

SPINNING, the art of combining animal or vegetable fibres into threads or cords, by twisting them together. Wool, silk, cotton, flax, and hemp, are the matters most commonly employed for spinning into threads; and of these, most of the vegetable fibres, except cotton, require to be wetted during the operation of spinning, to render them more supple; but cotton, wool, and silk, are spun in a dry state.

The machines employed for spinning are of very different kinds,

## SPINNING.

kinds, and adapted to the materials to be operated upon; but they have all a spindle, revolving with a rapid motion, to twist the fibres which are attached to the end of it, and are supplied in a regular quantity, as fast as the twisting motion of the spindle will form them into a thread; and there is also some provision of a bobbin upon the spindle, to take up and retain the thread when made.

The most ancient mode of spinning is by the spindle and distaff, and this method is the simplest of all others. The spindle is nothing more than a piece of hard wood, made round, and sharp-pointed at one end, so that it can be made to spin upon its point, in the same manner as a child's top: the upper part is reduced to a pin or peg, and it is this part which has the fibres united to it, the lower or enlarged part being only to give sufficient weight to make it spin. The spinner must be seated upon the ground, and after having put the distaff in motion upon its point, by twirling it between the hands, get it up to a rapid motion, by striking it occasionally with the hand, with a motion very similar to that by which a child keeps up the motion of his whipping-top, when he draws the lash of a whip round it.

The flax, or material which is to be spun, after being properly prepared, is lapped round the end of the distaff, which is nothing more than a stick that the spinner holds in the left hand, so as to be conveniently situated to draw off from it a few fibres at a time, with the finger and thumb of the right hand, to form the thread. The upper part of the spindle, which is made smaller, like a pin, has the ends of the fibres which are to form the thread attached to it before it is put in motion. These fibres are drawn out of the bunch which is wound upon the distaff, and held between the finger and thumb, so as to be in the direction of the length of the spindle; therefore, when the spindle is once made to revolve, it twists these fibres together, to form a thread, and as fast as the thread forms, the spinner draws off more flax from the distaff, and guides the fibres between the finger and thumb, so that they shall be regularly delivered out, and make an even thread. The motion of the spindle is constantly kept up, by striking it as often as the hand can be spared from the operation of guiding the thread. When by these means as great a length of thread is formed as is convenient to reach from the end of it to the spindle, the thread is wound upon the outside of the small part or pin of the spindle, for which purpose the spinner applies the fore-finger against the thread, close to the end of the spindle, and bends the thread at that part, so that it will be at right angles with the direction of the spindle, instead of being nearly in the direction of its length; and also, that it will be guided opposite to the middle of the pin, or small part of the spindle, instead of being at the extreme end thereof. In this situation the motion of the spindle, which is continually kept up, occasions the thread to wind up, or lap upon the pin of the spindle, instead of twisting round upon itself, as in the former case; but when nearly all the length of thread is thus disposed of, the finger is removed from the thread, and it immediately assumes its original direction, by slipping to the extreme end of the spindle, so as to be twisted round itself by the motion of the spindle, and more fibres are now supplied to it from the bunch upon the distaff, to form a fresh length of thread. In this manner the spinning proceeds, until as much thread is spun and wound upon the pin of the spindle as will make a moderate sized ball.

This simple and inconvenient method of spinning becomes very efficient, when the spindle, instead of being spun upon the ground, is mounted in a proper frame, and turned by a wheel

and band; this forms a machine which is called the one-thread wheel, and is still used in the country for spinning wool: the spindle is made of iron, and placed horizontally, so that it can revolve freely; and the extremity of the spindle, to which the thread is applied, projects beyond the support.

The wheel which turns it is placed at one side, the pivots of both being supported in upright pieces, rising up from a sort of stool. The spinner puts the wheel in rapid motion by its handle, and its weight is sufficient to continue the motion for some seconds; then walking backwards from the spindle, in the direction of its length, she supplies the fibres regularly, and the motion twists them into a thread; but when a convenient length is spun, the spinner steps on one side, and reaches out that arm which holds the end of the thread, so as to alter the direction of the thread, and bring it nearly perpendicular to the length of the spindle, which motion gathers or winds up the thread upon the middle of the projecting part of the spindle. This being done, she holds the thread in the direction of the spindle, so that it will receive twist, and retreats again to spin a fresh length of thread. For spinning wool, it is not wound round the distaff the same as flax, but the spinner holds a lock of it, doubled over the fore-finger, and draws away the fibres from the middle part of the lock, to do which with regularity is the great art of spinning by hand.

