

Power Skiving

FLEXIBLE AND EFFECTIVE PRODUCTION OF INTERNAL GEARS

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The process with the somewhat cumbersome title of “method for cutting gear wheels using a cutting tool similar to a gear wheel with cutting edges on the faces of the teeth” in the patent application more than 100 years ago has matured into one of the most economical gear cutting technologies around — power skiving.

The inventor, Julius Wilhelm von Pittler, intended to use it to make rings with internal gearing. Yet it was only with the technological accomplishments of the 21st century that Pittler T&S GmbH were able to realize gear cutting machines on the basis of the PV series for the efficient production of ring gears, for example. All those years ago, von Pittler was forced to link all machine movements mechanically. It wasn't until intelligent software and a computer-controlled numeric control came along that it was possible to move the five axes extremely precisely and synchronously to one another in an interpolating way. Developments in the tool segment such as more sturdy powder and carbide alloys as well as high-performance coating for tools also played their part.

Due to a lack of efficient production technology for internal gearing, spur gears and external gearing became established in drive engineering

in the course of the last 100 years. In the field of internal gearing production, the methods shaping and broaching were the order of the day. Yet this has all changed thanks to the latest developments in the field of power skiving technology. This technology allows manufacturers to get round the disadvantages of the competing processes and benefit from increased flexibility and higher output at the same time.

Production of internal and external gearing in one clamping

Unlike shaping, power skiving is a continual hobbing manufacturing process which avoids the unproductive stroke and removal movement. The advantage: machining time is reduced by at least the factor 3. In addition, power skiving is much more flexible than broaching, because the machine operator can configure the dimensions such as the two-ball dimension using the NC control. Helix angle and the flank shape can also be modified using the NC control. The high adaptive capacity becomes clear when it is born in mind that gearing can be cut both internally and externally.

In the case of external gearing, the technologies of power skiving and hobbing are competing more and more often. Since significantly less space is required

for the tool outlet for power skiving, the technology is opening up new possibilities for designing cost-saving gearbox components. Even workpieces with constraining contours can be produced efficiently using this method.

In the past, critics claimed

that power skiving was less productive than hobbing. This claim cannot be generalized, however. Because in an optimized process, the main times and tool costs are by all means comparable.

During broaching, component quality is determined mainly by the tool geometry of the broach, and can thus not be influenced during the machining process. The high costs of the tools, set-up, treatment and storage of the broaches is another disadvantage.

