is continually increasing by the accumulation of the rove, and as the speed of the rollers remains constant, it is necessary to vary the speed of the bobbin, so that, as it increases in diameter, it may diminish in speed, and wind up the rove at the same rate throughout. The mechanism for effecting this is, in some machines, very complicated.

The next operation is forming the thread from the rove. For this there are two kinds of machines used,—one, the throstle, which is a simplification of Arkwright’s spinning frame, and consists of a set of drawing rollers with bobbins and flyers as in the roving frame ; the other is that combination of the drawing rollers with the jenny, which is termed the *mule.* In the roving and throstle frames the twisting apparatus is stationary, and merely twists, and the twisting succeeds the drawing. In the mule the twisting apparatus recedes from the rollers faster than they yield the sliver, and consequently has a drawing as well as a twisting power. In the throstle, the rove being pulled by the bobbin through the flyer, is, while yet tender, subject ed to a continual strain. In the mule the rove is only subjected to strain, as it receives twist enough to enable it to bear the strain without injury. The mule, too, by the peculiarity of its mode of action, destroys those inequalities of the rove which result from defects in the drawing, or injury sustained in the roving. To understand how it does so, it is necessary to observe, that, when a thread of unequal thickness is twisted, the fibres which compose the thick parts, forming larger and more oblique spirals than those which compose the small parts of the thread, require a greater force to twist them, and consequently remain soft, while the small parts become comparatively hard twist ed. If a considerable length of such a thread were pulled, the fibres of the thick parts would slide upon each other ; while those of the smaller parts, being mutually compressed, by their greater degree of torsion would resist the drawing asunder. The drawing would thus take place only in the thick parts; and, as they diminished in size, the twist would gradually become equally diffused. The mule, acting in this manner, with a drawing and twisting power, upon a considcrable length of unequally sized, and consequently unequally twisted rove, reduces its inequalities, and renders it level and uniformly twisted throughout.

Having thus endeavoured to make the reader acquainted with the general principles on which these machines act, we shall now proceed to describe the machines themselves. Arkwright’s first machine was called the water-twist frame, from having originally been driven by waterpower. It consisted of a pair of retaining rollers and a pair of drawing rollers, such as those we have used for the sake of illustration, which effected the extension of the sliver. From the drawing rollers the sliver passed to another pair of rol 1ers, called the delivering rollers, which, moving with the same velocity as the drawing rollers, had no extending power, but merely compressed the sliver and delivered it to the twisting apparatus. This consisted of the bobbin and flyer of the Saxon or flax wheel, improved in respect of the flyer being rendered automatic in spreading the thread on the bobbin, in the manner which will be seen in the descriptions and drawings of the roving and spinning ma­chines ; and this automatic action was shortly afterwards, with good effect, transferred from Arkwright's machine to the handwheel by a Mr. Antis. Each system of rollers and twisting apparatus in Arkwright’s machine was separate, and was driven by a separate system of gearing, and pulleys and bands, rendering the machine, when of great extent, exceedingly complicated. One of the greatest improvements of modern days, is the simplification of the moving parts, by making each roller continuous along the whole length of the machine, and using only one set of driving apparatus at the one or other extremity, and by making the shaft for driving the twisting machinery also

continuous, as will be seen in the drawing of the frame for flax spinning.

We have seen that the parts of the machine which per form the operations of drawing and twisting, viz the rollers, and the bobbin and flyer apparatus, are very simple. The compexity arises, therefore, from the number of parts required to communicate motion to these parts, and to regulate their movements; and the arbitrary nature of the form and arrangements of the parts for communicating motion, causes the great differences which exist in the various spinning machines. In a brief sketch like the present, it is obviously impossible to notice the many beautiful arrangements which, from time to time, have been introduced. In addition to those machines figured in Plates CLXXVII. CLXXVIII. CLXXIX. Art. Cotton Manufacture, we shall pre sent our readers with some of the spinning machines used in the flax manufacture, and also with the latest improvements in the cotton and worsted spinning machines, which we are enabled to do in the most perfect manner, having, through the kindness and liberality of Mr. Smith of Dean ston, been furnished with beautiful drawings of the self-actor cotton and woollen mules, of which he is the inventor and patentee.

Referring then to the above-mentioned Plates, we proceed to the description of the machines contained in Plates CCCCLXV. CCCCLXVI. CCCCLXVU. Plate CCCCLXV, fig. 1st, is an end view of the first machine used in the operation of flax spinning, and which is called the spreading machine. A is a board or table, called the spreading table, over the surface of which an endless web moves round rollers at its opposite ends; on this endless web the stricks of flax are spread, and are by it carried forward to the retaining rollers B. As it comes from between these rol lers, it is acted on at the opposite side by the gills or moving hackles, which, with their moving apparatus, occupy the space between B and C the drawing rollers; the upper drawing roller C is moved by the friction of the under one, and is called the pressing roller; its surface is usually covered with leather. The pressure is communicated either by a lever and weight, as in the figure, or by a spring and screw. D the delivering rollers. These have no drawing power, and move just so fast as to keep the sliver tight between them and the drawing rollers, and by them the sliver is dis charged into the can E, placed to receive it. All these rol­lers, when seen in front, as in fig. 2, exhibit the appearance of narrow wheels, as, were they made broader than is required for the mere action on the sliver, the flinty surface of the flax would speedily wear them down into channels, while, by being narrow, their whole surface is worn down equally, and funnel-shaped plates are placed in front of the rollers, to guide the sliver properly between them. The whole of the motions are taken from the drawing-roller shaft in the following manner. A belt from the main gearing of the mill works over a fast pulley on the drawing roller-shaft, which has also a corresponding loose pulley to receive the belt when the machine is to be stopped. To avoid complexity, these pulleys are not shewn in the drawings. A pinion *a*, on the end of the drawing roller-shaft, communicates motion through two intermediate stud wheels *b*, *c*, to a pinion *d,* on the end of the shaft which drives the gill apparatus; on the end of the shaft is fixed a small pinion *e,* fig. 3, to drive the under retaining roller B, through a spur wheel *f* whose axle carries a small pinion *g,* gearing into another spur wheel A, which gears into a spur-wheel *i*, fixed on the roller axle, and the upper retaining roller is driven by the friction of the under one. The pinion on the shaft of the spur-wheel *f* also drives the inner roller of the spreading table through an intermediate spur-wheel *k,* working into a spur-wheel *l,* fixed on the roller axle. The lower delivering roller has on its end a pinion *m,* which is driven through the intermediate wheel *o* by the pinion *n* fixed