A spinning-machine more perfect than this is the one-thread flax-wheel, with spindle and flyer; it has the property of constantly drawing up the thread as fast as it is spun, instead of spinning a length, and then winding it upon the spindle. For this purpose the spindle is made longer than the other, and is turned by a band and wheel; but the wheel receives motion from the foot by a small treadle, because the spinner sits before the wheel to work the spindle, which is supported upon its two extreme ends, and near one end the flyer is fixed; this is a piece of wood curved to an arc, the vertex of which is fixed on the spindle, and from the extremities of the arc two arms proceed, so as to be parallel to the spindle, and at such a distance from it as to admit a wooden bobbin to be fitted loosely upon the spindle; and at the same time the arms of the flyer can revolve round the bobbin without touching it. The end of the thread is fastened to the bobbin, and conducted through a hook fixed in the flyer, so that it proceeds from the circumference of the bobbin to this hook, in a direction perpendicular to the bobbin, but turns round the hook so as to come into the direction of the spindle. The thread is then conducted through a perforation made in the centre of the end of the spindle or pivot, upon which it revolves, and to this end of the thread the fibres are supplied. The twisting motion given by the revolution of the spindle forms them into a continuation of the thread, which is gathered up upon the bobbin as fast as the spinner lets it go through her fingers, by a tendency which the bobbin has to turn slowly, at the same time that the flyer to which the thread is hooked is revolving rapidly round the bobbin. For this purpose a string is passed round a small neck upon the bobbin, and one end of the string being fastened to the frame, the other has a small weight to draw it tight round the neck of the bobbin, and occasion friction. In other spinning-wheels, a second band from the great wheel is made to turn the bobbin more slowly than the spindle. The thread which passes over the hook of the flyer is rapidly carried round the circumference of the bobbin; but as the bobbin follows the motion of the flyer, it only winds up as much thread upon the bobbin as the difference of the two motions; and

## SPINNING.

and this tendency to wind up can be increased or diminished at pleasure, by the friction which is occasioned by the string or band which passes round the neck of the bobbin. When the winding-up of the thread upon the bobbin has accumulated a ridge of thread upon it opposite to the hook in the flyer, the thread must be shifted to another hook opposite to a different part of the bobbin, for which purpose the arms of the flyer are furnished with different hooks, and this must be repeated several times, until the whole length of the bobbin is filled; it is then taken off to be reeled, and replaced by another empty bobbin.

An improvement was made in the spinning-wheel by Mr. Antis some years ago, which was an application of what Sir Richard Arkwright had before invented. The object is to obviate the necessity of stopping the wheel to remove the thread from one hook to another, in the manner just described. For this purpose, the bobbin is made to move regularly backwards and forwards upon the spindle a space equal to its length, so that every part will, in succession, be presented opposite the hook over which the thread passes, and thus receive the thread regularly upon the whole length of the bobbin. The additional parts necessary for producing this movement are as follow: a pinion of only a single leaf is made to project from the extremity of the pivot of the great wheel, or a worm or endless screw formed on the end pivot, will answer the same purpose, which is to actuate a wheel of seven inches diameter, and ninety-seven teeth; therefore ninety-seven revolutions of the great wheel will produce one revolution of this smaller wheel; upon the face of which a circular ring of wire is fixed, and supported from the wheel by six legs, so as to be oblique to the plane of the wheel, as it touches it at one part, and at the opposite side of the ring projects nearly three-fourths of an inch. This ring of wire gives motion to an upright lever, about fifteen inches long, and moving on a centre at three inches from its lower extremity, where it has a pin fixed in it, and resting against the oblique ring of wire; therefore, when the wheel turns round, it communicates a small motion to the lever, in consequence of its obliquity to the plane in which it revolves. The upper end of the lever is connected to an horizontal sliding-bar, situated beneath the spindle, and having an upright piece of brass, which works in the notch of a pulley, formed on the end of the bobbin, and drives the bobbin backwards and forwards upon the spindle, according as the oblique ring of wire forces the pin at the lower end of the lever in or out, when the wheel moves round. To regulate and return this alternate motion, a small weight hangs by a line to the sliding-bar, and, passing over a pulley, rises and falls as the bobbin recedes and advances, and tends constantly to keep the pin at the lower end of the lever in contact with the wire. It is evident, from this description, that one staple only is wanted to the arms of the flyer, which being placed near the extremity, the thread passes through it, and by the motion of the bobbin, is laid regularly upon it from one end to the other.

