, the screwing of which tight or easy causes the bobbins to wind up the thread faster or slower; S, the four whirls of the spindles; T, the four spindles which run in iron plates V, explained in letter M; W, a wooden frame of the whole machine.”

With such a clear description we are not left in any doubt as to Arkwright's invention.

It is interesting to observe that Strutt's name does not appear, but Smalley signs as a witness. Strutt never shared with Arkwright in the profits of the patent; thus Arkwright received all the license fees, the patent remaining his sole property, the partnership alone being allowed free license. This patent ran the full term of fourteen years and was never challenged during its period in a Court of Law. The fact of Paul having patented the roller drawing principle in 1738 does not appear to have been known to anyone until about the year 1781, when the patent records were searched in view of the forthcoming trial in respect

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of his second patent, when Arkwright sued infringers and won his suit. It was the result of this trial that brought about the celebrated *Scire Facias* trial of 1785.

The only discoverable similarity between Paul's and Arkwright's specifications is in the wording. Paul merely mentions the bare principle, whereas Arkwright gives the details which make that principle a success. Paul uses two pairs of rollers, though Wyatt mentions four in his notes. Arkwright states he uses four rollers in pairs, the top covered with leather and the bottom fluted, and the series automatically weighted to ensure contact. It is impossible to bring oneself to the conclusion that Paul or Wyatt ever succeeded in anticipating Arkwright or that Arkwright founded his invention on that of Paul. The two patents only agree in one particular, viz., the principle of roller drawing.

I am inclined to think that neither Paul nor Wyatt had what I term "spinning sense," the absence of which is to be found throughout the Wyatt MSS. Wyatt found that plain rollers, with hard surfaces, did not draw, so he tried "covering with leather, cloth or shagg, hair or bristle brushes, points of metal set in wood or fixed in leather and afterwards wound round the rollers which makes it in some measure resemble the face of the common cards." Drawing under such conditions is an impossibility. His suggestion to use leather comes nearer to Arkwright's idea, but, as he follows on with descriptions of totally different materials, it seems he had not realised the importance of resilient leather covering. Further, it is quite possible he had in view hard shoe leather, which is what Higgs said he employed, when he gave evidence at the *Scire Facias* trial (see below). Again it is probable that Paul and Wyatt made the rollers with fixed pressure. Had they possessed the spinning sense they would have avoided such combinations.

Arkwright, living at Bolton and Manchester, was in a cotton-spinning atmosphere, and therefore gained the spinning sense. He fluted his bottom rollers and drove them only; the top rollers were covered with soft alum leather, such as was then, and still is, used for making gloves. Such leather was capable of being pared down level and thin. The contact between the top and bottom rollers was maintained by leaden weights, carefully regulated so as to give flexibility and to be capable of almost automatic adjustment. This system remains unaltered to this day. The combination around the principle of roller drawing as invented by Arkwright is the entire secret of his wonderful success.

It is interesting to relate a curious incident, which, like many others associated with Arkwright, has been told and retold with considerable distortion.<sup>14</sup> When the Cromford Mill began operations, there appeared a trouble called "licking," viz., the cotton, instead of being given to the spindle, lapped round the front rollers. In his trouble, Arkwright appealed to Strutt for help to solve the diffi-

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<sup>14</sup>The late Hon. Frederick Strutt vouched for the accuracy of this version.

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culty, and he, at once discerning the cause, took a piece of chalk from his pocket and chalked the front top rollers, when the licking ceased. The atmosphere at Cromford being damp, the alum-tawed leather absorbed the moisture, hence the licking. The method of covering the top rollers by Arkwright may be seen on his machines in the Science Museum, South Kensington; it comprises a curious and neat form of sewing.

In the life-size painting of Arkwright by Wright, at Willersley, the beautiful residence built by Arkwright in the Vale of Cromford, he is seen seated alongside a table on which reposes a head of rollers. The front top rollers are red or brown, and the three back top rollers are white alum leather. The front top rollers are evidently covered with bark-tanned sheep leather, much as they are to-day, and this change doubtless arose through the licking difficulty. Alum-tawed leather continued to be used until recent times in Scotland, but its employment has, I believe, now finally ceased.

