of the friction pulley *t*, and on the other into a series of ex­ternal teeth 4 ; the pulley *t,* and the wheel 4, are both fitted loose on the shaft *r;* when the shaft r, with its arm 58, move round, the pinion being in gear both with the teeth of the pulley *t,* and the wheel 4, has a tendency to carry both of them in rotation with it; but if either of them be held fast, it is evident that the motion of the pinion will communicate so much additional motion to that which is loose, by acquiring from the stationary wheel a motion round its own centre, as well as its motion round the shaft. In this way, whatever part of the motion of the one is restrained, will be imparted to the other. This restraint is imparted to the pulley *t,* by a band or strap passing round it in its groove. The band is of cotton thread, made fast at one end to a stud *t,* projecting from the frame, and passed round the pulley and carried along to the opposite end of the headstock, where it is attached to the cross-tail *t' t'* of the lever *u*; and the degree of tension communicated to the friction-band can be modified within certain limits, by the lever *u* having a moveable weight *u*' adjustable in any position by means of the pinching screw. When the threads are winding upon the bare stems of the spindles, at the beginning of a new set of copes, and for a few stretches after the commencement, it is necessary to increase the motion of the spindles suddenly at the beginning of each winding on, until the bottom of the cope has acquired some volume. For this purpose an additional pressure is applied to the lever *v*, through the connecting rod proceeding from the lever *w*, upon the lower sur face of which pressure is thrown by a simple apparatus connected with the building bar of the carriage, to be after wards described.

The mode by which the amount of twist is regulated, is as follows. On the outer end of the driving shaft F, there is an endless screw F, working into a screw-wheel X, on the end of an upright shaft. The number of teeth on the screw wheel is so regulated, as to cause it to perform one revolution during the time when the twist is throwing into the threads, after the carriage has reached its limits at the head ; and it stops the twist by a cam X', on its upright shaft acting on the levers, which throw the belts from the fast to the loose pulley of the speed-shaft.

The next thing to be considered is the apparatus attach ed to the carriage for *backing off,* and for building the threads regularly on the copes during the winding on. When the carriage has arrived at the utmost limit of its outward stretch, and the spindles have been stopped by the break, then before the taller wire can be put down to guide the threads upon the spindles, the operation of *backing off* or unwinding the spiral coils of thread from the spindles, takes place. The usual mode of effecting this, is by causing the spindle to make three or four backward revolutions ; but a more simple mode is here adopted. An under taller shaft U, with its arms and wire, stretches along the whole length of the carriage, and is placed behind the building faller shaft V ; but its arms are so much longer, that its wire is in front of the building wire, and the wire is kept in such a posi­tion, while the carriage is coming out, as to be at about a quarter of an inch distance below the threads, and by being raised at the proper moment, it strips the spiral coils from off the spindles. To the further end of the under faller shaft, there is attached a lever *y,* carrying an adjustable nμt to the lower part of which the upper part of a spiral spring is attached by a hook, and its lower end to the framework below. The effect of the spring is to draw down the lever, and consequently to raise the under faller wire. This is how ever counteracted until the proper moment for stripping off the coils, by a projecting lever *z* at the other end of the under faller shaft, being held down by a moveable rod z': the upper end of the rod is attached to the lever z by a stud bolt passing through an opening in the arc head of the lever, and its lower end rests on an inclined plane, forming

part of the building-on apparatus to be afterwards described. On the rod there is an adjustable stud, made fast by a pinching screw, which, resting on the top of a lever W, prevents the spring from drawing up the under faller. When this lever is turned round its fulcrum, in the manner we shall afterwards see, it allows the rod to fall, and the under faller consequently to rise, and the faller is again depressed at the proper instant, by the inclined plane z'' attached to the building-on apparatus, which we shall afterwards describe, raising the rod into its original position, in which it is again retained by the lever W. From the near end of the building wire shaft V there projects a toothed arc 5, gearing into a vertical rack 6. This rack has a small pro­jection on the back, to which is jointed the folding arm 7, whose opposite end is jointed to the folding leg 8. The lower extremity of the folding leg carries a friction pulley, which rests on the upper surface of the curved piece 9 ; and it also carries a T-headed nut, which works in a vertical groove on the spur piece 10 attached to the carriage, and so guides the lower end of the folding leg in a vertical line, while it is moved up and down by the action of the curved piece. If the bent arm and leg be drawn into the same straight line, while the friction pulley of the leg remains in its po­sition, the rack to which the upper joint of the arm is attached will move up, and acting upon the toothed rack of the building wire shaft, will turn that shaft round, and depress the wire ; and the depression of the wire will be greater or less, as the foot of the folding leg is at a higher or lower point of its vertical slit. To force the folding leg and arm into the same straight line, the following apparatus is em ployed. A sliding bar X called the poker, resting upon a bearing at 11, is attached by a joint to the connecting arm 12, whose other end is attached by a joint to the folding leg. When the carriage is nearly at the limit of its back ward motion, the end of the poker to which the arm 12 is attached, catches against, and is retained by the end of the lever 13, while the carriage runs back to its full stretch. The poker is thus sent home, and as a consequence, carries with it the arm 12, and the jointed leg and arm 8 and 7 ; and it carries these a little beyond the vertical position or line of centres, from which they are again disengaged, and fall into the position represented in the drawing, when the carriage, having arrived nearly at the limit of its inward course, causes the adjustable nut at the other end of the poker to strike against the bracket piece Y of the frame. In considering the next apparatus described, we shall show that the point upon which the folding leg rests, is subject to being raised and lowered, and consequently the sliding bar is also raised and lowered ; the effect of which is to make the nut at the end of the poker strike on different vertical points of the restraining bracket Y ; so that by making the surface of this bracket upon which the points strike to lie in an oblique direction, the exact period of liberating the jointed leg and the building faller can be regulated with precision. Thus, when the building takes place at the bot tom of the spindles, the faller is made to be liberated sooner than when the building approaches nearer to the point, and by this means the due tension of the thread is preserved at the lifting of the faller. A palm from the arm 12, reaches to the supporting lever W of the under faller, and carries a stud which works through the curved slit in the tail of the lever, and retains it in its position ; and a small spiral spring, seen in the drawing, being attached to the end of the palm, and to a pin upon the folding leg, serves to keep the arm 12 in its place. From this arrangement it follows, that as the lower end of the folding leg is moved up in its vertical slit, it will carry the stud of the palm nearer to the fulcrum of the lever W ; and that when the jointed arm and leg are brought into the same straight line, the stud of the palm will force the lever W round its fulcrum more or less quickly, as the stud of the palm is at a greater or less dis