The invention has also another advantage over the old method, which always winds the thread in ridges upon the bobbin; and if the thread breaks in reeling the yarn, the whole bobbin may as well be thrown away, because the thread cannot easily be found again; but this improved wheel always winds the threads across upon one another, by which means the end can never be lost.

In order to regulate the friction on the bobbin, and retard its motion in a greater or less degree at pleasure, there is a neck of brass or steel fattened to one end of it, and embraced by a kind of small vice, or pincers, fixed to the

sliding-bar. This vice must be made either with two elastic springs with wooden tops, or of wood wholly, and faced with leather; but if made of wood only, then a spring must be made beneath the shoulder of the screw, to answer the same purpose. By tightening this screw more or less, the friction on the bobbin may be regulated to the greatest nicety, provided the springs are of a strength rightly proportioned to their functions. It will readily appear, that all this may be done without the least effect on the velocity of the whole machine, as thereby nothing is added to the general friction so as to obstruct it.

It was not until the latter end of the last century, that spinning-machines of greater powers were constructed; but all threads were spun by one of the machines which we have described; the first being used for cotton and wool, and the other, with the bobbin and flyer, for flax; but for very coarse threads, two spindles were applied to the latter machine, and the spinner having the wool wound round a band, tied it round her waist, instead of winding it upon a distaff, and was thus able to draw out fibres with each hand, and supply two spindles. And of the other simple spindles, several were made to turn together by the movement of one large horizontal wheel, around which the spindles were arranged in directions radiating from the centre, and each spindle received a rapid motion by the contact of the edge of the large wheel, which was turned round by one person. The spinners each stood opposite to his respective spindle, so as altogether to occupy a large apartment, and by this means they could do much more work than formerly, having none of the interruptions of turning the wheel.

The first improvement of any importance in spinning, was that of the spinning-jenny, invented by Hargraves, as related in our article COTTON; and the machine itself will be described under the article WOOLLEN *Manufacture*. This machine consists of a number of spindles, similar to those of the one-thread wheel, which are all mounted in a perpendicular direction in the same frame, and turned round by one large wheel, situated in an horizontal direction, and put in motion by a crank at the upper end of its spindle. The threads from each spindle are conducted nearly in an horizontal direction, but being quite at the point or upper extremity of the spindles, do not wind upon the spindles, but will receive twist, because the threads slip over the top of the spindles as they revolve. The threads are guided between two rulers of wood, called the *claps*, instead of the finger and thumb of the spinner. These rulers are made to fit together, so as to hold the fibres between them, and are fitted up with wheels at the end to run upon the frame, and thus advance or retreat at pleasure from the spindles. It was not attempted with this machine to spin a finished thread immediately from the lock of wool or cotton, but coarse and loose threads are previously prepared on the hand-wheel, which can be done with great rapidity, and the coppins or balls of these loose threads are placed in the jenny, and conducted, first between the claps or rulers before mentioned, and then to the spindles. By this means, when the carriage of the claps is drawn backwards from the spindles, the claps being separate, the threads draw between them from off the coppins, and at the same time that portion of each thread which is between the claps and the ends of the spindles, receives its twist; but having drawn out a certain length of each thread in this manner, the claps are shut together; and the motion of the spindles, as also the retreat of the claps, is continued, by which means the threads are stretched out to their intended fineness, and being thus finished, the threads are wound upon the spindles, by being brought opposite to the middle part

## SPINNING.

of the spindles by a rail of wood, called the *faller*, which moves upon centres, so as to descend horizontally before all the spindles, and depresses all the threads together, so that they will wind up by the motion of the spindles, and as they wind, the clasps return towards the spindles. The operations are then again repeated, and thus continued, until the coppins or balls of thread, wound upon the spindles, acquire their proper size.

