The thread whirling process in the hands of the surgeon

**What could be more complicated to achieve than thread cutting or tapping on a lathe...
However – thanks to a whirl-type process and the DECO 2000, what used to be impossible has now become reality at high output.**

Of course, this is becoming easier and easier with present-day numerical controls because the turn-key sub-programs make it possible to manage the material and successive passes well in advance. But despite this programming facility, machining by chip removal still remains a tricky operation especially when having to tackle alloys such as titanium and stainless steels, especially for thread cutting or tapping, where the useful life of the tools is considerably reduced. But a method does exist and meets the wide demand from the medical and dental sectors. TORNOS-BECHLER has taken the lead and adapted itself to the high quality standards required for such applications. Surgeons in the dental and medical fields need surgical implants of all shapes and sizes, including bridges and screws. These parts are made from stainless steel, recast under vacuum, or titanium, so as to ensure complete biological compatibility and above all, prevent any risk of rejection.

These constraints, coupled with the high precision demanded, especially of screws used in orthodontia or micro-surgery, stimulated the company to improve the potential of its lathes by developing procedures suitable for this purpose. One of the most striking specialities is the technique of machining internal and external threads according to the whirl threading principle, which is now possible on the DECO 2000.

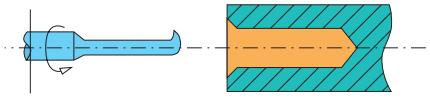
Thread whirling – an interesting alternative to thread cutting

As opposed to thread cutting and tapping, thread whirling produces clean contours without burrs. The tools used, also have a greater useful life, the machining time is shorter and tool breakage is a thing of the past. The main applications of whirl threading are dental implants with internal threads, screw-to-bone implants, surgical screws and maxilla-facial screws with external threads. This process also dispenses with the long withdrawal of the bar from the guide channel, thus avoiding seizure due to an excessively long projection.

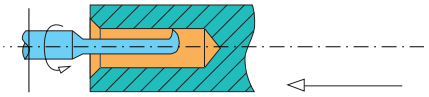
Thread whirling can be executed both for external thread cutting and internal tapping. This machining process, which is carried out on the bar or in counter-operation on an automatic lathe, requires a high-frequency spindle turning at speeds up to 30,000 rpm. During internal tapping, the spindle axle must run parallel with the part being machined, whilst for external tapping, this axle is inclined, depending on the screw pitch angle. The hard metal tool must have a shape similar to the thread profile being executed.

Description of the process

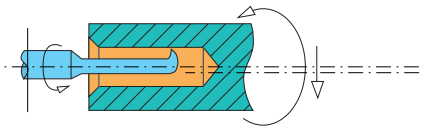
Let us now examine the machining of an internal tapped hole by whirl threading. The procedure, which is illustrated in the figure alongside, is as follows:



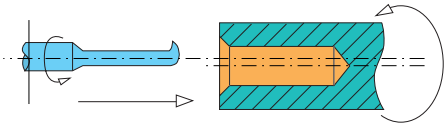
1. *The part is presented before the tool which is turning at high speed.*



2. *The tool is introduced to the inside by the sliding headstock driving the part.*



3. *The part turns slowly, either in the tool direction or in the opposite direction, depending on the type of thread being cut (left pitch/right pitch). The tool, which is conveyed by a numeric axis penetrates the material of the revolving part by lateral displacement. This offset is equal to the depth of the thread being machined.*

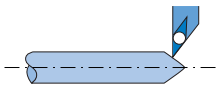


4. Start of tapping at the base of the hole. The thread is executed in a single pass. Both the part and tool are turning. The part is withdrawn at the speed of one pitch per turn of the spindle.

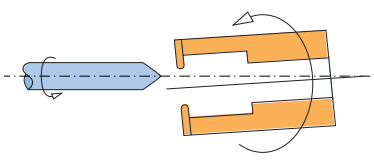
This process is 60 % faster than conventional tapping. The useful life of the tooling is also far superior. More than 2500 titanium parts can thus be tapped without breaking. Coupled with this, is the fact that the cutting speed can reach 200 m/min, thus ensuring an irreproachable thread quality. As for precision, this is guaranteed by numeric incrementation, both in depth and diameter. There are no burrs or residual chips and the thread cutting depth can be more than three times the diameter of the thread. It is even possible to machine right down to the bottom of a blind hole or even very small threads, e.g. M 1.4.

External thread cutting

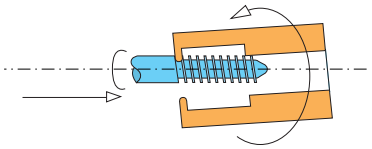
Thread whirling can also be used for external threads, but this is a little more complicated. What is required is a high-speed spindle revolving at a speed of up to 12,000 rpm and a device which is specially fitted to the end of the lathe which can rotate and incline in relation to the thread pitch angle. This mechanical inclination is set once manually for each thread line. Machining is carried out using a bell-shaped tool comprising three cutters of the same section as the thread undergoing machining. This tool can, of course, be re-sharpened as required. The entire threading depth is executed in a single pass. We shall now describe the process.



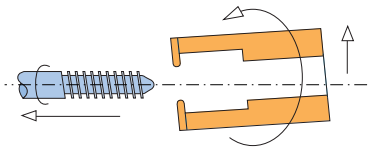
1. *The surface facing the part is turned, if necessary.*



2. *The spindle, which drives the whirl threading tool is positioned in front of the point of the part undergoing machining. It revolves at high speed whilst the part simultaneously turns in the opposite direction at slow speed.*



3. *Machining can start by longitudinal penetration of the part into the bell-shaped tool. The feed rate, which is synchronised with the two rotation speeds, continues until the required threading length is achieved. It should be pointed out that only one tooth is in contact with the part at any time, thus guaranteeing a fine cut.*



4. *Once thread cutting of the part is complete, the whirl threading spindle (the tool) is released to the side and the part can be longitudinally withdrawn. The length of the thread cut may be as much as 30 mm.*

This process offers several benefits, the first being the excellent useful life of the tool with its constant contours which can be re-sharpened up to 40 times.

The surface state of the threads is perfect because the tools rotate at high speed in the opposite direction to that of the part, thus avoiding the undesirable lands of the face which are sometimes found with conventional threading by milling.

Special features, such as left or right threading, threading from above a screw head or even conical threads can also be achieved because of the flexibility of programming the TB DECO software and through the multi-axis interpolation of the DECO 2000.

Medical applications

In order to understand the requirements of the medical implant market, TORNOS-BECHLER worked in very close co-operation with specialists in this field and executed parts made from titanium or stainless steel 316L, in particular. These are materials which, based on current research, are best tolerated by the human body. Those industrial engineers working very closely with the dental medical sector and surgery have become very demanding. They will only be happy with the best. This pledge of excellence with respect to implant materials and screws in particular, is met by the whirl-threading machine, coupled with the flexibility of the DECO 2000 concept. At present, this provides the best threading / tapping quality on offer in the small parts turning industry. In approaching the medical implants sector, TORNOS-BECHLER is penetrating an innovative market that is in the throws of development. It is doing this for several reasons: fixing techniques are making progress; we have not heard the end of materials such as stainless steel recast under vacuum, titanium and the alloys of the future; new machine tools can now machine these difficult materials far more easily and, to cap it all, the machine tools of the DECO 2000 range can now execute operations which were still only dreamt about yesterday.