Considerable reduction in the time needed for changing workpieces

Automatic centering improves machine use in milling large gears

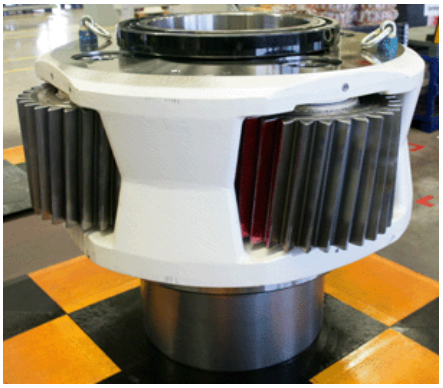
The exploitation of productivity reserves through automating parts handling is a question of the unit numbers involved. These were generally too low for gear wheels for large gearboxes. In partnership with a customer, which produces gears for wind energy converters, Gleason-Pfauter has now succeeded in automating workpiece centering at a plant for milling large gears. Productivity has increased sharply thanks to a considerable reduction in downtime.

"The manufacture of gearboxes for wind turbines has its own very particular challenges", according to Dipl.-Ing. Jeannot Pinkert, Production Manager at Eickhoff Wind Power GmbH in Klipphausen/Germany. The company, which is part of the Drive Technology division of the Gebr. Eickhoff Group in Bochum/Germany, has specialized consistently in the production of gearboxes for wind turbines in the 2.5 MW class. Above all, the utmost reliability is demanded of these gears, which convert the slow revolutions of the rotor by a factor of around 100 to the far higher values of the generator. Repairs or even an exchange at the top of the tower would cost enormous sums - simply to provide the requisite crane would, it is estimated, entail costs of well over € 100,000.00.

The customer requirements of at least 20 years of uninterrupted operation in the harsh environment of a nacelle, where the technology is exposed to violent fluctuations in temperature, extreme humidity and constant vibrations, places the most stringent demands on the quality of the material and the precision with which it is processed. These requirements are made even more exacting by the need to save as much weight as possible, since the weight of the nacelle is a critical factor, which must be kept as low as possible. Additional there is the permanent pressure to cut costs constantly. Only by cutting costs the plant operator can offer a competitive price in an international marked.

Cost reduction is a key factor

"The constant effort to reduce costs is therefore a key requirement of the market", adds J. Pinkert. To satisfy this, every opportunity in gear production more economic must be seized. This starts with construction, where it is an issue of reducing the number of types as far as possible through modularization and the intelligent creation of alternatives despite the vast range of requirements. This is the precondition for manufacturing larger unit numbers and consequently reducing costs. The entire production process must also be examined at every stage and tapped for possible potential savings. This is also true for the manufacture of gears.



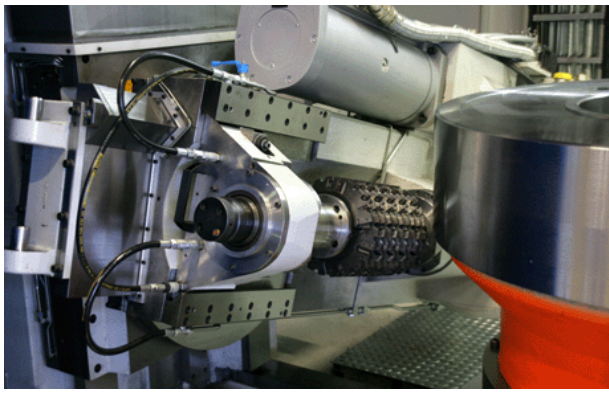
From single piece production…

"As a rule, in the case of large gearboxes, single piece or small batch production predominates", says Dipl.-Ing. (FH) Wolfgang Gross, District Sales Manager at Gleason-Pfauter in Ludwigsburg. The prime reason for this is the fact that large machines or plants and equipment are often custom products, whose characteristics have to be optimized precisely for the area in which they will be used. Of course, this is also true of the gears used therein. These are virtually always specially designed models, which are only produced individually or in very small batches. Naturally, the degree of automation of the workpiece handling of the milling and grinding machines used for the gears is correspondingly low. Not least the dimensions of the workpieces are a major obstacle to automation. Diameters of well over 1,000 mm in some cases and weights of up to several tons often make the manufacture of suitable workholding equipment and fixtures uneconomic. Apart from the substantial capital lockup, their storage would also entail substantial operating logistics expenses.

…with manual clamping….