The next improvement in spinning-machines was the introduction of the slubbing-machine, or billy, for preparing the rovings for the jenny; an operation which was at first performed by the hand-wheel. This machine has similar parts to the jenny, but they are differently arranged, to adapt it to spin the wool as it comes from the carding-machine, in the state of cardings, which are locks of wool drawn out to about the size of candles, and from two to three feet in length. For this purpose the spindles are made to travel on the carriage, and the clasps stand still, being the reverse of the jenny. The cardings are laid upon an endless cloth, which revolves over two rollers, and lies in an inclined position at the end of the machine; and one carding is laid upon the cloth opposite to each spindle, the ends being pieced with fresh cardings by children, as fast as the spindle works them up. A roller presses down upon the cardings, to hold them fast upon the feeding-cloth, and to make them move with it; and just beyond this roller the clasps are fixed to hold the rovings, when the proper lengths are drawn out by the retreating of the spindles, which, as before stated, are situated in the carriage. The operation of the billy is the same as that of the jenny, *viz.* that the carriage is drawn out, and the feeding-cloth revolves over its roller to give out the cardings until a certain length: the clasp is then shut down, and the further extension of the threads is produced by stretching; which being done, the threads are wound upon the spindles.

The inventions of sir Richard Arkwright soon superseded these machines. His principal invention in the spinning was the introduction of the rollers, to draw out or extend the fibres to their full length, which is by this means much more perfectly performed than by the fingers of the spinner. For the immediate twisting of the thread, he adopted the spindle, bobbin, and flyer of the old flax-wheel, placed in a vertical position, but added to it the important improvement of raising and lowering the bobbin, to distribute the thread regularly and equally upon all the length of it, the same which we have before described as being applied by Mr. Antis to the common spinning-wheel. A full description of this machine, which is called the water spinning-frame, will be found in the article *Cotton MANUFACTURE, Plate IX. Cotton Manufacture.*

The spinning-jenny was again introduced, and rendered equal, and for some purposes superior, to the water-frame, by Mr. Crumpton, who combined with it the system of rollers of sir Richard Arkwright, and called it the mule. It is also fully described under *Plate XI. Cotton Manufacture.* See *Cotton MANUFACTURE.*

The great success which attended the spinning of cotton by these machines, induced many persons to attempt the spinning of flax and wool by similar means. Short wool, for the manufacture of cloth, is spun by the billy and jenny; but flax and long wool for worsted require very different treatment from cotton and short wool, particularly the flax, owing to the great length of the fibres, and to their being of such irregular lengths: in consequence, when they are extended by the rollers, on Arkwright's principle, some fibres will be broken, if the distances between the rollers is too small; and on the other hand, if the distance is too

great, the fibres will not be properly extended. The latter, however, is the least evil of the two; and, in consequence, the spinning-frames for flax have the rollers, between which the extension or drawing out is effected, placed at a distance of from 14 to 18 inches between the first two pair of rollers, through which the flax passes; the next two pair six or eight inches; after which it is passed between the third pair of rollers at a distance of five or six inches, and then delivered to the spindles, which are similar to those of the water-frame, but placed in an inclined position. The rollers are made in a very different manner from those for cotton, being only narrow wheels just wide enough to receive the fibres of flax between them; and the fibres are prevented from getting out sideways by small tin spouts, through which the flax passes, as the rollers draw it forwards. The reason of this is, that the flinty surface of the flax would soon wear a hollow part round a plain roller, which would then let the flax slip through; but the narrow wheel wears down equally over the whole breadth of its edge. The lower pair of these rollers, or wheels, revolves in a small trough of water, in the same manner as a grind-stone, and thus keeps the flax constantly wet, which is necessary, in order to soften the fibres, and make them spin into a firm and smooth thread.

Worsted is also spun in a frame resembling the water-frame of Arkwright, from which it only differs in the relative distances of the rollers, by which the drawing out or extending of the fibres is effected.