In 1775 Arkwright took out a patent (No. 1111) mainly intended to protect his carding-engine. Six years later he sued a number of infringers of this patent and won his suit. This result set all the spinners in alarm, and in their anxiety they appealed to the Government to have the decision set aside. This was accomplished by Writ of *Scire Facias* in 1785; His Majesty's Attorney General being the plaintiff. This action definitely set aside the 1775 patent. Whatever may be said of that trial, everyone agrees that we owe the present continuous carding-engine of to-day to the inventive ability of Richard Arkwright. The principles involved therein remain with us, though detailed improvements have been introduced as the result of general experience.

It is from the report of this trial that we learn something of the claim of Thomas Highs to the invention of roller drawing, and his evidence is worth retailing.

Of the man himself we have been able to learn little. He was a native of Leigh, near Bolton-le-Moors, and by trade a reed-maker. His evidence at the *Scire Facias* trial of 1785, so far as it is material, is as follows:—

Mr. Serjeant Bolton: Look at the rollers through which the thread comes, the roving or spinning, or whatever it is called. Did you ever see rollers like those before 1775, before Mr. Arkwright's patent?

(It will be noted that Sergeant Bolton refers to Arkwright's patent of 1769 as though it was part of the 1775 patent under trial.—A.S.J.)

A. I have seen rollers; I made rollers myself in 1767.

Q. You see one is fluted, the other covered with leather.

A. I see it is.

Q. Was yours the same way?

A. Yes, mine was, *two years after, but not then.*

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Q. Not at first?

A. No.

Q. In 1769 yours were like it?

A. They were, mine had fluted work, fluted wood, upon an iron axis; but the other roller was the same, only it was covered with shoe leather, instead of that leather; I am informed it is such as they make shoes of.

If Highs' evidence is to be relied on, it follows that he and Arkwright had been working on the solution of the mechanical spinning problem at the same time and contiguous to, though, as I think, unknown to one another.

John Kay, who was for some time in Arkwright's employment but was dismissed for theft, gave evidence which is worth quoting:—

Q. Before you go further, who did you get the method of making these models from?

A. From Mr. Highs, the last witness.

Q. Did you tell Mr. Arkwright so?

A. I told him; I said another man had tried that method at Warrington. (Highs had stated in evidence, "I employed one Kay, who came from Warrington.")

Q. Look at that, was that the sort of model, or was it at all like that?

A. It was with rollers.

Q. It was with double rollers in that way?

A. Yes, with four pairs of rollers; this has only two.

Q. Were they fluted?

A. No.

Q. Neither of them?

A. No.

Q. Neither top nor bottom?

A. No.

In face of Highs' admission, that he never employed the essentials in Arkwright's system until two years after Arkwright invented it and was operating the system commercially, and Kay's damaging confession that he did not make the model for Arkwright with fluted rollers, Highs' claims must be dismissed as those of a dreamer.

Arkwright accumulated great wealth, and he is said to have offered to finance the Government of that day in its wars, provided it would continue to him his patented rights for a number of years. He became High Sheriff of Derbyshire, and was knighted by King George III. He died in 1792, aged 60, and was buried in the pretty church at Cromford which he built.

Looking backward, I cannot but think that Arkwright was fortunate in having as his associate and partner such a fine type of English gentleman, of such high moral standing and sound common sense, as Jedediah Strutt. It would, almost,

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seem as though he moulded his behaviour and demeanour on that of his partner, with the result that Arkwright was admired and honoured by all who became associated with him in his works. The two men were opposites in religion and politics; Strutt was a Unitarian and a Radical, whereas Arkwright was a Churchman and a Tory. Yet both remained life-long friends, and the families have continued that friendship to this day.