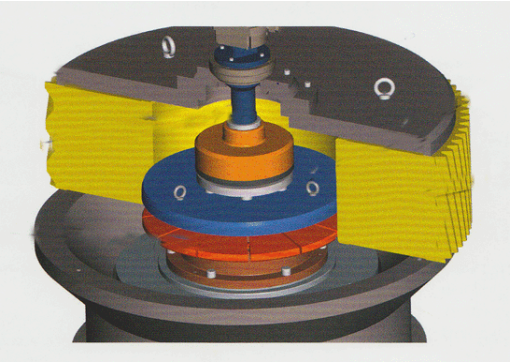
"The process of loading and aligning workpieces in the gear milling machines was therefore equally tedious", explains Christoph Schneider, Head of Construction, Workpiece Changeover Systems and Workholding Equipment at Gleason-Pfauter in Ludwigsburg. The pre-machined blanks for so called bore-type parts – sprockets with an axial through-bore – were previously placed on a special workholdings with the help of a crane and roughly pre-centered there using a centering-ring. The fine alignment was subsequently effected with the help of an aluminum hammer. The time involved amounted needs approx. 30 minutes. This reduced the time the equipment was available by about 20 to 25%. By consistently focusing the plant in Klipphausen on the manufacture of a narrowly defined product range in the multi- MW segment, Eickhoff laid the foundations for the transition to serial production. As a result, it became possible to design individual machines virtually exclusively for the production of specific components.

Automation was adjusted to…



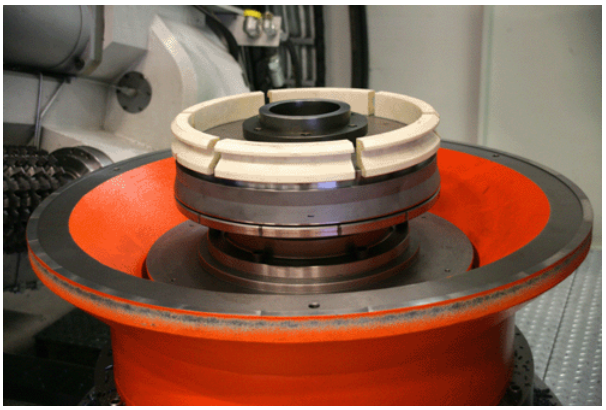
"For us this was a good opportunity to bring a suitable solution to the point where it could be produced in partnership with Eickhoff Wind Power", explains W. Gross happily. This is in line with Gleason's corporate philosophy of not simply depositing equipment with its customers. Rather the company views itself as a partner with a responsibility to provide complete production solutions, which comprise all aspects from machines to tools, workholding equipment and onto questions of logistics and handling. The department in question in Ludwigsburg has already developed numerous clamping solutions for the most varied areas of gear wheel production. These also include the X-Pandisk® concept. This is based on the idea of pre-aligning bore-type parts when placing them on the backing ring and automatically centering them with the requisite precision in the subsequent clamping process. However, developments of this kind can only be carried out together with the customer. The idea is one thing, its implementation in a design that withstands the individual requirements of the various users is quite another.

…practice in partnership



"We realized this when installing the X-Pandisk® solution", remembers C. Schneider. In principle, it's a case here of aligning the workpiece with the requisite final precision, having pre-centered it, by expanding a disk-shaped element (expander). This is effected with the help of the same draw rod, which also operates the clamp plate, which fixes the workpiece in a non-positive way on the backing ring. The crucial "tricks" here include decoupling both movements through an additional spring element in the draw rod. This ensures that the clamp plate only exerts clamping force once the centering is complete.

As expected, according to C. Schneider, it also became apparent with this project that the original design would have to be adjusted to the individual needs of the customer's business. In particular, optimization of the disk arranged above the expanding element, which is responsible for the pre-centering, was required. It became clear here that the strains caused by the reciprocating movement of the blanks, which weigh several tons, were too great when swung in with the crane. This meant that the requisite operational reliability of the design could not be guaranteed sufficiently in the long term. A better solution was found with the participation of both companies. This comprises a multi-stage pre-centering process using additional plastic elements that have been screwed on. These act as shock absorbers on contact with the workpiece because of their elasticity.



A marked increase in productivity

"There were also further detailed improvements such as with regard to the optimal diameter increments between pre-centering and the expanding centering element", remembers J. Pinkert. Everybody was happy with the support provided by Gleason. The introduction and optimization phase following the initial installation took a total of about nine months with interruptions to adapt the equipment at Gleason-Pfauter. The test phase can now be considered as virtually complete. The company aims to stop the runout checks shortly, which were previously carried out with the help of a dial indicator, since it has shown that the requisite accuracy of ± 0.02 mm is safely complied with in the process. With this final step, the downtime for workpieces changeover will be reduced to 1/3 of the previous time. In terms of machine productivity, this equates to an increase of around 20%.