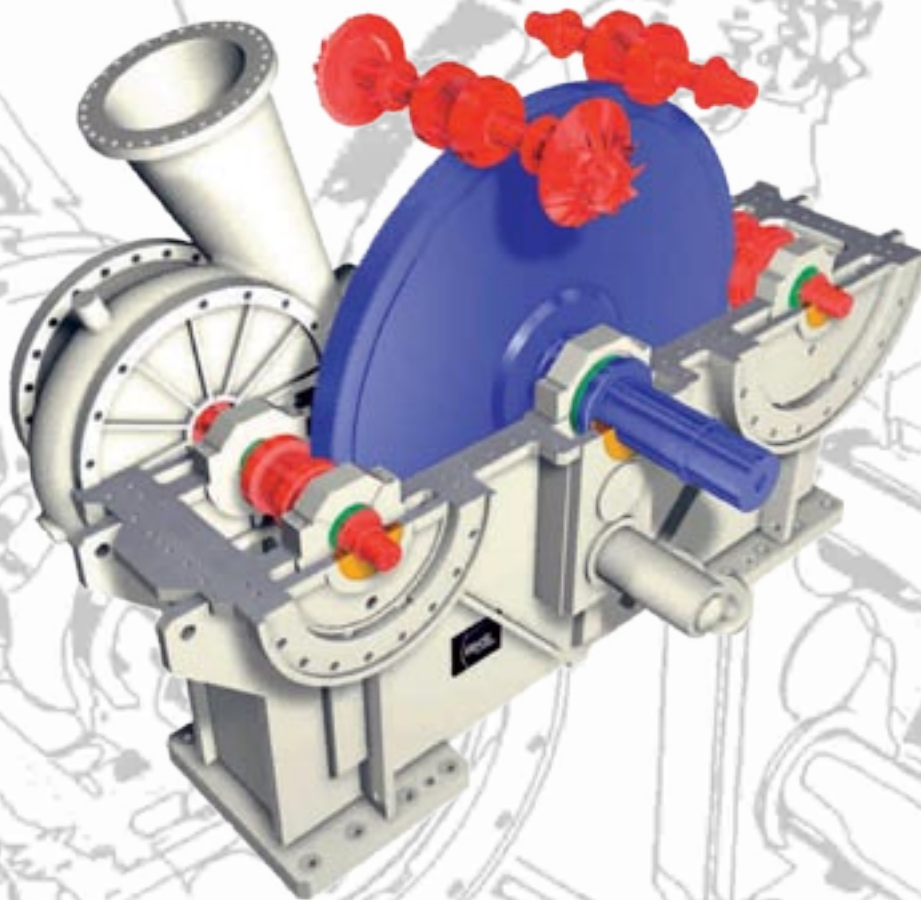


Integral gear unit for use in compressor applications with up to five shafts (ten levels).



Driving Gear with Turbo Action

The Plans of Turbo Gear Unit Manufacturer BHS Getriebe

Lothar Hennauer has a clear vision when it comes to the future of BHS Getriebe GmbH: maintaining the group's independence as a turbo gear unit manufacturer and realising above-average growth rates. In an interview at his company in Sonthofen, the Director revealed what needs to be done to translate the vision into reality.

by Franz Graf

The success story dates back to 1932 when the abbreviated name of the company still stood for "Bayerische Berg-, Hütten- und Salzwerke" [Bavarian Mine, Steel and Salt Works]. The same year also saw the beginning of the gearbox manufacture when the company took over the Stoeckicht licence for epicyclic gear units. "Stoeckicht is synonymous with a design", continued Lothar Hennauer, "which was ahead of its time in terms of its sheer ingenuity. The inventor succeeded - at a time when production quality was still far from sophisticated - in finding an optimum load distribution for the toothing - and did so purely by applying design engineering principles. We are forever constrained to continue develo-

If you enter the German search term "Turbogetriebe" in Google the company BHS Getriebe GmbH appears near the top of the list. This is not especially surprising, given that the Sonthofen-based company with a turnover of over 50 million euros in 2004 regards itself as world market leader in turbo gear units. "We have been the world number one for

many years in the integral gear unit segment", said Lothar Hennauer, the manager responsible for the technical side. "and not just in terms of quantity but also in terms of the number of variants". This year the management team of the Oberallgäu company is anticipating a turnover in excess of 54 million euros, generated by some 300 employees.



