centres have been lost, a simple apparatus, called a boring collar, is made use of. It consists of a puppet, capable of being fixed on the bed of the lathe, in the same manner as the puppet O, fig. 1, and as a substitute for it. On the right hand side of this is fixed, by a bolt through its centre, a disc of cast iron, which has been turned perfectly flat, and which is of as large diameter as the height of the puppet above the bed will admit. On this disc a circle is traced, the highest point of it being exactly level with the centre of the mandril; and all round the circle are bored holes, varying in their dimensions, to suit the different sizes of the objects which require to be centred. The disc moving round on the bolt by which it is attached to the puppet, the hole suitable for the article to be centred is turned uppermost, so as to be on a line with the mandril, and the disc is then fixed in that posi­tion by another bolt or pin, which is passed into a hole in the puppet below the centre, through one of another inner series of holes in the plale, which correspond to those above described.

The slide-lathe which we have described is one well adapted for the machinist; but for particular uses, certain modifications are made in the apparatus : of these we shall immediately speak. In the mean time we may observe, that a very useful arrangement of the slide-lathe has been made by Mr C. D. May of Edinburgh. In his lathe the slide works, not on the top of the bed, but along its face : it thus can pass from end to end clear of the puppets, and the lathe can at once be converted into an ordinary one to work by hand, by moving the slide to the right hand extremity of the lathe, clear of the shifting puppet, and applying the ordinary rest to work by hand. This lathe is very neat, is simple in construc­tion, and occupies little space

The modifications in the slide-rest are as follows : The upper slide, in place of being able to move at right angles only to the lower rest, may have other motions given to it. It may be made to turn round on a centre, and, by an index and graduated arc, may be set at any angle to the axis of the mandril. In this way it is used for turning conical work. The rest may be made, too, to receive cutting instruments, to which circular motion may be given, while the article operated upon remains stationary, as mentioned in the second division of the subject.

In this case a frame is added to the lathe, consisting of two uprights, one at each end, carrying a series of pulleys put in motion by bells from the fly-wheel, and which again, by means of a band, give motion to a pulley fixed on the end of a revolving cutter, carried by the slide. It will at once be seen, that when an article is held in a chuck on the end of the mandril, and turned round, so as, by means of the divided circles on the spur-wheel face, to present any number of sides to the action of the revolving cutter, and when the cutter itself can, by means of the double slides and turning motion, be set in almost any position relative to the work, the variety of uses of which this arrangement is sus­ceptible is almost infinite. Holes may be bored with it radiating from the axis of a cylinder, as for the spokes of a wheel : they may be bored in a straight line, or in a helical line ; continuous grooves may be formed in any direction. By using proper cutters, any of the geometrical solids may be formed in the lathe. A very obvious application of this apparatus is to the cutting of the teeth of wheels, either direct or oblique. Suppose that it is required to cut a wheel of ninety teeth : a circle in the dividing plate on the face of the spur-wheel, containing ninety holes, or any mul­tiple of that number, is selected, and the spring pointer being fixed in the first hole, a proper cutter, fixed on a vertical spindle, is made to act on the wheel, and to cut out the first tooth to the proper depth : it is then withdrawn, and the mandril is turned round until the pointer falls into the second hole of the dividing plate ; the cutter is again applied for the second tooth, and so on successively for all of them In what we have described we have supposed the work to be fixed to the mandril of the lathe, and the cutting instruments attached to the slide ; but the case may be reversed, and thence arises a new variety of applications. A cir­cular saw being fixed on the mandril, an article held in the slide-rest may be presented to it, so as to be cut in any plane. Large drills, too, may be carried by the mandril, and the work to be bored fixed to the slide.

To the other varieties of the art the term of ornamental turning or engine-turning is generally applied. Among these are rosette turning, eccentric turning, elliptic turning, epicycloidal turning, and spiral turning. The lathe for the first of these has this peculiari­ty. The head on the left, in place of being fixed firm on the bed, stands between centres parallel to the spindle at the level of the bed. It is kept in its proper position by the adjusted pressure of four springs, one of which is fixed at each side of the front and back pup­pet. On the spindles are fixed the rosettes, from which the lathe derives its peculiar motion. These rosettes consist of wheels, discs, or portions of cylinders, having their surface indented in various forms. Fixed parallel to the spindle, but at a lower level, is the bar on which the rubbing apparatus is fixed ; the rubber, being placed in contact with one of the rosettes, and incapable of yielding to the inequalities of its surface, forces the spindle on which the rosettes are placed, and consequently the article operated on, to move in various regular curves, as the indentations on the rosette guide them. The rosette may be applied to elliptical turning by using a proper chuck, as described under that head. For ver­tical waved lines, a pinion is fixed on the head of the spindle, working a rack attached to a vertical slide fixed in the front puppet ; to counterbalance the slide, a cord is attached to its top, passed over a pulley above, and attached to a weight at its other extremity ; thus the pinion is relieved from unnecessary friction.