Mr. Seymour-Jones remarked that his paper was to have been read in April, but had been postponed owing to the coal crisis. One advantage had resulted from the postponement—the paper was being presented in the City in which the invention of roller spinning had its birth, and in the Library that possessed the Wyatt MSS. which contained what evidence there was on Wyatt and Paul's share in the invention of drawing by rollers.

The author gave only a brief epitome of his paper, prefacing it by a description of the preparation of cotton fibre and of hand spinning.

He exhibited a photogravure of the Wright portrait of Arkwright, a facsimile of one of Arkwright's letters, and a number of photographs connected with his life and work.

#### DISCUSSION.

The discussion was taken part in by Mr. Brownlie, who moved a vote of thanks to the author, Mr. Hulme, who seconded, Mr. Pendred, Mr. Welfens, Mr. Powell, Mr. Jenkins and the Hon. Secretary. The consensus of opinion was that Paul and Arkwright were both original and both deserving of credit, but the latter had the credit of having established an industry of vast importance. Mr. Welfens advanced the theory that Paul had been trying to spin cotton waste, and gave up drawing rollers after trial as too difficult and too expensive. The author, replying, did not agree; his contention was that Paul had failed because he used sole leather, which was useless, whereas Arkwright used alum-tawed leather, and discovered the right way to put it on the rollers.

The vote of thanks was carried by acclamation, and at the close of the meeting Members spent an hour inspecting the Wyatt MSS. and a number of books, belonging to the Library, treating of the history of cotton manufacture. The Boulton and Watt Collection also came in for study.

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Appendix.

Transcript of

HOLOGRAPH LETTER

RICHARD ARKWRIGHT TO JEDEDIAH STRUTT.

Cromford Marh 2<sup>d</sup> 72.

Sir,

Yours yisterday came to hand together with a bill from Mr. Need Value 60<sup>lb</sup> (i.e. £60). I have sent a little cotton spun on the one spindle & find no Difficanty in geting it from the Bobbin & Dubeld & Twistd in the maner you see it at one opration. One hand (i.e. workman) I think will do 40 or 50lb. of it in one day from the bobins it is spun upon, that is in the new whay. I am certain of it ansuaring & one person will spin a Thousand Hanks a Day so that wee shall not want 1/5 of the hands I First expectd notwithstanding the Roaveing takejng so few. I see greate Improvements every day. When I rote to you last [I] had not thorowly provd the spining; several things apening I could not account for sinse then has proved it—I have made trial to twist it for Volverets & find what the[y] do with five operations [I] can do with one that is duple & twist it Redey for wharping at one time; first they reel, second wind, third Duple, fourth twist, 5 wind reddy to wharp, & all these done one thred at a time except Twisting. [I] shold like you [to] try a little of this hard [yarn] in a rib<sup>d</sup> fraim; I think it shold not be whet but beate. Plais to send the solft [i.e. soft yarn] to Mr. Need. One has a slacker throw then the other, naither of [them] perfect but [I] shold like to see a stockin or part of one; pray Bring a Little with you. Mr. Need spakes of wanting Tho<sup>s</sup> Bell & a turner but [I] cant see what they whant Tho<sup>s</sup> for. I spok to Coniah & dar say he will com if he was properly aployd to or they might get a man from Hibisons but there is no person at the mill that will put themselves out of their way to be of aney servis Except teas(e) Mr. Needs hart out with a continual want & uneasiness. As to sending aney hand from hear I cant think of doing [so], for where they get a shiling clear there shall [be] in a few months 40, I am posative. If Mr. Need thinks best [I] can go one or two days p<sup>r</sup>. wheek to Nottingham & shall shortly suply them with Roaveings from hear if wee cant spin 2000 Hanks a Day which I am certain I can in four months at the out side, and now as solfter [i.e. softer yarn] can be spun faster than hard, stocking yarn will ansuar best & will be Dubled with very little expence. At the mill the[y] whant Cards puting on. Andrew might do that as it requiers no greate judgement, but I sopose he is a deal taken up in those Looms & the profits of wich will scairsly pay wharehouse room. If he can be got to wheave by the

