III. AN IMPROVED DRIVE FOR THE UNIMAT SL

The standard drive for the Unimat SL consists of a rubber drive belt from the motor pulley to the spindle pulley, with the option of one or two reduction pulleys driven by small rubber belts for slower drives. This works well under small load conditions, but when a tool is applied to the work the belts tend to stretch and slip, particularly the longer final drive belt. This gives a loss of torque at the spindle, and the only way to keep a good drive is to increase turning speed so that a flywheel effect is maintained with the weight of the chuck and workpiece turning. The lower the drive speed the less the flywheel effect and the more the belts stretch and slip, which is self-defeating since the lower speed is intended to give a more powerful drive.

My design overcomes these problems and makes the Unimat a more efficient machine tool without affecting any of the drive capabilities of the old model, so that grinding and small hole drilling can still be carried out as before, without any dismantling.

The improved drive consists of the addition of a flywheel assisting a gear drive coupled by a toothed nylon belt. This drive through toothed gears is very positive and with the new standard drive position B it is impossible to stop the drill chuck turning on the main spindle with the hand. Now an electronic speed control may be fitted in the motor lead to give a controllable range of drive for all turning conditions and materials. The drive was derived from that of the small power hacksaw, which is simply made; the same sized toothed belt is used as it can be readily bought from model shops as a spare for a radio controlled stock car, size 100 x LO31.

The principle of the improved drive is that the motor is used to drive a flywheel, via a rubber belt, and the improved torque of the fast-moving flywheel is conveyed positively by a toothed drive to the slower-moving main spindle, giving even greater turning force. The ratio between the drive spindle and the flywheel is 30 to 7, approximately 4.3 to 1, which was determined empirically by sizes and turning centres of the lathe. In operation the drive is quite powerful so that if a tool jams in, or a workpiece jumps from the

chuck, the effects can be quite shattering, but, with luck, the worst that will happen will be a few teeth sheared from the nylon belt by the small gearwheel, but the jaws of the 3-jaw chuck can easily break a tooth or two within the scroll with the force. If the slow drive plate is used instead of the standard motor drive plate there are a few thou less between the spindle centres which gives a little slackness to the belt and enables the teeth to jump if a jam occurs, but the motor must be switched off immediately or the belt will rip. Keep a spare belt handy.

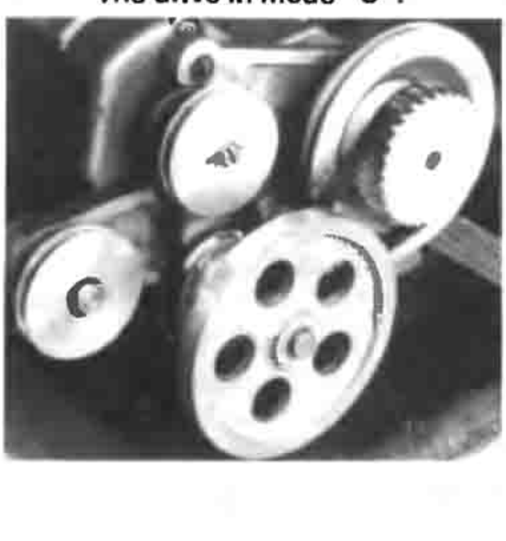
Flywheel and Spindle

First make the flywheel spindle — this replaces the shorter spindle of the intermediate pulley group — using the original pulley and twin ball races. The spindle is turned from $\frac{3}{8}$ in dia mild steel, or use silver steel if the b.m.s. stock measures undersize. Chuck the end for the flywheel and turn the rest down to 6 mm, thread $\frac{1}{2}$ in at the end with a 6 mm die to take the metric nut, and make another nut from $\frac{3}{16}$ in hex brass to act as a locknut, drill No 7 and tap for 6 mm. If you have no I.S.O. Metric taps and dies use 0 BA and make both nuts.