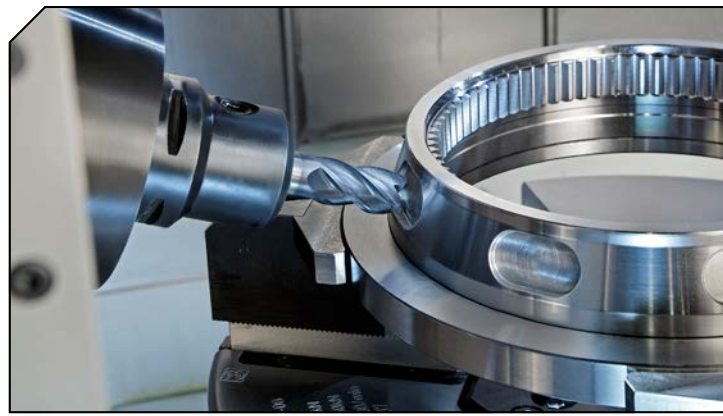
Tool change saves costs

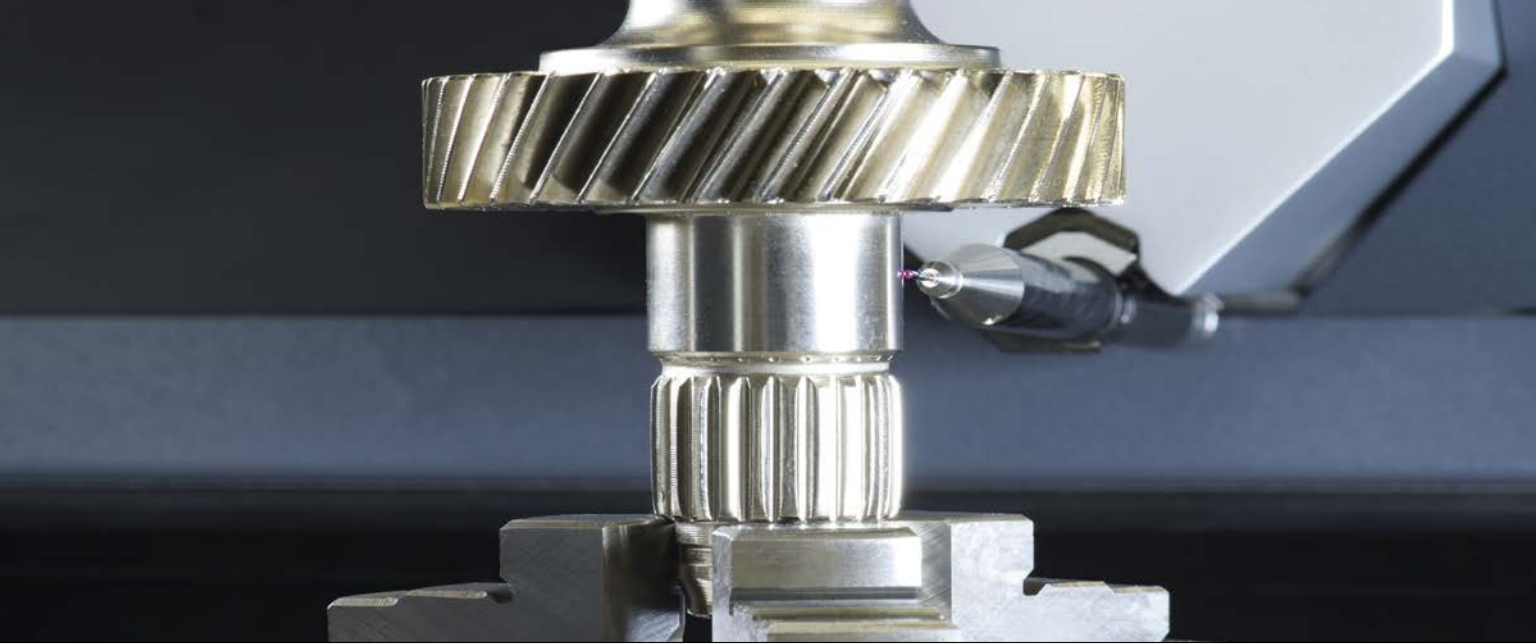
With the PV range, Pittler T&S offers a whole series of machines using power skiving technology. This covers the whole workpiece diameter range from 30 to 1,250 mm. All the machines have 5 axes and a tool magazine for simple and fast tool change.

Alongside the pure tool management of different skiving wheels, the tool change includes tactile measuring sensors and other metal-cutting tools. This allows the cutting process to be divided into roughing and finishing.

A roughing tool with standard indexable inserts removes more than 90 percent of the material. This goes decidedly easy on the finishing tool, which creates the involute contour and results in lower tool costs.

A further advantage of the tool magazine of the Pittler PV range is the complete machining option for workpieces. This means procurement and transport to other machines is no longer required. Reclamping faults are avoided. Further advantages: processing and delivery times are sped up, the complexity of workpiece handling is reduced, intermediate storage is not required and manufacturing structures are flexible rather than rigid.





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Economic production of crowned tooth flanks

Unlike the methods already described, power skiving influences the straightness of the tooth flanks. If both flanks are cut offset, the result is crowned tooth flanks. This allows the contour to be corrected on the one hand, and new geometries to be created on the other. This cannot be done more efficiently by any other manufacturing method.

