tance from the lever’s fulcrum, or, what is the same thing, as the lower end of the folding leg is more or less elevated in its vertical slit.

The form of the copes when finished is conical ; and to build the thread in this form, it is necessary that the building wire should at first have a very limited range of mo tion, guiding the thread over that part of the bobbin alone where the body or thickest part of the cope is to be, and gradually extending the surface on which the thread is to be deposited at every successive layer, until the cope be completed. To effect this, it is necessary that the appara tus of the jointed rods which we have described, should first have a very limited range of motion. The friction pulley at the foot of the rod, rests, as has been said, on the curved surface of the piece 9∙ This piece turns on a joint in the building frame at 14, and has a tongue 15, passing down to a pin 16, which moves in a horizontal slit in the headpiece

17. This pin projects from the frame, and carries a nut 16, through which a screw, held in bearings in the headpiece

17, works. On the end of the screw there is a ratchet-wheel

18, which is moved round a tooth at every traverse of the carriage, by the lever of its paul being acted upon by an inclined plane 19, attached to the carriage ; and thus the screw carries the nut 16 and its pin along the slit in the headpiece, under the end of the tongue of the curved piece 15. A diagonal bar 20 in the building frame rests also up on the nut pin. The lower surface of this diagonal bar is nearly a straight line. As the pin moves along under this sur face, the building frame 21 is allowed to drop gradually in proportion to the obliquity of the diagonal ; but as the sur­face of the tongue 15, which rests on the pin, forms an angle with the line of the plane of the diagonal, so the tongue piece, and the curved surface-piece to which it is attached, will be allowed to drop more than the building frame, as the nut passes along; and the curved surface will thus be more and more declined from the horizontal position, thereby allowing a greater vertical movement of the folding leg at each successive draw, the effect of which will be to increase the range of the falling wire, and consequently to give the body of the copes a longer form. When the pin has been carried to a certain point, it escapes the tongue-piece, and proceeds along the surface of the diagonal only, which being straight, and at a regular inclination, allows the building frame to fall down through equal spaces at each successive draw, producing also equal increase on the range of motion of the falling wire. When a set of copes has been completed, the pin is wound back by the winch attached to the end of the screw. The whole of this apparatus is attached to a sliding bar 22, working on studs fixed to the frame of the carriage, and having at its further end a rack, into which a pinion, attached to a wheel on the axis of the carriage, works. This wheel moving in unison with the carriage, by means of the pinion and rack, causes the sliding bar to perform a traverse of six inches at each draw. The curved piece 9 is thus moved under the friction pulley at the foot of the folding leg, and forces it to move in its vertical slit, to the ex tent regulated by the screw apparatus which we have just described. To this building apparatus is attached the simple addition before alluded to, for throwing an additional pressure on the lever *v.* It consists of a small lever 23, jointed at 24, and having a nose-piece on its opposite end resting upon the nut pin 16. From the nose-piece end there projects a pin, 25, at right angles, which, when the carriage is at its outward limit, passes along the under surface of the lever o, and by means of the rod connecting this rod with the lever U, throws an additional tension upon the tension band ; and as the nut 16, by the action of the ratchet-wheel, is drawn back, it relieves the nose-piece of the lever, which falls down into the position shown in the drawing, and its pin ceases to act on the lever *o,* until one set of the copes being finished, the nut and pin 16 are again brought forward

by the screw and winch, and raise the nose-piece, ready to commence a new set of copes. The apparatus which forces the poker home is the spinner lever 13, whose inner end is attached by a universal joint to one end of another lever, 26, the other end of which is attached to the bottom of the vibrating frame. When the regulating wheel ceases to move, the vibrating frame vibrates nearer to its centre, and by means of the lever 26, moves the outer end of the spinner lever toward the carriage, which is at that time nearly at the limit of its outward course ; and the lever thus lays hold of a projecting piece on the end of the poker before alluded to, and so slides it home.

Leaving the minor parts to be incidentally noticed, we shall proceed to describe the general action of the machine during the completion of a stretch or draw. The carriage being at the roller beams, the machine is put in motion ; and the pinion working in the outer teeth of the regulating wheel, brings out the carriage with a slow and uniform motion, while the rollers move in exact unison, and the speed shaft is in full motion to give twist to the thread, as the slubbing is given out by the rollers. When the carriage is nearly at its utmost limit, a finger piece 27, attached to the pulley bearer of the carriage S, comes in contact with the tail of a hanging lever 28, which is connected by a wire 29, to a cross-tail 30, on the bottom of the axis of the lever. This causes the lever 31 to move round its fulcrum, and throw the driving belt of the pinion shaft from the fast pulley M to the loose pulley M, whereby the movement of the regulating wheel, and all the movements taken from it, are stopped ; but the speedshaft T being driven directly from the main shaft, continues to revolve. When the proper quantity of twist at the head has been given, the cam *x* will have arrived at the point of the lever 32, and pushing it round upon its fulcrum, will cause its opposite end 33, to draw the wire 34, attached to the guide lever 35. This shifts the belt from the fast pulley K, of the speed shaft T, on to the loose pulley K'; and the cam immediately moves the lever 36, which, through the medium of the wire 37, draws off the break lever-catch 38, and allows the break to fall down upon the break pulley, anil stop the movement of the speed-shaft and spindles. At the same instant, the cam *x'* having reached the adjusting point of the lever 31, moves this lever, and throws the belt again upon the fast pulley of the change-shaft. Thus the shaft is again in motion, and its pinion travelling down the radial series of teeth of the regulating wheel, causes the vibrating frame to vibrate towards the centre of the wheel. The cam on the bottom of the vibrating frame, in its progress, passes over the friction pulley of the break lever, and relieves the break ; and at the same time the spinner lever, which is attached by its rod 26, to the bottom of the vibrating frame, turns round its fulcrum, and shoves forward the sliding bar or poker, there by relieving in the first instance the under taller, which immediately rises and strips the coils, and the continued motion of the spinner lever and sliding bar forces up the folding leg into its vertical position, and consequently forces the building wire into its building position. When this movement is about to be completed, the pinion of the regulating wheel has arrived at that part when the motion of the wheel begins to be reversed, and the carriage begins gradually to move inwards. At this instant, the winding on motion, which is taken from the regulating wheel, begins to act, and the movement of the carriage and winding-on continue to operate, until the carriage has reached its in ward limit at the beam. The adjustable pin at the end of the poker then comes in contact with the bracket piece Y of the framework, and relieves the building taller ; and a projecting finger 38, attached to the upper bearer of the guide-pulley of the carriage, comes in contact at 39, with the cross lever of the belt guide 35, and throws the belt again on the fast-pulley of the speed-shaft, and the