

Working with improvised equipment.

A real rose engine, particularly one with all the facilities I want to use, would cost a lot more than I can afford, and I don't have the engineering skills to build one. I decided to see what I could do with readily available, cheap workshop accessories, bolted together with the minimum of home-made components.

My headstock is a 5C spin indexer (a cheap Chinese import). It needs a 5C collet and a thread adaptor to hold chucks, or you can hold the work directly in a 1 inch collet. It gives 1° indexing, with a 36 hole plate and 10 vernier holes for the pin. It's not the quickest form of indexing, but it gets easier with practice. I clamp stops to the plate and rotate the work by hand for segment work. I think it's a good idea to get an idea of what you can do with ornamental turning before you get lost in rose work.

As well as rotating, the mandrel can pump, guided by a multi-wave swash plate. I hold the rosette against the rubber by hand, as I rotate the work. This is easy with sensible rosettes, and it allows me to manipulate impossibly deep rosettes which couldn't be used on a machine with a proper drive. For a long time I only had the swash movement to play with. It is the most underestimated effect, which can be added to any pumping mandrel. The swash plates don't have to be large diameter: the mandrel's about 1½ " diameter, the pumping rosettes fit over it and are under 2½ ".

For lateral rose engine effects, it would be easy to mount the indexer on plummer blocks to produce a rocking head. This is the commonest type of rose engine, and generally the easiest to mechanise. I'm not keen on potential distortions caused by the rocking action. I like to use large throws, which would show-up the distortion from a small rocking head.

Linear bearings on rails give a distortion-free lateral movement. I use them for jobs like fitting box lids. I'm not impressed by the high-tech, 6 row bearings I'm using. I suspect Lignum Vitae bearings, sliding on ground steel rods, would be less troublesome in a dusty environment, and better at absorbing vibrations.

There is an even easier method. When I'm showing rose turning to engineers, I often tell them they have a rose engine in their workshop, which they haven't noticed. All you have to do is sit the indexer on a free-running rotary table, so that it can swivel from side to side. Normally, the centre of rotation comes between rosette and work. By varying the relative distances from work to c.of r. and rosette to c.of r. you can vary the throw. If rosette and work are both at the same side of the c.of r., you can produce strange effects which aren't possible on a conventional machine. The work follows quite a curved path, but this just forms a dome shape on the face of the work, which enhances most patterns. I'm still happy to use this arrangement, particularly for wilder work.

It really doesn't matter how you produce the movements. Rose turning is simply a combination of rotation with lateral and axial linear movements. If you've got a fixed headstock to work with, there are lots of ways of moving the cutter, to produce the shapes.

I found it impossible to hold both rosettes against their rubbers at the same time, so I use a cord and weight arrangement for the lateral movement. Once you have a lateral movement available, you can use it to generate spiral patterns. Translate rotation into linear movement by wrapping a cord round a spindle at the back of the mandrel and tying the other end to a fixed point. You have to calculate what diameter of spindle has the right circumference for the lateral movement you need. It sounds really primitive, but it's surprisingly effective and controllable.

The great appeal of old rose turning, done with broad fixed tools, is the bi-convex bulges which can

look so organic. It's often suggested that the German turners of the early 17<sup>th</sup> century, who were devoutly religious, were also obsessed by breasts and buttocks. Unfortunately, if you're using a fly cutter to shape the work, it produces a concave cut, and it's not easy to produce a convincing convex shape. (Wonder if I could get a development grant to hire a model.) You might use some kind of copy-turning device or curvilinear apparatus. I prefer to generate shapes from circular curves and straight lines. My sliderest is too cumbersome to add a spherical action, so I added another rotary table to carry the headstock assembly. Lining-up the work relative to the centre of rotation can be difficult, particularly with a swivelling headstock. The radius of the fly cutter obviously affects the curve produced. You're cutting the curve followed by the centre of revolution of the cutter, modified by the radius of the cutter. It's all too easy to get a curve just right, then lose it completely as you take a final skim.