Simplified user interface

The power skiving machines from Pittler T&S are all constructed with the very latest control technology on the basis of Siemens 840D SL. This allows the machine to be used as a 5-axis machining center with *ShopMill*. In addition, a suitable post-processor makes free-form surfaces with milling possible. The company, based in southern Hesse, equips the machines with a special user interface for power skiving. This allows an employee with basic knowledge to pro-

duce gearing. The NC program is generated automatically. The data is requested with the aid of a graphic interface. The data is also transferred to an automatic measuring program which checks the quality of the gearing. This means the measuring sensor can measure the result directly after machining. It does not replace a gearing measuring machine, but does provide a first quick check of the quality achieved and is thus an important aid during process run-in.

Clamping technology with DVS system

Concentricity is essential for component quality, particularly where thin-walled ring gears are being machined. This is why Pittler T&S got together with SWS Spannwerkzeuge GmbH, an associated



company within the DVS Technology Group, to develop a special diaphragm chuck as well as special chucks using the hydro expansion principle for this application. This DVS system solution permits sensitive clamping without warping the component.

For more information:
DVS Technology America Inc.
Phone: (734) 656-2080
www.dvs-technology.com

Sandvik Coromant

INTRODUCES GRADE ISO H05 AND H15 APPLICATIONS

To help manufacturers enjoy benefits such as reduced cycle times and greater tool life when performing hard part turning, Sandvik Coromant has strengthened its existing offer in the ISO H05 to H15 application area with the introduction of two new grades, CB7105 and CB7115. The grades will be of particular benefit to those machining transmission components for the automotive industry, where lower cost per part can be achieved.

With CB7105, Sandvik Coromant has

created a grade for hard part turning that offers enhanced crater wear resistance in comparison with existing solutions, while CB7115 is designed to provide users with better fracture resistance than today's available grades. These benefits equate to higher speed and improved edge line toughness, respectively.

Hard part turning is usually a finishing or semi-finishing process where typical machining challenges include high surface and dimensional tolerance demands, along with competitive tool life.

CB7105 and CB7115 have been developed to tackle these challenges through the application of a high performing PCBN grade material and coating as well as appropriately adjusted edge preparation on the inserts. In combination with high quality control during insert manufacturing, this results in a number of end user benefits.

"CB7105 allows machine shops to achieve lower cost per part when used as part of a high speed machining strategy," states Torbjörn Ågren, product manager, turning at Sandvik Coromant. "Alternatively, users of this grade can benefit from longer tool life at lower speeds. CB7115 is also designed to deliver lower cost per component, typically though the adoption of one-cut strategies at higher speeds."

A case in point saw one trial site increase production of case-hardened 16MnCrS5 (HRC 57-62) automotive components by at least 15 percent after switching to CB7105 and CB7115. In fact, the CB7115 surpassed 600 components (at 0.15 minutes time-in-cut) with predictable surface generation and a lower Rz value. The cutting speed was 170 m/min (557 ft/min), while feed rate was 0.22 mm/rev (0.008 inch/rev) with a cutting depth of 0.15 mm (0.006 inch).

CB7105 and CB7115 offer updated PCBN material, edge preparations and improved edge-line quality to ensure better and more predictable tool life and edge-line security.

For more information:
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www.sandvik.coromant.com



Traub

TNL18 AUTOMATIC LATHE OFFERS IMPROVED DYNAMICS

The Traub TNL18 series Swiss-style automatic lathes perform even more dynamically with an enhanced CNC control, axis amplifier, and more dynamic drives, resulting in significantly improved accelerations and top speeds. In extensive tests, the developers made sure that the mechanical conditions of the machine harmonize with the new dynamics.

The TNL18 includes an optimized drivetrain which will benefit all machines in the Traub sliding/fixed headstock automatic lathe range: the TNL18-7B with its seven linear axes and the B-axis on the upper turret; the TNL18 9 with autonomous counter spindle and nine linear NC axes; the Traub TNL18-9P, optimized for series production.

The rugged mechanical construction of the Traub TNL18 machines effectively handle the new accelerations which are up to 25 percent faster than the previous TNL18. Better acceleration and optimized NC programs can reduce machining times by up to 21 percent, while the quality of workpieces remains unchanged.

