HSG complete grinding of gear shafts in a single clamping with the QUICKPOINT process

Three grinding spindles for complete processing in one clamping, QUICKPOINT-CNC OD grinding, high-speed grinding with CBN and low volume oil coolant for the entire grinding process hallmark a new grinding solution - one which Erwin Junker Maschinenfabrik GmbH has developed for the manufacturers of input, output and gear shafts.

Fig. 1: Finish grinding line for the complete grinding of gear shafts in a single clamping

Since 1985, Junker has caused a furore with its QUICKPOINT CNC OD grinding process, whose point contact method achieves a far higher stock removal than conventional grinding methods. Junker has developed high-speed grinding with CBN into a key area of expertise, which contributes significantly to the company's high-tech reputation. This expertise makes Junker a system supplier of complete finish grinding islands and finish grinding lines to its customers in the automotive sector.

As part of its platform strategy, Junker has developed a CNC swivel wheel head - based on the 3000 series machine bed - with three grinding spindles. This, in combination with the grinding process's low volume oil coolant creates a flexible and economical solution for the complete processing of drive shafts in a single clamping.

The finish grinding lines designed for Opel POWERTRAIN GmbH each comprise two type QUICKPOINT 3000/60 CNC machines. The specified production capacity of each grinding line (comprising two machines) is 60 drive shafts / hour in a single clamping. In one clamping means: all operations are carried out on one machine. The advantages: good coaxiality, improved roundness, cylindricity and roundness. All this is made possible because the QUICKPOINT grinding process requires no work piece driver. According to customer numbers this process is designed to produce 250,000 parts / year for 2 gear shaft types.

Using a gantry loading system integrated into the machine's full protection cover and a conveyor located outside of the machine, the process achieves short retooling times due to the elimination of the work piece driver coupled with the use of CBN technology and a fully-automated grinding operation - highly flexible with a diversity of work pieces and suitable for every batch size.
This machine concept is therefore also highly suitable for matching the evident trend in the automotive industry towards smaller batch sizes.

Fig. 2: Junker OD grinding machine QUICKPOINT 3000/60 CNC with integrated gantry loader and work piece conveyor for the fully-automated high-speed complete grinding of gear shafts in one clamping on one machine

Swivel wheel head for three spindles

The core of the automated grinding process in one clamping is the new CNC swivel wheel head. Its B axis has a resolution of 0.0001° and is free of radial play. Three grinding spindle supports arranged uniformly around its circumference enable collision-free CNC-controlled swivelling of the roller bearing mounting grinding spindles. The swivel movement is powered by a direct drive (torque motor). In the X-axis, the wheel head is hydrostatically guided to be completely stick-slip-free on Junker's typical round guide ways.

