ELECTRONIC OT DEVICE

Ornamental turning on a regular lathe

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DURING THE PAST TWO YEARS OF demonstrating the RS3000 at shows and woodturning groups, many people have asked "what does it do?" Because it works so fast, it is not possible to see what it does, and in the environment of a show it is not possible to simply and quickly say what it does. In fact there is little chance to do more than point to what has been done with it, and make a few simple cuts. The simplicity of operating the machine belies its complexity and accuracy. It is an instrument, not a toy. I hope that the following will answer some of the questions.

The concept

The concept underlying the operation of the RS3000 is deceptively simple. Instead of having a revolving cutter approaching a stationary workpiece at precise indexed positions, in order to create one concave pattern element at a time, as is generally the case in conventional ornamental turning, the RS3000 uses the combined motions of the rotation of the workpiece with the backwards and forwards motion of its cutter to produce a whole set of concave pattern elements around the work at one setting (see drawing below). Because a microprocessor calculates the index positions, there is no need for an indexing head on the lathe. Because all the pattern elements are being cut to the same depth at the same time, there is no struggle to get them all equal. And because the control equipment needed for the cutting portion of the machine is designed to fit in the place of a conventional tool rest, the machine can be fitted to a conventional lathe These factors in combination put some facets of ornamental turning within the scope of conventional lathe users for the first time ever.

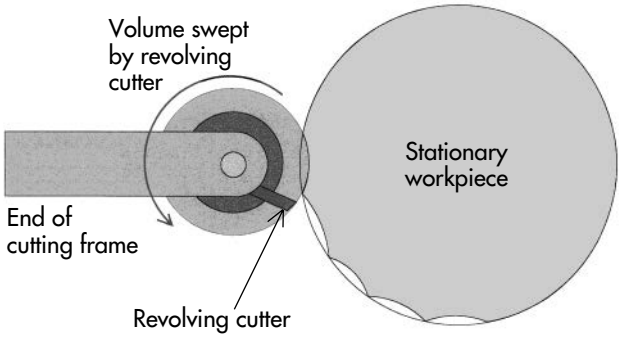
Accuracy, and how

Consider for a moment cutting twelve identical pattern elements spaced exactly around the perimeter of a workpiece, and then consider that that workpiece is spinning at 500 rpm. Each revolution takes 0.12 seconds. A pattern element can represent a maximum of 1/12th of a revolution; therefore, the maximum time available to cut at each position is 10 milliseconds. On a six-inch circumference piece, each element would be $^1/_2$ inch long. As each pattern element cannot be cut with one stroke of the cutter without tearing the timber, any cutter cutting such a pattern element would have to relocate at the start of each cutting point exactly, for every shaving, as the cut position goes past. As the shavings need to be in the region of 0.001 inch thick to give a good surface finish to the cut, the cutter needs to relocate with an accuracy of much better than that, i.e. much less than 0.02 milliseconds. In short, the accuracy is staggering.

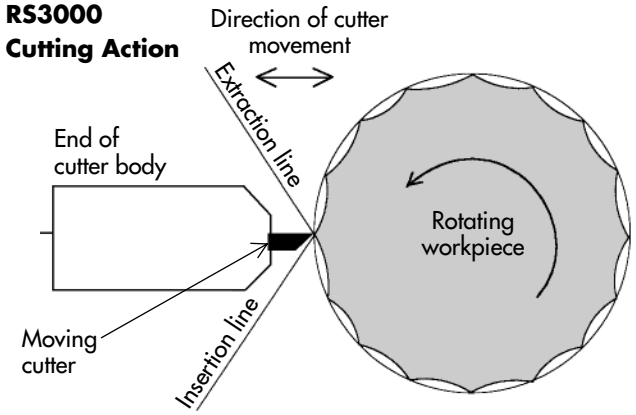
How does it do it? The position of the revolving work is accurately signalled to a microprocessor by a magnet placed on the headstock shaft. As this rotates, it passes a sensor, which in turn gives a signal to the processor in the control box. The processor can then monitor the lathe speed, and check that it is reasonably constant before calculating the index points and starting the cutter.

The cutter motion is powered by a solenoid. However, solenoids that produce enough power to cut are simply not fast enough to operate the cutter directly, and so the solenoid is used to withdraw the cutter from the work, storing energy in a spring, much like winding a clock. When the solenoid is de-energized, the cutter jumps forward under the impulse of the spring and is arrested at the end of its travel by another spring, giving the cutter an exact prescribed path in relation to the moving work. The solenoid is then re-energized, and the

Typical Conventional Ornamental Turning Cutting Action



RS3000 Cutting Action



The RS3000 consists of a microprocessor/sensor and magnet system. Together, they monitor lathe speed and control a solenoid-driven cutter mounted in a conventional tool-rest base. At right is a small sampling of the range of decoration the system is capable of.

cycle begins again, with the processor calculating the next position at which to de-energize the solenoid to cause the cutter to cut at the next position in the cutting sequence. All this happens in as little as 25 milliseconds per cut.

Because the cutter does not cut adjacent cuts one after the other, but skips several positions before making another cut, the apex where two cuts meet is an exact point. The cutter does not cut at all positions in any one revolution of the work; in fact the cutter is in contact with the work intermittently, and out of contact at least 80 percent of the time.

The processor holds programming to index the cutter at 6, 8, 12, 16, 18, and 24 positions, and to rotate those positions in 2.5-degree steps relative to top dead center. Also, the processor adapts to differing lathe speeds. Generally the machine is used at around 500 rpm, but in order to decorate smaller items, below 1 inch in diameter, the lathe speed may be increased to up to 1,500 rpm for lower numbers of index points.

On top of all this, the process is so accurate that it is possible to stop the lathe as many times as may be necessary to examine the progress of the work, and the cutter will relocate exactly into the same set of cuts when the lathe is switched on again.

The "processor controls" control the number of index points, their positions relative to top dead center, and the facility to turn the cutter off without forgetting the chosen settings. These are operated by push switches on the front of the control box. In addition, there are mechanical controls for other aspects of cutting.

How does it make patterns?

It doesn't. The operator does. None of the forms of decoration that can be produced using the machine are programmed, though all are repeatable. The way that decorations are built up using the machine is the same way that decorations are built up in conventional ornamental turning, but in a fraction of the time. The only task done for the operator is the indexing of the concave cuts, which the operator has to choose from the programming. In short, it just goes in and out, and the operator makes the choices as to where, how many, how deep, and what shape the cuts are.

Fitting it to a lathe is a simple matter of positioning a magnet and a sensor, assembling the control gear, and fitting that in place of the normal tool rest. Operating it is a relatively simple matter of pushing some buttons, setting the other controls, and controlling the cutter body manually.

Summed up, the RS3000 is an electro-mechanical self-indexing reciprocating cutter. The only things that are not in the control of the operator are the calculations themselves, and who wants to do sums?

Any design is composed of a series of elements. The shape of these elements is controlled by the operator either directly or indirectly. Other rules of ornamental turning apply, such as using polished cutters, and the types of wood that can be used. The shape of the chosen cutter, if the elements are to be shallow or deep, if they are to meet or not, if they are to be used singly or in combination, if they are to cover the whole surface of the work, or to be assembled into a band or border—all these factors are dependent upon the imagination and skill of the operator both as a designer and craftsman. What the RS3000 does is bring these facilities within reach.

More information about the RS3000 can be found at http://members.aol.com/MTOram *or from Farris Machinery, 800/872-5489. Martin Thompson-Oram, the inventor of the RS3000, is a Registered Professional Turner in Yorkshire, England.*