Double-lip boring tool for hard processing by MAS tools&engineering, Leonberg/Germany

SPEEDY©turn gets the Job done quicker - even your Hard Machining

A correctable double-lip cutting edge opens up significant rationalization potential in the hard turning of forged gearwheels: Not only are machining and downtimes drastically reduced—but machining costs as well.

Manufacturers must constantly contend with conflicting demands: There is pressure to reduce costs on the one hand while increasing quality and productivity on the other. The hard processing of gearwheels at John Deere in Mannheim, Germany demonstrates how these issues can be reconciled under one roof. The Speedy-turn boring tool by MAS from Leonberg contributed significantly to this success.

Users of agricultural machinery, particularly tractors, also expect ever greater performance and compact designs (Fig. 1). This means that components such as engines and transmissions must be continuously developed and optimized. Production technology has a vital role to play in this regard. For instance, compact gearwheels can only transfer high output and torque levels reliably over long operating lives if close tolerances and high accuracies are observed. The designers and manufacturing specialists from the Gears and Shafts module at John Deere Werke Mannheim, have engaged intensively with this trend. With a global workforce of 56,600 (as of November 2008), John Deere is one of the largest manufacturers of tractors, agricultural and forestry machinery as well as gardening and property maintenance equipment.

Production of Gearwheels switches to Hard Turning

The optimization of the production of gearwheels overall was a top priority in Mannheim. Rudolf Wolf, who was in

charge of production at the Gears and Shafts module when the Speedy tool was introduced, was quick to recognize the significant technical and economic benefits of hard turning compared with the previous practice of rough turning and grinding (Fig. 2). Therefore, he introduced the procedure in Mannheim and has continu-

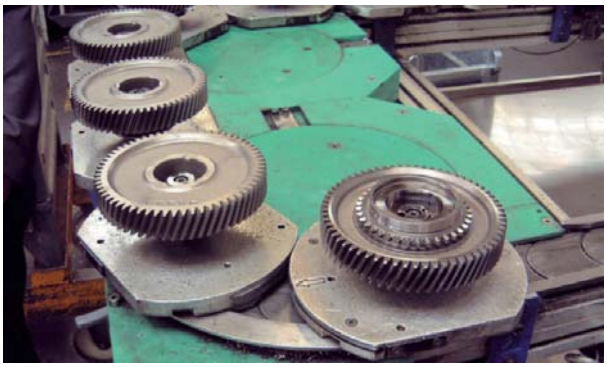

Fig. 2, More precise and more productive: The hard processing of gearwheels (left unprocessed, right processed) enables John Deere to realize significant technical and economic benefits

ously optimized the processes ever since. The improvements spearheaded by him ultimately contributed to a situation where the Mannheim plant leads the way in the John Deere Group thanks to its high productivity and quality.

Despite the economical and highly productive processing systems already in place, the specialists at Deere are constantly seeking to make improvements. With normal hard turning using single-lip tools, even slightly worn cutting edges generate increased antipenetration cutting forces. These lead in turn to dimensional deviations and poor surface quality; consequences of the shortened service lives include unnecessary costs and downtimes. In addition, there is the significant work involved in measuring workpieces and monitoring processes. As Udo Priesnitz, Manager Gears and Shafts Drive Train Factory, explains, this led to the decision to further optimize hard processing.

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In close cooperation with the manufacturing engineers at MAS, and with Laurent Maggiore in particular, Karlheinz Pirlich, tool specialist and planning engineer at John Deere in Mannheim, looked for additional process improvements. Together, they tested the Speedy-turn double-lip boring tool developed by MAS (Fig. 3). In this application, it has two round indexable inserts, whose insert pockets are offset by a few angular degrees on the circumference of the lathe tool—which means that they are not exactly opposite one another across the diameter. Since both cutting edges are located on the circle of rotation diameter, they support the boring tool in the bore. This reduces the tendency to run off center in the bore.

Fig. 3, More productive, more reliable, more economic: In a single production step, two round plates at the circumference bore the hole to finished size, an additional axial indexable insert machines the face on the gearwheels

The key advantage of these tools is their higher productivity. With two cutting edges, it is possible to double the feed of the boring tool compared to the previous single-lip cutting edges. Moreover, the configuration of the cutting

edges enables sensitive correction of the bore diameter in the range of a few micrometers. This can be done using the NC program, which eliminates the need for time-consuming and laborious mechanical adjustments to the tool or the tool holding fixture. The innovative boring tool was originally developed for combined turning and grinding processes for rough-cutting bores in hardened components. In this application, it achieves significantly higher productivity compared with single lip tools.

Hard processing to finished size

At John Deere, the Speedy-turn proved equally suited to hard turning forged gearwheels. The bores are now machined to their finished size using just the boring tool. As Priesnitz confirms, this has yielded vast improvements in productivity in particular. In comparison to single-lip tools, the double-lip boring tools reduce machining times substantially. They also enjoy significantly longer tool lives in terms of the quantity units they produce. For comparative purposes, Priesnitz cites figures such as downtimes reduced by up to 90 percent due to the tool change and up to 60 percent lower costs thanks to the overall reduction in machining times. In the latter case, the reduction is almost 70 percent.

Fig. 4, Impressed with success: Udo Priesnitz (left, Manager Gears and Shafts Drive Train Factory John Deere Werke Mannheim) and Karlheinz Pirlich (tool specialist at the Gears and Shafts module) are impressed with the high quality of hard processing

The long tool lives in terms of the quantity units they produce by the Speedy-turn boring tools can be attributed primarily to the sturdy round indexable inserts, which also help cut costs. If they start to wear, then can be turned by a few angular degrees and refitted, which gives them much longer usable cutting edges. The boring tools also ensure greater process reliability. For instance, it is now sufficient to measure only every twentieth component after boring. Most importantly, the machine operators are impressed with the process reliability. The tools achieve accuracies of ± 5 to 8 µm in the cylindrical shape and diameter of the bore without difficulty. Priesnitz is convinced that Speedy-turn by MAS has significantly improved productivity and quality on the one hand while reducing overall costs on the other.

Tool specialist Pirlich concedes that they had to work through a learning curve before achieving this success. When used for the first time, the double-lip Speedy-turn tools must be adjusted. Due to the completely different geometry and mode of operation of these tools, this required a rethink compared with conventional boring tools. However, John Deere in Mannheim mastered this within a

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