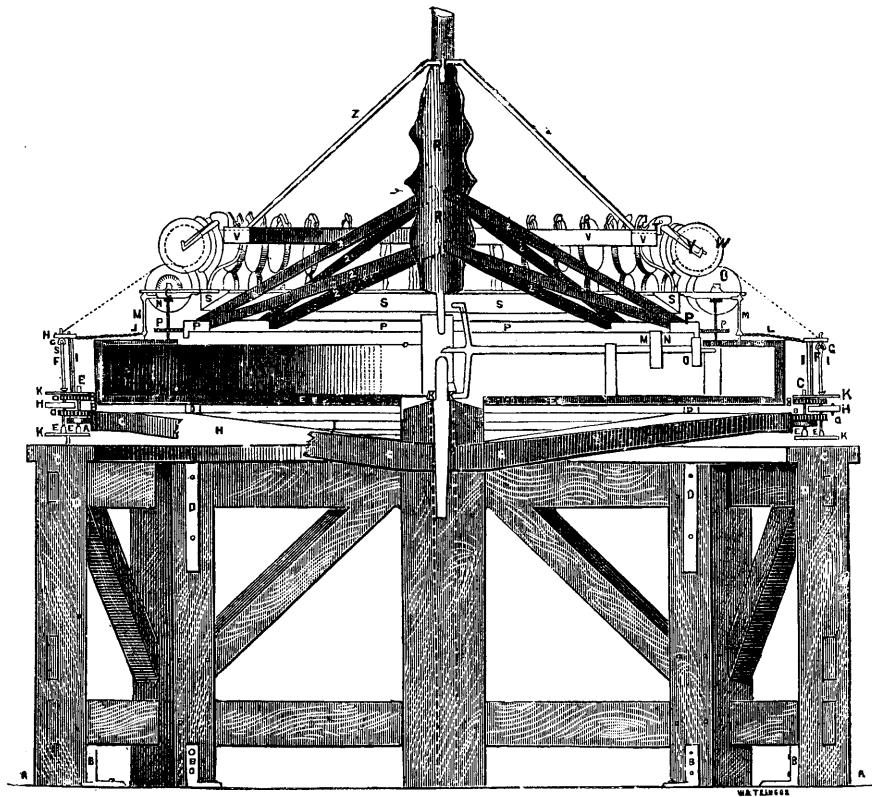
THE INVENTION OF ROLLER DRAWING IN COTTON SPINNING.

Pees [i.e. piece] or yard & out of the mill, [I] shold sune set that plase in Better order but while he is in it is scairsly posable. Except he has his own whay no good will be don with justis or him, & what I sade to George is what I shold say again: it whas unraisenable. In a few weeks [I] shall move for wee can do without them all. It is onley seting another pair of cards &c; hear wee have begun of them. [I] shold like to know if aney acount as come from Hallifax lately; he has sent som other cards but not the quantety I Rote for and no Letter or bill with them. [I] shold [have] Rote to Mr. N. but has not time & wold [like] when I do send to send some twe [i.e. two] threds, solft and as even as silk. I am sertain I can [make] the first fraim; I have hands to make three frames in a fortnet. It shall be don you may depend upon it, but I whant somebody to look after the spinning &c. I have rote to Kay yesterday; if he will not come can you think of somebody? A yonge man was hear this wheek sade he had spoke to you; this is his Riteing I send Inclosed. What do you think of him? He seemes a likely person but has all to lern. I am afraide no one man will know all that I should expect the[y] might. Rich<sup>d</sup> has hit upon a method to spin woostid with Roulers; it is quite sertain, & only altering the shape—that is Round on one side and flat on the other—so that the twist gets under or betwixt them at sertain time[s], it will ansuar I am sertain. Query: will not Cotton make whipcoard as good as silk, properly Twisted? It may be don all at onst from the bobins. Pray Rite to Mr. N. what he thinks best. I cant think of stoping this Concern hear as that at Notting<sup>m</sup>. is (not) or Ever will be aneything in comparison to this. There is hands to be got there & if he wold have mee com over I shall, but not take aney hands from hear. I ask<sup>d</sup> Mr. Whard to get some Let [? lead] pipes to bring the water into the mill; they are coninuially [i.e. continually] fetching. It might be brought in the Rooms. Wold it not be best to fix a Crank to ore [one] of the lying (?) shafts to work a pump or Ingon in case of fire? Bring the belts with you. Desire Ward to send those other Locks and allso some sorts of Hangins for the sashes he & you may think best and some good Latches & Catches for the out doors and a few for the inner ons allso and a Large Knoker or a Bell to First door. I am Determind for the feuter to let no persons in to look at the wors [?works] except spinning. The man Mr. Whard Bot the ash Board from call<sup>d</sup> for his money & says he will send the other shortly. I am tired with riteing so long a letter & think you can scairsley Reed it. Excuse haist