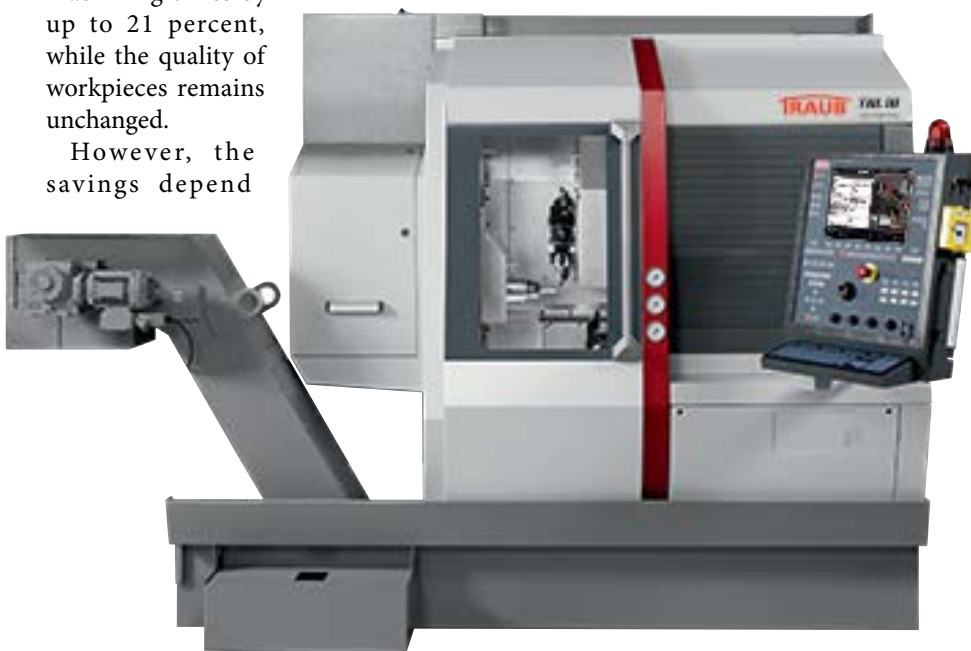
However, the savings depend

also on the complexity of the workpiece. While for a "simple" shaft that is machined mostly at constant cutting speeds and with only a few tool changes, the savings are about five percent, it is completely different for a dental implant with numerous different turning, drilling and milling operations. Besides reduced secondary times, the shorter acceleration and deceleration processes allow significantly higher feed rates for these complex cutting contours, resulting in the said 21 percent time savings.

Even if the user does not implement such cycle time-related optimization measures, he still benefits from the new powertrain. A much higher contour accuracy is possible, and on components with high precision requirements, this can be of great benefit if it reduces the number of measurement processes required.

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Gleason

INTRODUCES 300GMSL MULTI-SENSOR INSPECTION MACHINE

Gleason recently introduced its latest innovation in gear inspection technology with the 300GMSL Multi-Sensor Inspection Machine; providing the capabilities of four instruments on one platform.

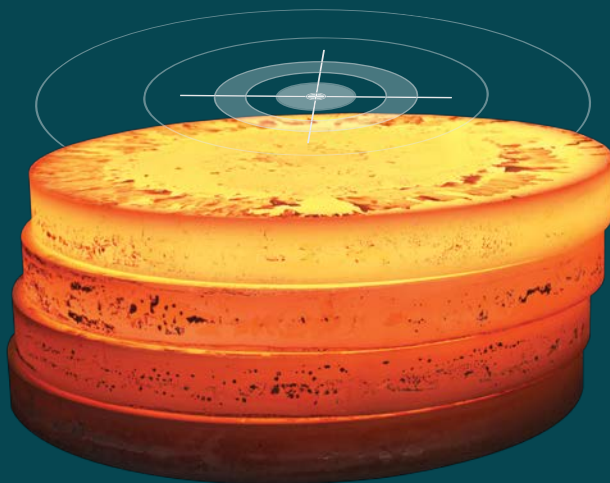
Designed for manufacturers of automotive, aircraft and other like-sized

gears, the 300GMSL offers a single, compact, reliable and easy-to-operate inspection solution to apply the most desirable gear measurement and analysis methods for both R&D and production applications.