I started cutting simple OT patterns with a dremel, held in a slider which runs on a flat table. Clamped-on fences and depth stops allow surprisingly accurate work, but you're limited to small rotary burrs and cutters.

Working with fly cutters needs a screw-controlled slide. It's easiest to work with 3 axes of movement. A cross-vice is usually the cheapest compound rest. They're very cheap and nasty, but if you don't expect much of it, you won't be disappointed. If you get one, strip it down and remove any burrs and rough patches from the slideways and gib strips. I rubbed the slideways with a nasty black molybdenum paste. Either, replace one of the gib strip screws with something easily tightenable, or drill and tap a couple of holes to take bolts to lock the slides. (This really isn't as difficult as it sounds. Most cast iron drills and taps easily. If you're really unlucky, and hit a hard spot, try again.) Reassemble the slides so that they run freely, and use the lock bolts to secure them when you're not using them to apply the cut. Sticky grease or oil on the slides usually collects dust and causes problems. If you can run them dry, you can forget about them.

I use a vertical slide, sold as an accessory for a small Chinese lathe, for the 3<sup>rd</sup> axis. It's supported by a laminated plywood arm, that allows you to alter the angle of the cutter without unduly changing it's height. This slide has to be oiled. It also needs a locking bolt. I've found 2 problems with these slides. The feed nut is made out of "cast brass" of abysmal quality. They frequently shear off, but of course suppliers don't carry stocks of spare feed nuts, so you have to make your own replacements, which need a tap that isn't in the standard metric set. It doesn't seem to make any difference what make you buy. The quality and thickness of cast iron is also questionable. If you overtighten the lock bolt, or the clamps in the t slots, the iron will probably crack.

You may want to fit depth stops to the slides. I've been remarkably unsuccessful at making stops that actually work. I found that cheap DROs are actually easier to use. They may not be accurate enough for an engineer, but on most patterns, if all cuts are better than 0.1mm accurate, they'll look fine.

I use another, more complicated rig for some work. The 2 main axes come from a long compound table. A vertically mounted rotary table sets the angle of the cutter. A pair of slides position the cutter relative to the centre of rotation.

The schematic diagram shows all the movements which might be wanted on this kind of rig. I've never assembled one that complicated, but I have bits of equipment that could do it, if I felt the need.

Lining-up all the different planes in a complicated rig can be a problem. It's easiest to work on a stable, horizontal table, using a spirit level to line it all up. There's usually something that you haven't spotted, misaligned amongst the complexities. You can often work for a time without any

difficulties, until a particular set-up reveals the problem, usually as something funny going on with the centre height.

However careful you are working out the relative positions of slide rest and headstock, it's likely to take several tries before you find an arrangement that works for all your chucks and sizes of work. All of my machines have several sets of bolt holes in the table top.

Ornamental turners normally operate fly cutters in cutting frames, driven by an overhead drive ( a long continuous drive cord running over pulleys between motor and cutter). Some American designs put the motor and cutting frame together in one package, mounted on the toolslide. This is fine if extra weight on the slide isn't a problem, and if the motor doesn't vibrate.

I've been using a Proxon BFW mill/drill to drive cutters. It's a variable speed (1-6000rpm), quiet, router sized machine. It will run happily for ages at low speed, but because there's no noisy cooling fan, time's limited at top speed, particularly on a hot day. They used to be wonderful machines but the last one I bought, 2 or 3 years ago appeared to have been assembled by untrained staff with no quality control. They're still on the market, so presumably Proxon have done something about their problems. All I can say is caveat emptor. If you buy one, it should be nearly silent at low speeds. If it's noisy, the assemblers have probably managed to wreck the bearings. It has a 1/2" 20tpi nose thread, for mounting chucks or a small boring and facing head (you have to make up your own adaptor). It also has collets, by far the best way of holding milling cutters. Unfortunately, they only go up to 6mm, and Proxon seem unimpressed by the fact that most tooling available in Britain is 1/4 inch. Thanks a lot guys. Unfortunately, there doesn't seem to be any other machine that can offer the same speed range and quietness.