Messrs. Clarke and Bugby obtained a patent in 1806, for improvements in a machine for spinning hemp and flax, which is intended to be worked by hand labour, and to be at such a small expence, as to bring it within the reach of small manufacturers. The inventors state it to be constructed upon such safe and easy principles, that no length of experience is necessary to enable children to work it; and that it occupies so little space, that the machines may be placed in small rooms, out-buildings, or other cheap places. To effect the above purposes, it was necessary to get rid of the flyer fixed upon the spindle used in the old machinery for spinning hemp or flax, which additions require a power in proportion of five to one; and also to surmount the difficulty which arises from the want of elasticity in these substances, and which prevents them from being spun, by stretching out at the same time that the thread is twisted, in the manner of the mule or jenny.

These patentees recommend a machine, which is in fact a mule with certain modifications; and to give the effect of elasticity in the fibres, they have two methods. The most simple, and that which they particularly recommend, is to provide a holder of large wire for every spindle, which holders are several inches in length, fixed in an arbor or shaft, that extends from one end of the carriage to the other.

This arbor or shaft, with the holders, may be considered as an enlarged and improved substitute for what is called the faller in the mules or jennies for spinning cotton, and the wire-holders fixed therein have elliptical eyes at their extremities, through each of which a thread is conducted in its passage from the rollers which draw out the thread to its spindle. The wire of which the holder is made, after forming the elliptical eye, is left or extended beyond the uppermost part, something in the manner of a cork-screw, so that the yarn may be conveniently slipped in when occasion may require it. These holders for each thread are for the purpose of keeping the yarn in a state nearly vertical over the tops of the spindle, when the carriage which contains them is coming out; and as they will readily yield or spring from the vertical position, they have the same effect as elasticity

in the fibres of the substance which is to be stretched out; but the wires being removed from the vertical situation at the beginning of the return of the carriage, and thrown into nearly a horizontal position, by inclining the shaft into which they are all fixed, they bring the yarn below the tops of the bobbins or quills which are fixed upon the spindles, which will then wind up the threads upon them when the spindles are turned round, and then the wire-eyes being regularly curved, and raised up again by the motion of an elliptic wheel, which is turned round by the machine, they distribute the yarn regularly upon the bobbins or quills, and prevent it from hinkling, and improperly doubling or twisting together. Another method of compensating for the want of elasticity in hemp and flax, is to fix a round bar of wood, about an inch and a half in diameter, the whole length of the carriage, about three or four inches above the tops of the spindles, so that the outer surface, or that next the person who works the machine, may be perpendicular, or nearly so, over the tops of the spindles, the inner side having pieces of wood or metal fixed or nailed thereto, leaving only small spaces or notches between each, for the yarn to pass through. The use of these pieces is to prevent the threads from getting together and entangling. Every thing relating to the wire-holders before mentioned, and the arbor to which they are affixed, must be applied in concert with these pieces of metal, which form a separation between the threads.

The art of spinning, which nature has given to many animals of different kinds for their preservation, and other purposes, is not confined to the inhabitants of the earth or air alone, but is even extended to those of the sea. M. Reaumur has shewn, by a series of curious experiments, that the common muscle, and some other shell-fish of the sea, possess it in a great degree of perfection. See *MUSCLE*.

But he observes, that though the workmanship is the same, the manner of producing it is very different. Spiders, caterpillars, and the like, make threads of any length that they please, by making the viscous liquor, of which they are formed, pass through a fine perforation in the organ appointed for this spinning: but the way in which the muscles form their threads is very different, as the former resembles the work of the wire-drawer, so does this that of the founder, who casts metals in a mould. The canal of the organ destined for the muscle's spinning, which, from its shape, is commonly called its tongue, is the mould in which its thread is cast, and gives it its determinate length. *Mem. Acad. Par. 1711.*

*SPINNING-Wheel*, in *Rope-making*, for twelve spinners to spin yarn at the same time, is about five feet in diameter, and is hung between two posts fixed in the ground: on its top is fixed a semi-circular frame, called the head, which contains twelve whirls, that turn on iron spindles, with hooks to their front ends to hang the hemp on, and are worked by means of a leather band encircling the wheel and whirls. The whirls are made to run with a truer motion when the head on the rising side of the band has a larger segment of a circle than the falling side; or in other words, let the base part of the head be longer from the middle than the opposite or falling side, by which means the band will be kept equally tight over the whirls, and consequently the motion be alike to all. *N.B.* Heads made in this manner have the wheel turned always the same way.