and am yours &c

R. ARKWRIGHT.

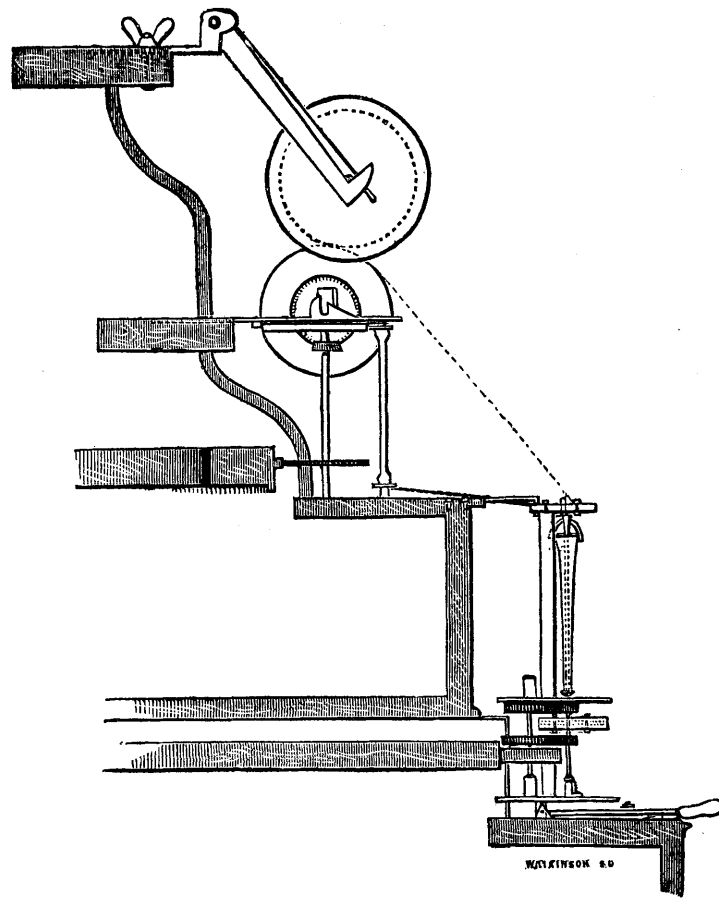
PLATE XV.



PAUL'S SECOND SPINNING MACHINE, 1758.