I sometimes use a small router for cutters (they find it easy enough to supply 6mm and 1/4" collets), sometimes even for small radius fly cutters. At low speeds the noise isn't too dreadful. Running a fly cutter at this speed has obvious safety implications. Fly cutters can break, and the faster they're going, the more damage flying bits can do. **This is not a technique for beginners.**

I limit myself to 1/8" diameter cutters, to avoid putting too much stress on the system. I use carbide. It may not be very sharp (I've still not got effective diamond lapping facilities), but it is very durable. If I had a source of cheap cobalt steel, I'd prefer to use it. Tests by an SOT member showed it keeps a better edge than carbide for much longer. For rose turning, the cutter revolves in a horizontal plane, exactly on centre height (unless you want the distortions that come from over or under height cutting). It needs a narrow V point, with a rounded tip. If you're cutting deep, steep plunge cuts, the V should be a very narrow angle (I've been using around 17° ). For reasonable shapes, 20° or just over should do. If the flanks of the cutter start cutting the sides of plunge cuts, they tend to leave unpleasant marks.

Traditionalists insist that the top of the cutter should have zero rake. For softer woods, a bit of positive rake might help. There's a problem with both of them : the wood is being cut at depth, before the surface is cut. A wood carver taught me years ago that tools should be shaped so that they cut the surface first to avoid splitting and get a clean cut. With a negative top rake, the surface is cut first. There's a problem of course. You tend to get more build-up of resinous gunk on the top face, which doesn't help the edge to cut. With perspex, as soon as you get a build-up, it starts to heat the work and gives a rough white finish. I still prefer a negative rake tool for perspex (try WD40 spray to reduce sticking and lubricate the cut).

If you're attempting complex turning, there's one essential rule. Start simple. If you add too many complexities at once, you'll end up totally bewildered. It takes time to understand what's going on, as well as learning to manipulate the equipment. If you get a spin indexer, the swash action's built in. See what you can do with that first. When you have some idea of what you're doing, try the

lateral rose action. Even when you understand the 2 effects, you'll still get some surprises when you combine them. Adding a spherical movement adds to the complexity. Cutting a shape can take several hours, and RSI is a danger if you're hand-rotating the work. You have to find ways of retaining control with relaxed hands, or of mechanising the process.

If you're cutting the work with a fly cutter, it doesn't matter which direction the work revolves. Sometimes, you get a better finish in one direction (usually the downhill cuts are cleanest). Often I work in both directions if I'm trying to tidy-up a shape. If the chuck is held by a nose thread, remember it can unscrew, ruining the work.

If I'm attempting to cut an unreasonably deep pattern, I often work one plunge cut at a time, taking them all close to the finished depth, before finishing with normal rotation. I find convex lobes the easiest to cut. You can rotate the work one lobe at a time, with time to move your hands while the cutter's sitting in the plunge cut. Long cuts, traversed across the work with the sliderest or a spherical arrangement, take a long time to do, and I have to be careful to keep my hands relaxed to avoid RSI.