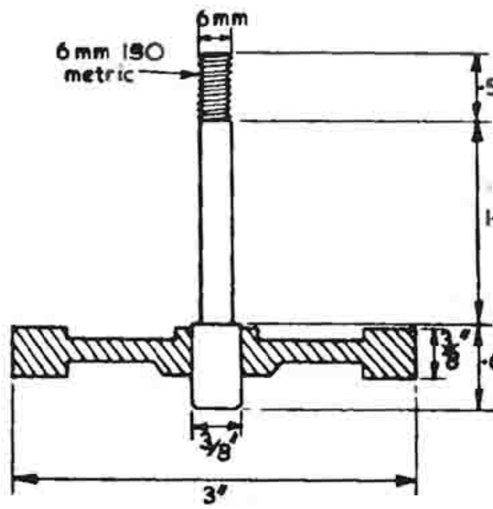
I made the flywheel from an old zinc alloy wheel from my scrapbox. This is perhaps a little large at 3 in dia, a brass blank of $2\frac{1}{2}$ in would make a better size. Drill a hole, $\frac{3}{8}$ in dia, in the centre, clean the hole and the spindle with C.T.C. and Loctite 601 the flywheel blank on to the spindle. Allow an hour for the Loctite to cure. With Loctite it is useful to remember that if a mistake occurs, say the flywheel slips half off the spindle when setting, do not despair, simply heat the lot to over 200°C and the parts will separate easily; use a big soldering iron. Face the flywheel in the lathe, holding first the 6 mm, then reversing and holding the $\frac{3}{8}$ in for the other face; turn the outer edge true.

To make the small toothed wheel it is necessary to make a 6 mm mandrel for turning and tooth cutting, and a seven division index

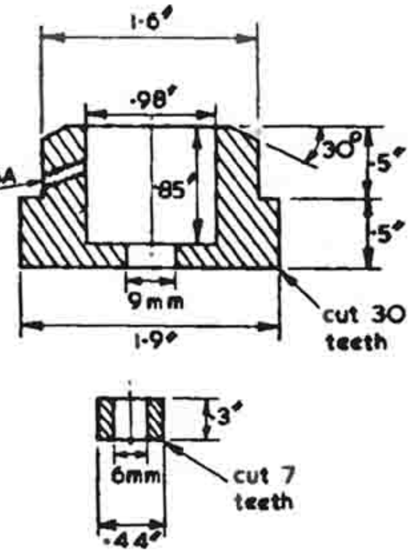
The drive in mode "C".



The parts required to make the new drive.



FLYWHEEL & SPINDLE



GEARWHEELS

plate for the dividing attachment. The mandrel is made from a piece of $\frac{1}{4}$ in dia mild steel with a collar turned 6 mm and the end threaded 2 BA for a retaining nut; make it about 2 in long to allow clearance for the chuck jaws when tooth cutting. For the index plate make a blank, to the same dimensions as the 48-tooth dividing wheel, from a piece of $1\frac{1}{2}$ in dia dural; leave the flange complete for cutting the seven teeth. On a piece of card draw a 5 in circle, with a concentric 11 mm and a 5 mm circle. Using a protractor divide the large circle into seven parts of 51.5 degrees, which is accurate to half a degree. Place the blank over the drawing using the inner circles as guides and scribe off the seven points; file a cut with a triangular file at each point. Remove the backplate from the 3-jaw chuck and place the chuck over the hub of the new plate. With a long centre punch mark the position of the three screw holes, drill them No 29 and tap through with a 4 mm I.S.O. Metric tap.

Small Gear

Make the small gear to the dimensions shown, secure the blank on the mandrel in the 3-jaw chuck on the dividing head with the seven-division plate in place and cut the teeth. Use the sloping sided cutter as described in a previous article. Fit the belt around the teeth, and the teeth will be slightly too large as the pitch line is within the continuous part of the belt. Turn down the teeth, using the mandrel in the drill chuck, 2 thou at a time, until the belt fits precisely. Loctite to the shaft with 601 up against the flywheel.

Large Drive Gear

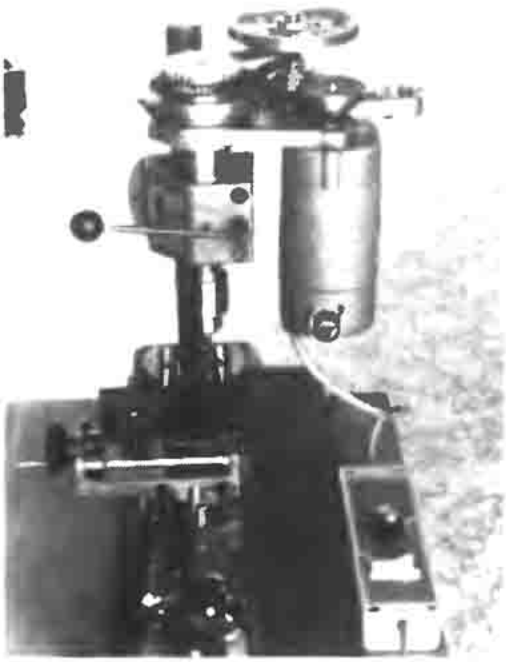
The main spindle drive gearwheel fits directly over the drive pulley hub and its securing nut. It is made a tight push fit and then locked by means of a grub screw. It can be made from 2 in dia dural or from

brass. Drill a 9 mm hole right through with the material held in the 3-jaw chuck, jaws reversed. Bore out to the dimensions shown, face off, then reverse in the chuck, jaws normal, gripping by the new bore. Turn the outside and rear face, then reverse again and with the headstock at 30 degrees take off the corner to fit the curved inside surface of the pulley wheel. Drill a hole for the grub screw No 43 and tap 6 BA. Try the wheel for fit, if burrs and bits interrupt the fit run the lathe fast and gently grip the hub with a strip of medium emery cloth until the wheel is a close fit; use a smear of silicone grease.

