machine is again in order to commence another stretch or draw.

Of Smith’s selfacting woollen mule, several parts are the same as those of the machine already described. To these we merely refer, reserving for particular description such parts as are peculiar. Fig. 1 is a side elevation; fig. 2 bird’s eye view; the other figures represent detached portions of the mechanism A A A is the general framework of the head stock, B B B the general framework of the carriage, C the main driving pulley, *C'* the corresponding loose pulley, D the driving shaft, which in this case lies along the frame work, EE' bevel wheels, through which motion is communicated from the driving-shaft to the shaft E', called the flywheel shaft, on which the drum F, and the flywheel

G, are fixed. The drum F by a belt communicates motion to the driving-shaft H, 'through its fast pulley H2 ; H' is the corresponding loose pulley ; I is a pinion upon the near end of the driving-shaft, which communicates motion through the wheels Il and I2, to the stud wheel K, on the central shaft K', of the vibrating frame L. From the wheel K motion is communicated to the wheel M, of the vibrating shaft M'. Upon the opposite end of this shaft the man­gle pinion N' is fixed. This pinion drives the mangle or regulating wheel N, as described in the former machine. The mangle wheel in this machine moves the carriage rack by the eccentric wheel O, fixed on the end of its shaft gearing into the other eccentric wheel O', whose shaft carries a spur-wheel P, which gears into the carriage rack P' P'. Round the periphery of the mangle wheel are external teeth, which, through the stud wheel Q, drive the pinion Q', fixed upon a small cross shaft R, called the roller shaft. Near the opposite extremity of this roller shaft there is fixed a disc R', working in the bosom of the toothed wheel S : this disc carries pauls, which work on a ratchet-wheel, fixed also in the bosom of the wheel S. The wheel S being loose upon the shaft, is allowed to remain at rest, when the disc moves in such a direction that the pauls slip over the teeth of the ratchet. The wheel S gears into the stud wheel T, which again gears into the wheel U, upon the end of the rollers U'. The stud-wheel T moves upon a stud carried by the radial lever T', whereby it is permitted to move out and in of gear with the wheel S. These movements are regulated by the disc lever V, which, resting with its outer end on a disc pulley on the end of the wiper pulley X, raises and depresses the point of the radial lever T', by the movement of the mangle wheel shaft. The place of the wiper on the face of the disc X, can be shifted to adjust the point of movement The roller shaft R carries another wheel *a,* which, through the intermediate wheel *a*', drives the wheel *h'* fixed on the differential shaft ft. This shaft carries the differential box c, which is the same as in the former machine, and through which motion is communicated to the twist shaft *d,* by its wheel *e,* for winding-on : its pulley is restrained by a band and lever, as in the former machine. *f* is the break pulley on the shaft *d,* with its ratchet-wheel" *f',* acting as described in the former machine. The manner in which the break is press ed on the pulley in this case, is seen in the detached draw ing, fig. 3. Returning to the driving shaft H, there is a pulley *g* running loose upon the shaft for raising the driving belt. Its nave carries a series of small pullies of differ ent diameters, for communicating motion to the cross shaft A, which carries a corresponding inversed series of pullies *h’,* by which a considerable difference of speed can at any time be attained. The outer end of the shaft *h* carries a small pinion *i*, which, through the intermediate stud-wheel *j,* drives the wheel *j',* running loose upon the driving shaft

H, but which, by means of a disc *k,* with a set of catches and a ratchet-wheel, as in the case of the wheel S. can be made fast to the driving shaft. By this means, when the belt is thrown upon the loose pulley *g,* motion is communicated by the pulleys fixed on its nave to the pulleys *h',* and consequently to the shaft *h,* which, again, acting by its pin ion *i* on the wheels *jj',* communicates a very slow movement to the driving shaft, and through it to the vibrating frame pinion, which works in the mangle wheel, which is necessary for regulating the back movement of the car riage, while the twist is throwing into the yarn ; and its speed can be easily and quickly modified to suit any grist of yarn, by shifting the band upon the grooved pullies *g, k'.* The amount of twist is regulated, as in the former machine, by the worm screw *l,* upon the main driving-shaft D, working into the crown wheel *l'.* The shaft of this wheel carries on its lower end the wheel m, which is called the change wheel, because its place may be substituted by wheels of various numbers of teeth, to suit the amount of twist due to the grist and hardness of the yarns to be spun. This wheel, through the intermediate wheel *m',* drives wheel *n* on the top of the cam shaft *n,* upon which are

placed the cams or wipers for moving the levers. On the ower part of the cam shaft there is a bevel wheel o, working into a corresponding wheel on the cross shaft *p,* called the stripping shaft. This shaft carries a radial wiper *p'*, which, as the shaft revolves, comes at a particular point in its course to press upon the lever *q,* which, being suspend ed and acted upon by the spiral spring *q,,* is retracted to its former position, when the wiper *p'* has raised it. The point of this lever operates upon the horizontal plane *r,* which is made to extend to a Iength exceeding the great est distance that the carriage requires to be removed backwards during the throwing of the twist, so that the stripping wiper *q* may always press upon some part of the plane.

On the inner end of the twist shaft *d* there is fixed the pulley *s,* to drive the cylinder pulley of the carriage *s'.* The band having been wrapped nearly round the pulley *s,* has its one end passed over one of the stud pullies *t,* at the righthand side of the framing, and carried from it over the cylinder pulley *s',* while its other end is passed round the other pulley *t,,* and thence over the tightening pulley *t2*. The tightening pulley *t*2 moves on a stud, which can be slid along the horizontal slit in the projecting part of the framework, so as to slacken or tighten the cylinder band. Having noticed the principal parts of the headstock, we proceed to the description of the carriage. The frame of the carriage is indicated by BBBB. 1, is the driving pulley, 2, the upper faller rod with its fingers and guide-wires. The apparatus for moving the building fallers is the same as that already described for the former machine. But the stripping faller apparatus is somewhat different. Two radial sockets 3, project from the under faller-rod 4, near each end; and in these are fitted a running-nut, which can be adjusted to any required extent of leverage, by turning round the screw ; and at the lower side of each nut there is a hook, to which the spiral springs 5, are attached, their lower ends being attached to the framework of the carriage. The springs are so adjusted, that they tend to pull round the under faller-rod, which raises the faller-wire with a due force of tension. A radial lever 6, extends from the one end of the under faller-rod, and has an adjustable stud 7, to which a rod 8, is fixed. This rod terminates at its lower end in a socket with a friction-pulley, which, coming upon the inclined plane at the side of the race-road, shoves the under faller to its resting position, when the carriage goes up to the rollers. The end of the stud 9, projects beyond the socket of the upright rod, and rests upon a moveable tap pit or sector 10, which is thus turned upon its centre, by the movement of the radial lever 6, attached to the folding-leg, when the poker is moved to put down the upper faller. By this escapement, through the movement of the tappit, the spiral springs are permitted to pull up the under fahre wire with considerable force, by which the coils