on the end of the drawing roller-shaft *o.* From this pinion motion is also conveyed to other three portions of the ma­chinery ; first, through the wheels *p q,* to the cleaning roller which is seen at F in the figures ; this roller is formed of wood covered with listing, which rubs on the surface of the pressing roller, and removes any filaments that may adhere to it ; second, through an intermediate wheel and pinion *r*, to a wheel *s*, on the shaft of which a circular brush is fixed, whose purpose is to clean the gills, as is seen in the enlarged representation of that part of the apparatus at fig. 11 ; and, third, to another pinion *t,* whose shaft carries an endless screw working into the teeth of a small wheel *u,* called the measuring wheel. Its purpose is to give notice to the attendant of the machine, whenever a pre determined quantity of sliver has passed through the rollers: this it does by a stud fixed on its face coming in contact, at every revolution, with the tail of a lever *v*, whose other end is attached by a wire to the spring of a bell ; when the stud, in its progress round, comes in contact with the upper end of the lever, the spring of the bell is drawn from its position, and the moment the stud escapes the lever, the spring is let back with a jerk, which rings the bell. The wheel can be substituted by others containing a greater or lesser number of teeth, according to the length of sliver re quired.

The only remaining part of the machine to be noticed is, a shaking motion, communicated to the cans while receiv­ing the sliver, that it may be deposited in regular layers. This is best seen in fig. 1. The can is placed on a hinged bracket at *v*, and is steadied by another bracket at *x,* both brackets having semicircular arms, which partly em brace the can; to these brackets, and consequently to the can, a regular jolting motion is communicated as follows. On a rod which passes across the machine a short lever *y* works; on its outer end is hung a weight, and to its other end is attached a rigid rod, connecting it with an eccentric fixed on the drawing roller-shaft. The lever is by this means jolted alternately up and down in every revolution of the drawing roller, and being connected by rods with the brackets *v, x,* they, with their cans, are also moved in the same manner.

Flax, after having been passed through the spreading machine, is drawn twice or oftener. The drawing machine is the same as the spreading machine, except in having no spreading table, the sliver being drawn directly from the cans, which are carried from the spreading machine, and placed at the retaining roller end of the drawing machine at H, and in having three in place of two retaining rollers. The drawing machine, too, is of a lighter construction than the spreading machine, and its gill teeth are finer.

Figs. 4 and 5 shew the two sides of the machine. A is the drawing roller-shaft, and the motion is communicated from it to the other parts as in the spreading machine.

The roving machine, fig. 6, is similar to the drawing ma chine, except that it is still lighter in construction, and that in it, in place of the delivering rollers, and the cans to receive the sliver, there is substituted the apparatus for twisting the rove seen detached in fig. 7. When the sliver leaves the drawing rollers of this machine, it is passed through the top part of the spindle, which is tubular, and called the eye of the spindle; it is then conducted by the flyers K to the bobbins L. The arms of the flyers are usually bent wires, with eyelits at their lower extremity, through which the thread is passed. Here they are represented to be tubular throughout their whole length, this being considered to make a smoother thread. The parts of the machine not already described are, the spindle rail M, the coping rail or shifting plate N, on which the lower disc of the bobbin rests. The coping rail has an alternating motion up and down through a space equal to the surface of the bobbins on which the threads are spread ; and by carrying the bobbin through this space, the thread is spread

equally over its surface. This alternating movement is variously effected. In the machine represented, it is done by a mangle wheel at O; but in other machines it is given by a heart wheel acting on the rail through a lever and chain. From the circumstances before described, it is necessary that the rotatory motion of the spindle and bobbin should be, to a certain extent, independent of each other; and, accordingly, while the speed of the spindle remains con stant, the speed of the bobbin is made to diminish as its diameter increases by the accumulation of thread. In the ordinary construction of the machine, this differential movement is regulated by the attendant, by the friction of a string which can be made to embrace more or less of the periphery of the bottom disc of the bobbin, as represented in the figure of the spinning machine. The spindle and bobbin are both driven by a band passing over a pulley fixed to them; and while the speed of the spindle re mains constant, that of the bobbin is gradually diminished as it fills, by the attendant moving the string successively along into the different teeth of a rack, so as to make it embrace more and more of the surface of the bottom disc, and thus create a friction which retards the speed. Thus the proper working of the machine depends entirely upon the vigilance of its superintendent; and a simple yet accurate differential movement is still a desideratum.

In the machine represented in the plate, the differential movement is exceedingly accurate and beautiful, but is so complex that it would require many detailed drawings, to give the reader a correct idea of it. This motion, and many other improvements in the spinning apparatus, are the invention, we believe, of Mr. Fairbairn of Leeds.

Figs. 8 and 9 are a side and front view of a spinning frame, drawn from a machine constructed by Mr. Russell of Kirkaldy. A A is the bobbin rail on which the bobbins from the roving machine arc placed ; *b b,* the retaining rollers ; *c c,* slip rollers for guiding the rove ; *d d,* drawing rollers ; *e*, the traverse shaft ; *f* the cylinder shaft.

The cylinder shaft is driven from the main gearing. A belt from a pulley on the end of the cylinder shaft gives motion to a pulley, which is called the speed pulley, be cause all the motions are calculated from it. The speed pulley shaft carries a pinion gearing into a wheel *b*, on the end of the drawing roller shaft, which again, by a train of wheels, communicates motion to the retaining rollers. The spindles are driven by small bands from the cylinders of the cylinder shaft passing over wharves on the spindle shaft; and the differential motion of the bobbin is produced by the friction obtained from a small cord or temper-band, as it is called, embracing more or less of the periphery of the under disc of the bobbin, as before described.

The motion of the heart-wheel, which, through the lever and chain, gives the traverse motion to the bobbin, is taken by wheel and pinion from the retaining roller shaft. The speed of the spindle is from 3200 to 3500 revolutions per minute. The average work of this machine is two hasps of yarn, of average quality, for each spindle in a working day of twelve hours.

The machines for drawing and spinning tow are the same, or nearly the same, as those for spinning flax. From the shortness of the fibre of tow, the drawing and retaining rollers are set much closer together, and the gills are cir cular.

In the fine spinning of flax, the thread is moistened, by being made to pass through a trough containing water; a practice probably derived from the custom of spinsters moistening the thread with saliva in household spinning. By the modern improvement of the substitution of hot for cold water, a much finer, smoother, and more even thread can be spun from the same quality of flax than before.

The flax-spinning machinery has recently been introduced with great success into the spinning of silk waste,