When it comes to complete machining, WALDRICH COBURG has been the leader for decades. The different technologies like milling, drilling, turning and grinding are made possible by special spindle units, which are perfectly adjusted to the processing technologies. As a further development we have now integrated gear milling on WALDRICH COBURG machines. So far, only a few manufacturers of special-purpose machines were able to implement this technology.

Gear milling takes naturally more than just a special spindle unit. An essential element is the high-precision rotary table. WALDRICH COBURG produces those in different sizes up to 400 t load. For the technology of gear milling, we optimized the drive train, composed of gear rim and gear drive, with the know how of dimensioning of the mechanical design as well as automatic control technology in the field of large machine building industry. This is the only way to control the large moment of inertia inside of the control loop of the CNC.

Internal gears are used in planetary gearboxes. These are needed in a large quantities especially in wind energy plants.

Big rim gears, as used in ore mills, can have a diameter of 15 meters and more. The weight of the work piece can be up to 250 tonnes.
Milling and hobbing of large external gears

Spindle unit HSPO 1000 and milling ram S2

- Max. Module: M 2S
- Max. Power: 75 kW
- Max. Torque: 7000 Nm
- Nominal Speed: 100 U/min
- Max. Speed: 170 U/min
- Automatic Swivelling: +/- 40 degree
- Inner Coolant Supply: 150 l/min with 15 bar

Milling and hobbing of large external gears

Both spindle units, for internal as well as external gears, are automatically clamped to the ram. During the machining process the Z-axis position remains fixed whilst the feed motion comes from the crossrail. The cross rail is also hydrostatically guided on the columns and is being electronic position controlled via gantry axis, just like the vertical and horizontal axes of all WALDICH COBURG milling rams. This way an extreme high geometrical accuracy is reached, with simultaneously highest stiffness.

Other functions like measuring of gears as well as programming with correspondent operating interfaces point out our high technological level.
First orders
Production system for complete machining of internal gears

The picture shows a highly automated, flexible production system, which is due to go into production in 2011. The system comprises two MultiTurn machining centres each with two rams (M3 and TM2), two automatic tool and spindle unit changers and a common pallet transport system. The hydrostatically table is used in turning or milling mode.

The two machining centres are used for turning, drilling, milling and gear milling operations and therefore subscribe to the „MultiTec“ philosophy. The advantages are obvious:
- Significant reduction in space required compared with four conventional individual machines
- Non-machining times are reduced to a minimum thanks to the smaller number of clamping operations
- The workpieces are produced, more precise and can be manufactured more cost effectively
- Optimum quality and productivity are the primary focus at all times

The workpieces are clamped on a high-precision set-up station. The repeatable positioning accuracy of the pallets on the set-up stations and in the machines is +/- 0.01 mm. This ensures that re-adjustment of the workpieces in the machines is avoided.

The concept allows the gear cutting tools to be changed virtually automatically in order to minimise non-machining times in the machine. This concept was either not implemented up until now on the conventional special machines or only to an partial extent. Each machine is equipped for this purpose with two gear cutting heads (HSPO 700), which are changed automatically. The machine has a position located in the attachment change area, which is used for inspection and for tool presetting of the gear cutters. A clean working area is provided here for operating personnel to fit the tools with new indexable inserts and then checking them.

Manufacturing technology

Because it is equipped with two rams, the machine allows simultaneous turning or simultaneous drilling operations. Both supports work on different contours of the workpiece during turning. The work sequence is synchronised and checked continuously by means of the CNC. The finishing operations are completed on the basis of „in-process“ measurement operations so that the internal and external diameters do not have to be measured manually. The current diameter is calculated following a measuring cut. The tool adjustment required is performed automatically in the CNC and the diameter is then finished turned.

In the case of gear milling, this concept allows helical gears of module size M16 to be produced with a duplex milling cutter (D = 550 mm). In other words, two teeth are premachined in one cut with a milling power of 50 kW and a feed rate of 400 mm/min. The feed rate can be doubled with a form milling cutter for individual parts.

Gantry machines for machining large gear rims

Gantry milling machines with integrated turntables are ideally suited for complete machining of large gear rims. Two such PowerTec gantries will roll out in 2012. The first machine has a clearance width of 7.5m and a 6.5m diameter turntable on which gear rims with a diameter of up to 12m can be machined for extra flexibility. This machine also has a floorplate with a surface area of 6.5 x 13m for machining cubic workpieces. An S2 is used as the milling support. The machine also has an automatic tool and spindle unit changer.

The 6.5m gear rims are clamped with a tightening gear, which supports the clamping device. Apart from the standard cutting heads for general milling, drilling and turning, the machine offers the HSPO 1000 spindle unit for gear milling. Gears up to module 55 can be produced using involute gear cutters and gear hobs.

The second machine is somewhat larger in its dimensions. It has a clearance width of 1m. The turntable has a diameter of 8m and the gear rims can be up to 17.5m in diameter. The floorplate of this machine measures 10 x 0 metres. It also has an automatic tool and spindle unit changer and a similar configuration of spindle units as the HSPO 1000. Because a tightening gear is also used here if required, the maximum turntable load is 400,000 kg.

The advantages of gantry machines for gear production can be summarized as follows:
- Complete machining with turning, drilling, milling and gear milling
- The diameter range of workpieces has no lower limit
- Machining options for all other types of workpieces
- Use of a modern CNC standard machine even for largest gear rims
- Productivity and automation level complies with WALDRICH COBURG standard