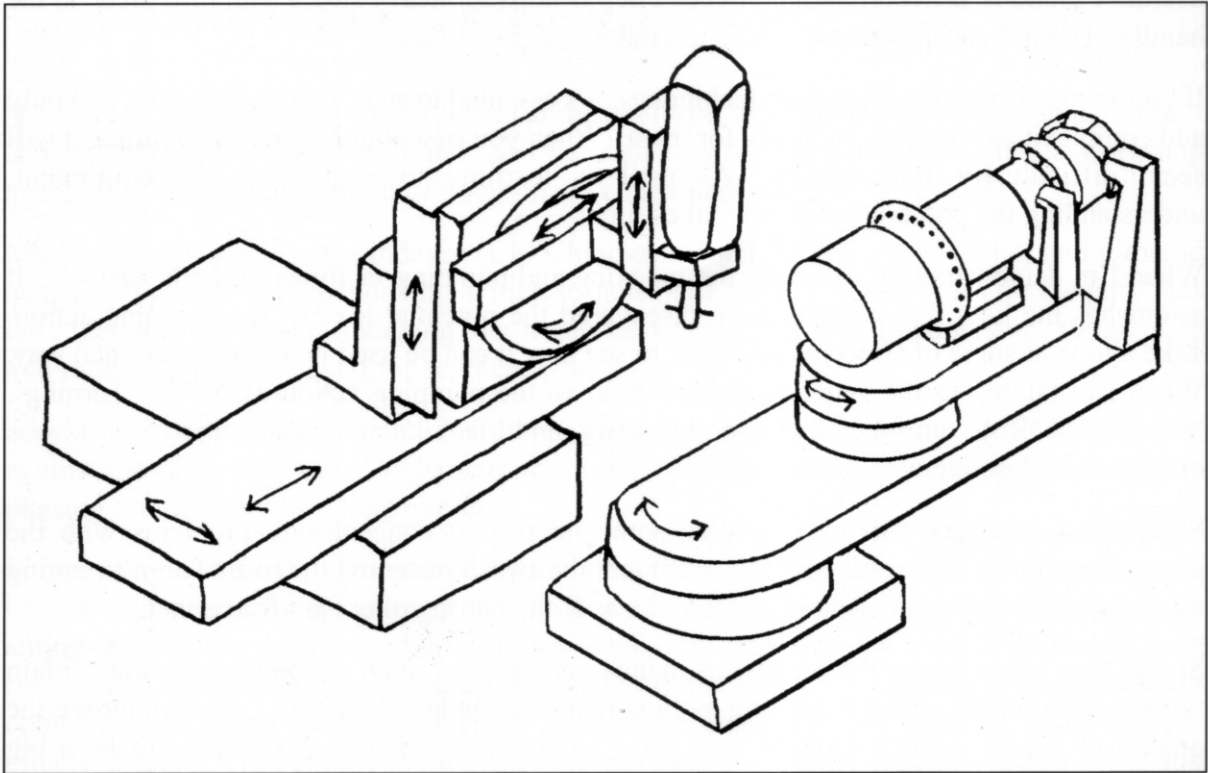
I've deliberately chosen to keep the process as manual as possible. I started as a wood turner, and love the feeling of the tools, as they gradually reveal the shape hidden in the wood. You get a similar feeling, manipulating the wood against a fly cutter. A mechanical drive, from a handle or a geared motor, could make life easier, but it also introduces new problems. Some rose turners insist that you need a slow drive, turned by hand, to rotate the work. I've disliked the hand drives on most of the rose engines I've tried. A good one's wonderful, but that same machine would work equally well with a geared motor.

Persuading the rosette to rotate against the rubber without "ski-jumping" at the points, is sometimes difficult. In simple terms, if there's a lot of tension on the belt at one side of the pulley, and there's slack at the other side, trouble is likely. Running the belt in a figure 8 between the pulleys can help. Keeping the belt tight helps. A long and stretchy belt is generally better than a short one. Applying some friction to the mandrel will often solve the problem. If it really doesn't want to play, you could try a toothed belt, or perhaps a worm drive. If you still can't persuade it to run happily, you have to wonder if your rosettes or rubber are an unhelpful shape..

I regard my present tooling rigs as temporary arrangements. In a few years, I'm sure I'll have something better, and I'm sure that hand-rotating the work will have lost its novelty. That will be the time to think of mechanising the drive.

For a perfect finish, the cutter has to track very slowly across the work. You can rough-out the shape quickly with deep cuts (provided you're not tearing grain out too deeply). The finishing cut should be very light, with the work rotating as slowly as 1 rev in 3 minutes. For an axial shape, the cutter should traverse equally slowly- perhaps 100 cuts per inch. The rule is, you go as slow as you have to, for the perfection that seems necessary to you.

My work is much rougher. I like the striations that a perfectionist tries to erase (a perfectly smooth finish on Blackwood looks awfully like plastic). I'd be happy if I could just get them even. Sharper cutters will help. I'm aiming for a finish that suits my style of work. If I were attempting classical pieces, I'd have to find ways of working to an appropriate standard, without striations.



This drawing shows the movements which may be required. In practise many of the positions are preset, and you only need the movements which will actually be used to apply the cuts.