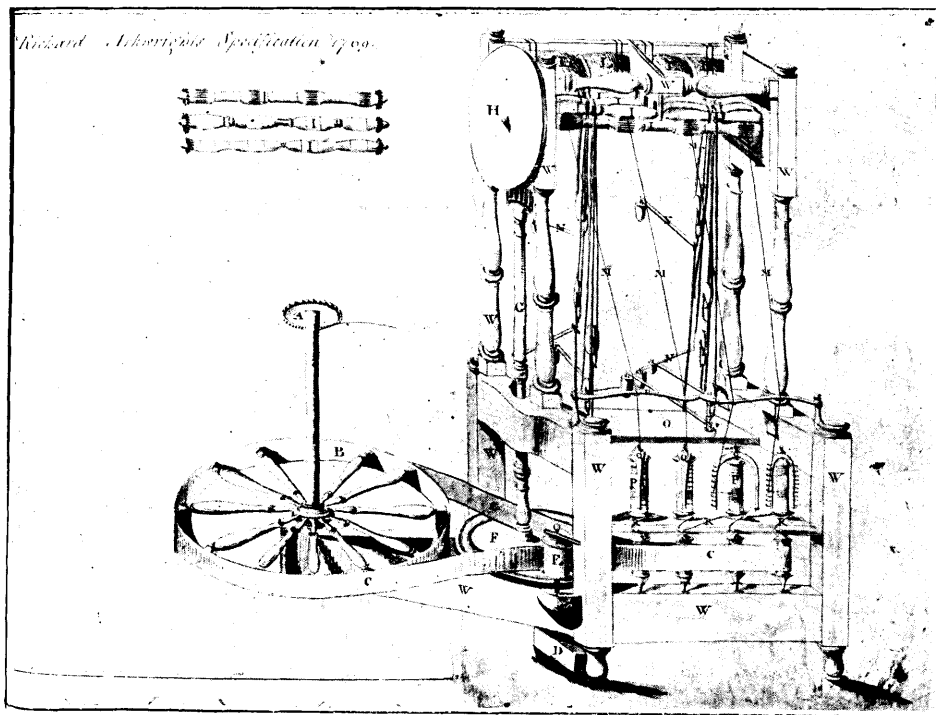


PLATE XVI.



ENLARGED SECTION OF PAUL'S SECOND SPINNING MACHINE.

PLATE XVII.



ARKWRIGHT'S SPECIFICATION DRAWING OF HIS SPINNING MACHINE. 1769.  
From the original in the Record Office.

PLATE XVIII.

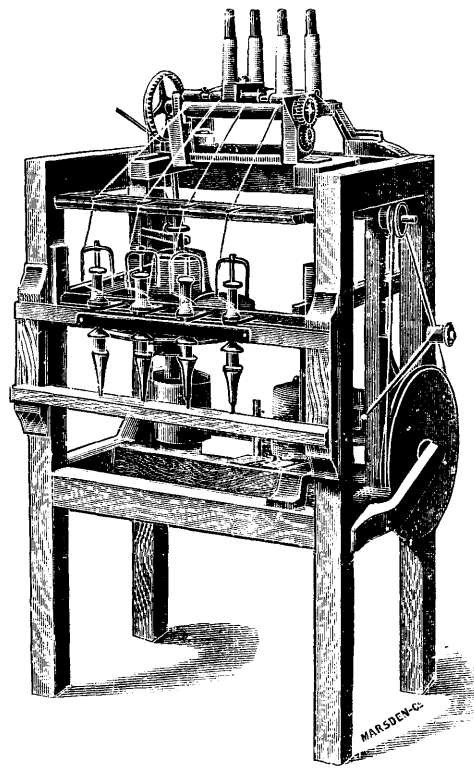


FIG. 1. ARKWRIGHT'S IMPROVED SPINNING MACHINE OR WATER FRAME, c. 1775.

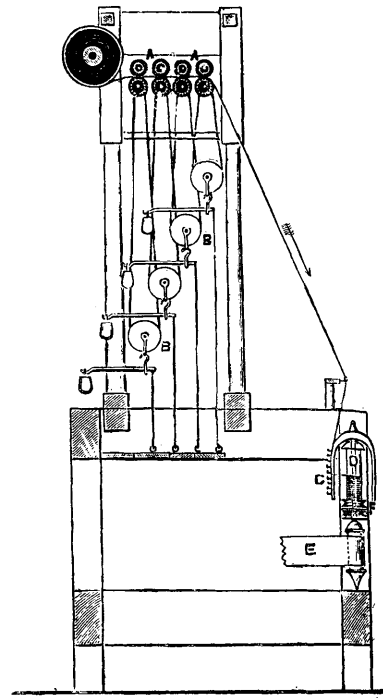


FIG. 2. SECTION SHOWING ARKWRIGHT'S DRAWING ROLLER SYSTEM.