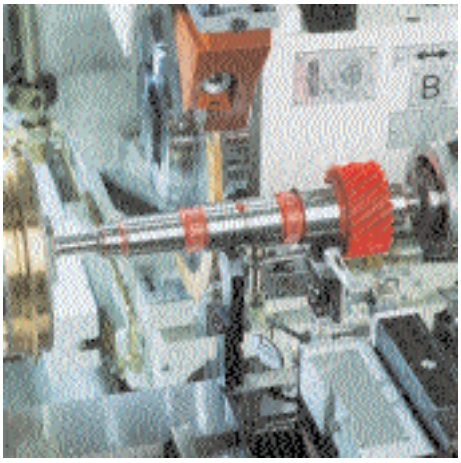


Fig. 3: Grinding spindle 1

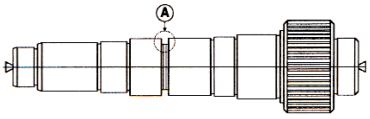


Fig 3a: Operation 1

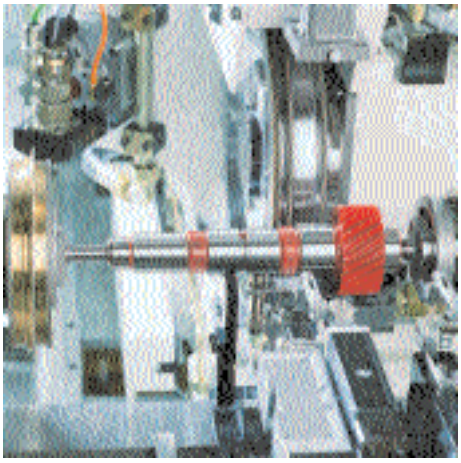


Fig. 4: Grinding spindle 2

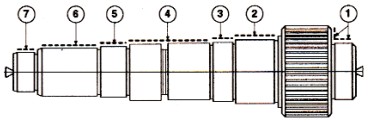


Fig 4a: Operation 2

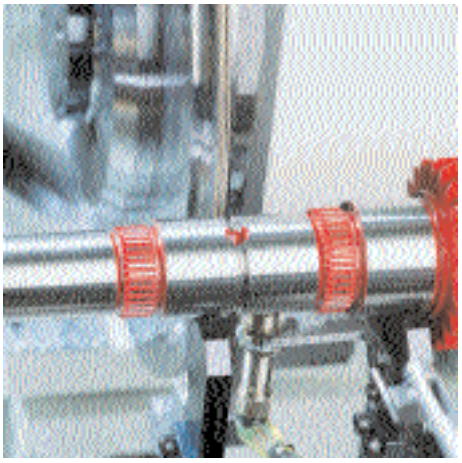


Fig. 5: Grinding spindle 3

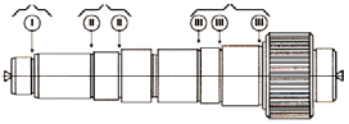
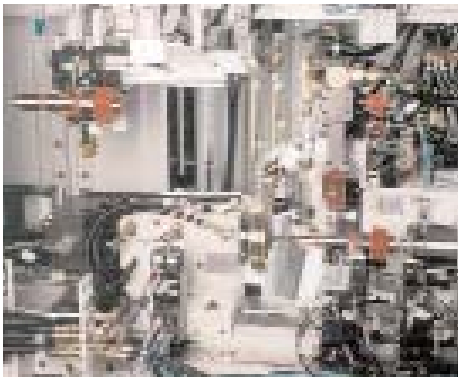


Fig 5a: Operation 3

Each grinding spindle is assigned a CBN grinding wheel according to the specified operation sequence with a grinding body Ø of 350 mm. The coolant nozzle at the outlet opening is engineered to the grinding wheel contour with the narrowest possible distance and can be automatically panned during the dressing operation at the height of the CBN grinding wheel lining. Grinding spindle units featuring integrated frequency-controlled rotary current asynchronous motors are used.

Fig. 6: Grinding cell with integrated loading portal for fast work piece change



Three operation sequences in one clamping

Using a fully-automated process, the machine is loaded and unloaded with pre-turned and hardened 16MnCr5 blanks with 0.25 mm radial and/or 0.15 mm axial stock from the gantry loading system from a conveyor belt located outside the machine.

The highly-flexible Quickpoint high-speed grinding process developed by Junker completely grinds the driveshaft using three grinding spindles, some with multiple-wheels in one clamping over three operations (Figs. 3 - 5). CBN abrasives are used in all operations:

Op. 1: OD and shoulder grinding using Spindle 1
Op. 2: Plunge profile and shoulder grinding using Spindle 2
Op. 3: Snap ring groove grinding using Spindle 3

To date, Junker's specially-developed grinding solution has processed 600 test work pieces to the customer's complete satisfaction. The following qualities were achieved:

Roundness:	0,001 mm
Concentricity:	0,005 mm
Cylindricity:	0,002 mm
Squareness:	0,003 mm
Dimensional tolerance:	0,003 mm
Surface finish Ra:	0,25 µm

With the QUICKPOINT grinding solution, the shaft diameter is guaranteed by a process-oriented measuring method rather than in the process measuring head common to OD grinding in the plunge profile method. This ensures compliance with close production tolerances. Standard positioning systems are employed for the longitudinal positioning of the work piece to the grinding spindle position.

Low volume oil coolant

Minimum oil coolant quantities are used for the grinding operation. In partnership with the Fraunhofer Institute in Aachen, Germany, the grinding process was optimized so that less than the usual oil quantity is required.

The goal of this joint research project was to reduce the coolant periphery (container, cleaning, cooling). This creates benefits in regard to space requirements, investment costs and energy requirements. The outcome - a significantly reduced coolant requirement. Instead of the previous capacity of 200 l/min at 20 bar, less litres / min. at low delivery pressure are now required. The lower coolant pressure achieves space savings and lower energy costs. This results in significantly lower investment and operating costs.

Erwin Junker Maschinenfabrik GmbH
Fon 07838/84-0, Fax 07838/84-302
www.junker-group.com

THE ADVANTAGES AT A GLANCE

- ***Complete grinding to the required work piece geometry in one clamping on one machine***
- ***Grinding without work piece driver***
- ***High flexibility through fast retooling for changed part variations***
- ***Economic grinding for small, medium and large-scale production***
- ***Compliance with close production tolerances and surface finishes in large-scale production through grinding in a single clamping using CBN technology***
- ***High process reliability and machine availability***