An extremely versatile platform, the 300GMSL is capable of perform-



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ing tactile probing to support traditional gear feature data collection on spur and helical gears, spiral and straight bevel gears up to 300 mm in diameter. In addition, the platform supports non-contact, laser, full form scanning for a wide range of workpieces to support gear development efforts where large amounts of data need to be collected faster than possible with conventional tactile probing. Optional features include surface finish measurement and Barkhausen Noise Analysis; to further improve throughput while reducing cost of ownership and floor space requirements.

The 300GMSL can be used for research and development applications such as rapid prototyping and reverse engineering. It is also well suited for normal production operations requiring high-speed topography inspection as well as increased non-gear inspection capabilities and the ability to inspect soft, compliant materials such as plastic gears.

The optional Advanced Operator Interface puts a number of powerful tools right at the operator's fingertips including video telephony, note pad and voice mail messaging capability along with QR/bar code reading. The user-friendly, fully Windows compatible GAMA application software suite provides users a highly intuitive interface with simple input screens for programming workpiece data.

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Gleason Corporation
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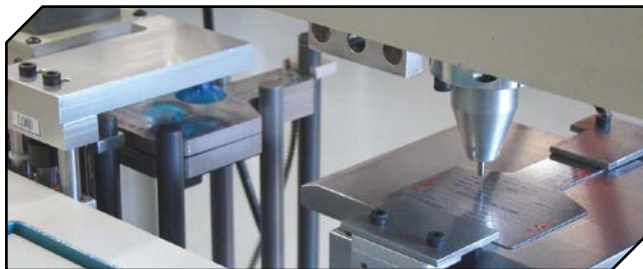
Kwik Mark Inc.

OFFERS AUTOMATIC NAME TAG FEEDER/MARKER

The new Tag Master 3 feeder was developed to eliminate the problematic tag feeding issues of escaping tags from the bottom of the magazine. The tags are transferred from the top to eliminate the jamming; scratching and other problems associated with bottom feed “coin changer” type escapements. This also means thickness tolerance; sharp edges, etc. are no longer issues. Available with Print Queue Driver; allowing multiple users to download job menus, variables, quantities, etc.

For more information:

Kwik Mark Inc.
Phone: (815) 363-8268
www.kwikmark.com



Kennametal

MILL 4-11 DESIGNED FOR SMALLER MACHINING CENTERS

The issue with many square shoulder indexable milling cutters is the stair-step effect they leave on workpiece walls.

Two years ago, Kennametal introduced a double-sided 90° milling platform that eliminates this issue while providing manufacturers a cost-effective machining solution to boot. The Mill 4 Series of indexable shoulder mills is now a proven performer, offering high metal removal rates, excellent tool life, and surface finish that frequently eliminates semi-finishing operations—and in some cases, can even be used as a finishing cutter, reducing reliance on expensive solid carbide end mills.

Kennametal is expanding its game-changing Mill 4 family with a new cutting tool, the Mill 4-11. Designed for smaller machining centers, the Mill 4-11 accommodates 40-taper CAT and BT, HSK50, and similarly-sized spindles. Due to its free-cutting capabilities, it is ideal for successful metal removal in less-than-rigid setups and on light-duty machine tools, multitaskers and live-tool lathes.

Tim Marshall, senior global product manager for indexable milling, said the Mill 4-11 enjoys the same strong insert design as its larger cousin, the Mill 4-15, but is 24 percent shorter and 34 percent narrower. With an 11 mm (0.433 in.) maximum cut length, this addresses the needs of those job shops and manufac-

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"What's unique about it is the step down," said Marshall. "Because of the insert design and precision, there's very little mismatch between passes—for example, using a 63 mm diameter tool (2.48 in.) and our SGE geometry, we were able to achieve less than 8 μ m (0.00003 in.) deviation between successive 6 mm (0.236 in.) deep passes. One of our largest automotive customers completely eliminated a finishing operation on a steel alloy housing because of it, saving them many thousands of dollars annually."