With the 30-division index plate in the dividing attachment and the 3-jaw chuck in place, grip the wheel by the bore to cut the square teeth. Use the straight-sided cutter for this wheel, and cut a deep tooth. When complete try the belt and, as before, take off 2 thou at a time until the belt fits.

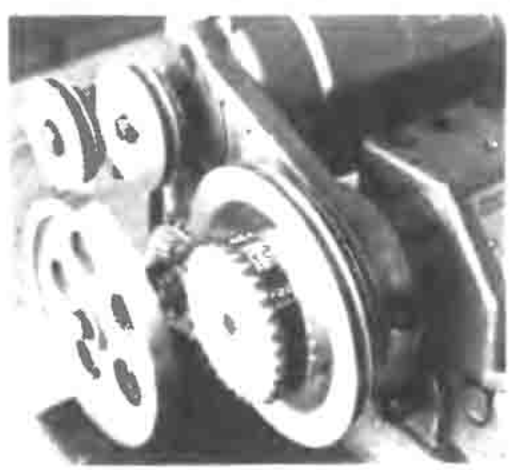
Fit the wheel on to the hub and secure with an Allen grub screw, make a file cut on the pulley to accommodate the Allen key, and deepen the mark the grub screw makes on the pulley hub with the tip of a drill. This is a good non-slip drive easily removable for the cleaning and regreasing of the main spindle.

Remove the intermediate pulleys and ball races from their spindle and reassemble them on the new flywheel spindle; fit the additional nut or the flywheel drives the assembly out of nut and bearings, tighten into the drive plate. The small gear is now flanged on one side by the flywheel hub and on the other by the smaller pulley, which is necessary for correct drive, so that the belt does not run off. Stretch a rubber belt over the flywheel on to the large pulley then to the smallest motor pulley. Fit the toothed belt over the flywheel on to the



Left: In the vertical position using electronic control.

Below: Another view of the improved drive.



small wheel, turn the flywheel whilst stretching the belt across to the big wheel; the belt does not stretch so it has to be manoeuvred with movement of both wheels. Switch on the motor and try the drive, if the intermediate pulley slips on the flywheel shaft a grub screw will be needed in the central pulley and secured.

At this stage centre up a piece of $\frac{1}{2}$ in dia steel, make sure the head and tail are locked up securely, and with a sharp knife tool in the toolpost, take off the eccentric, then advance the tool into the work 6 or 7 thou and turn off a bright curl of metal right along without a falter from the little motor. Then try another mode of drive. If you have the slow motion drive plate, reverse the motor pulley and fit another belt from the small motor pulley to the large second intermediate pulley, then from the small second intermediate pulley to the large pulley on the flywheel shaft fit the other small belt. Switch on this slow drive and take just a thou off the steel with a first-class finish. Reverse the motor pulley back and, with the rubber belt middle to flywheel middle, turn a piece of dural or brass at this higher sped and powerful drive.

Electronic Speed Control

With the power available I felt it would be advantageous to fit an electronic speed controller and get a more controlled range of running speeds. I carried out tests with an ammeter which showed that under heavy load conditions the same power became available to the motor even when the motor was only pulsing round, as when running under bypass power.

With the controller fitted I carried out a series of tests with various materials and at different speeds and modes of new drive; I have tabulated the results as a guide. All the spindle speeds shown on the tables are approximate figures for the main spindle with no load applied; when a tool is applied the speed drops until the motor is driving at the necessary power.

This improved drive transforms the Unimat into a cleaner-working efficient machine without impairing its vertical and horizontal capabilities. The design is such that the modification can easily be removed with only an indentation on the hub to show where it has been. The only improvement may be to fit a guard if you have small children about.

Finally, a word on cutting lubricants for working and cooling with the small lathe. These are most easily dispensed on to the work by means of polythene washbottles, the sort used in laboratories. They provide the right requirement by squeezing; when not in use loosen the cap slightly so as not to squirt fluid when picking up the bottle. When cleaning up the Unimat after use the soluble oil will float out on the surface of light machine oil.