In eccentric turning, an eccentric chuck is used. This consists of a solid circular plate, which is fixed to the mandril of the lathe. On the face of the plate are fixed two guides, so as to form a dovetailed slide for another plate, which is moved by a screw sunk in a slot in the under plate. On the upper plate is a circular toothed plate, which is capable of being turned round its centre, and is retained in any position by a catch, which falls between its teeth, and is held by a spring. On the centre of this wheel is fixed a screw similar to that on the nose of the mandril, and to this is chucked the work to be turned. The first plate moves, of course, concentric with the s indie of the lathe ; but the slide, with its circular plate, can be moved so that the work revolves with any degree of eccentricity required.

Epicycloidal turning is another beautiful variety of the art. Like eccentric turning, this is performed by a chuck peculiarly formed, but so complicated as to be totally unintelligible with­out the aid of numerous figures; we are under the necessity, therefore, of referring the reader to the works quoted at the end of the article for a full explanation of it. In Bergeron’s work, he will find beautiful engravings of the apparatus for this and the other varieties of ornamental turning, with minute descriptions.

Elliptic turning will be found described under that title.

The lathe for spiral turning is constructed as follows. On a shaft lying above the bed are three drums, or large wheels, with broad rims, that on the extreme left being smaller than the other two. To the circumference of the latter is attached a cord, which is stretched tight to the end of a strong elastic beam or spring fixed at the roof. On the bed, beneath this drum, is the fixed head, which con­sists of two puppets fixed at about two and a half feet asunder. In the top of each puppet is fixed a brass bush, in which the spindle, which is perfectly cylindrical, moves as directed by the leading screw, consisting of a cylinder of wood, firmly fixed on the spin­dle between the two puppets, on which is grooved out a screw of the same pitch as that required to be made. This is effected by placing beneath, and close to the cylinder, a wheel having a thin, round, or pointed edge, and turning on centres in a forked frame, after the manner of a framed pulley. The frame of this wheel is fixed on a stiff centre, so as to be capable of being set to any angle. If the spindle be then caused to re­volve, it will also move in a longitudinal direction, in exact pro­portion to the divergence from a right angle, at which the wheel is set. and there will be traced on the cylinder a screw, which, when cut to fit the edge of the wheel, is a leading screw. These leading screws may be multiplied indefinitely, by shifting the wheel to different angles, to mark a y number of cylinders or leading screws that may be required. On the spindle at the front of the leading screw is a wooden pulley, round which passes the cord which conies down from the large drum on the left ; it then passes down and is fixed to the left corner of the treadle, the other end of which is raised by a cord passing straight from its extremity to the large drum on the other end of the shaft. By pressing down the treadle, the cord, which. as before remarked, passes round the pulley on the spindle, causes it to revolve; it also, by unwinding from the drums, causes them and their shaft to revolve, and the smaller drum, as it revolves, warps round it the cord attached to the spring in the roof, thereby bending it. It is evident that, whenever the pressure of the foot on the treadle is removed, the elasticity of the spring will cause it to pull off the cord which held it down, and cause the small drum round which the cord was wound, and the other drums, and the spindle, to revolve in the op­posite direction to that caused by the descent of the treadle.

The shift ng head consists of two puppets and a spin<lle. the same as that just described for the fixed head. Solid on the head of each spindle is a socket or hollow cylinder, in which is fixed, by means of a side-screw or otherwise, a strong taper screw: one of these screws is inserted into each end of the piece of wood to be turned. The rest has a groove, through which the tool passes, in order to prevent the longitudinal motion from displacing it. It is evident that no more length of twisted work can be produced at once than the length of the leading screw: but by shilling the rest, and taking care that the cuts join accurately, the twist or