Scott Etling, director of global product management for indexable milling, said the Mill 4-11 platform offers a full complement of grades and geometries. "KCPM40 is our go-to grade for most steel applications and our newest KCSM40 is our first choice in aerospace and medical machining. Of course we have cast iron and aluminum grades, and a variety of edge preps and corner radii up to 1.6 mm (0.062 in.) as well," he added.

The Mill 4-11 is also easy to use. Each insert is securely locked in place with a single M3 screw, and marked with a series of dimples to indicate geometry and insert style. Marshall recom-

mends customers keep the tool clean and the screws lubricated with a small amount of grease, and says it's a good idea to mount all of the inserts with the dimples or markings facing the same direction. "This improves accuracy during indexing, no matter whose cutting tools you're using," he added.

The cutter has uneven pocket spacing designed to break up machine harmonics and reduce chatter. Because of its complex insert geometry and positive placement in the pocket, it has an effective radial rake angle between 1° to 11°, depending on the cutter diameter, and an axial rake angle of 3°, this despite the Mill 4-11's double-sided design.

When taking cuts up to approximately 6.5 mm (0.255 in.) axial engagement, the cutter is essentially "step-less," although Marshall said cuts up to 11 mm deep (0.433 in.) are possible while still maintaining square, smooth walls. Best of all, it removes material quickly. "We've performed extensive testing," Marshall said. "Time and again we beat the competition, in some cases by 35 percent greater metal removal rates and 40 percent or longer tool life. It's quite simply a great addition to our portfolio."

For more information:

Kennametal
Phone: (724) 539-5000
www.kennametal.com



Liebherr

OFFERS NEW TECHNOLOGY FOR INTERNAL GEAR TOOTH PROFILE GRINDING

Liebherr has added a new internal gear tooth profile grinding technology, based on its proven OPAL grinding technology, to its portfolio. This involves a belt-drive spindle, which can be fitted to the standard GH 4.0 grinding head as well as to the new GH 5.0 and GH 6.0 grinding heads. Initially the internal gear grinding arm will be available in two different sizes, while others are to follow shortly. Custom internal gear grinding arms can be developed to match customer workpieces on request.

"The switch over is really simple. Changing between external and internal gears takes a maximum of half an hour," Dr. Hansjörg Geiser, head of the gear cutting machinery development and design engineering team, explains. "You detach the external gear grinding disk or worm, hang the internal gear grinding arm on the hardened stop bars to ensure repeat accuracy and fix it in place with a handful of screws, then tension the belt-drive disk and the belt and attach the cover. Internal gears can then be ground using a grinding disk of 100 or 125 millimeters in diameter—an innovation at Liebherr." The external gear grinding head does not have to be touched, and external gear grinding quality is again the same as before once the internal gear grinding arm has been detached.

IG Opal 4.0 is the name of this innovation that functions at a maximum spindle speed of 12,000 rpm. A larger version, the IG Opal 4.1, featuring a maxi-



mum grinding disk diameter of 125 millimeters, is also already available. Both arms were successfully tested using CBN and corundum disks. Where dressable grinding disks are used, the internal gear grinding arm travels up to the grinding dresser that is also used for external gear grinding.

All internal gear grinding arms are modelled in 3D and can be used in very confined spaces. "Collision inspections are simple and extremely reliable," emphasizes Andreas Mehr, who is responsible for grinding and shaping technology development and consultancy at Liebherr-Verzahntechnik GmbH. "Small-diameter internal gear teeth can therefore also be machined quickly and easily. Colleagues at Liebherr-Aerospace, which uses Liebherr gear cutting

machinery to manufacture their own components, have confirmed this to us." The aerospace engineering specialist is one of three first buyers of this new technology. As in the case of external gears, this new internal gear teeth technology works with a multi-rib grinding disk system that can rough- and finish-grinding. That is particularly important to users, who regard speed and costs as

important, for instance customers from the aerospace industry. Grinding disks made of dressable corundum or electroplated CBN can be used in conjunction with the spindle. These are also manufactured at Liebherr's plant in Ettlingen (Germany).

For more information:

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