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ping the legacy he bequeathed to us." Two further milestones were reached along the road to success based on the Stoeckicht principle taken by BHS Getriebe - namely the takeover of Krupp's gearbox construction arm in 1971 and finally in 1989 the takeover of the gearbox arm for stationary applications of the Heidenheim drive technology firm, Voith Antriebstechnik

With large cost-intensive gearboxes, prototypes for trial purposes are just not feasible

In past years the company has been faced time and again with big challenges and opportunities, such as when business operations were sold off to the American firm "The Cincinnati Gear Company" in 1996 when the Sonthofen BHS works were segmented. At that time the former affiliate retained its characteristic medium-sized structure still prevalent today. Six years later, in 2002, the Munich investment company Equivest GmbH & Co. and the management jointly acquired the shares of the private limited company BHS Cincinnati Getriebetechnik GmbH and changed the company's name to BHS Getriebe GmbH. In the following years some 12 million euros were invested in the firm.

In a secondary buyout in July 2005 the internationally-minded Frankfurt investment consultancy Halder Beteiligungsberatung GmbH acquired from Equivest the Sonthofen gear unit arm which had grown substantially in the interim. Other shareholders include both directors of BHS Getriebe, Dipl.-Kfm. Dieter Groher and Dipl.-Ing. Lothar Hennauer.

"As the trend in recent years has shown, we have gained enormously from the benefits of private equity for the site", concluded Lothar Hennauer. Questioned about safeguards for the future, the graduate engineer replied, "Back in 2000/2001 we spent some time looking at the company's strategic direction, and concentrated in detail on the measures we could take to ensure that the site would remain competitive in the future. It was then that we decided on a clear-cut focus on turbo gear units. This would require financial backing, however, because our production machinery is expensive and, at over 50 per cent, our value-added ratio is relatively high." Needless to say, the bid for global competitiveness is being mirrored in depth on the technical side and, given that BHS is a classic manufacturer

of products with variants, the issue of simulation has been well and truly thrashed out in Sonthofen. Simulation tools allow much more foresight at the planning stage because, with the large cost-intensive gear units of the kind built by BHS, prototypes for trial purposes are just not feasible. Moreover, Hennauer and his team of engineers often have to respond to last-minute changes to product specifications made by the end user. "This calls for good software tools capable of cushioning the impact of modifications."

At this point the graduate engineer acknowledged that a gear unit which would previously have taken them 12 months to develop can now be developed in six months thanks to the smart simulation tools, adding that this, however, is only the tip of the iceberg. Despite the concentration on turbo gear units the product range at BHS Getriebe GmbH is decidedly broad. This is reflected in the number of variants as much as anything else. The production range includes high-performance turbo parallel shaft gear units, integral gear units and epicyclic gear units designed for high-speed and industrial applications. Customers mainly come from large-scale industries, such as chemicals/petrochemicals, oil production, transportation and refining, natural gas gathering, production and

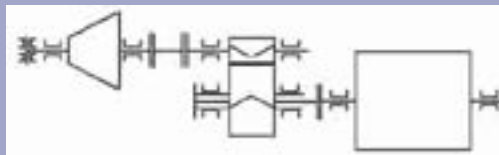
Engineering in the spotlight

Turbo gear unit designs (parallel shaft gearbox)

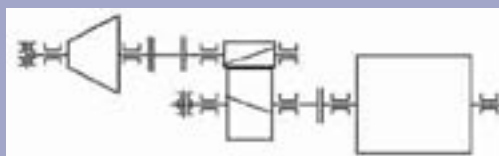
The correct choice of tothing is crucial for a turbo gear unit for reliable torque transmission at pitch line velocities of up to 220 m/s. The teeth characteristics in the gear unit designs illustrated here have proved ideal for optimising the features of the entire system in terms of the prime movers and output machines connected (e.g. steam turbine - generator):

- Double helical gearing
- Single helical gearing
- Single helical gearing with thrust collar

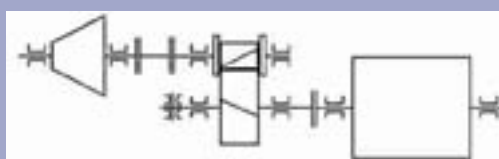
Spur tothing is only used for turbo gear units where requirements are less demanding.



Gear unit design with double helical gearing



Gear unit design with single helical gearing



Gear unit design with single helical gearing and thrust collar

Turbo Gear Units

processing, and power generation. Some of the OEMs featured among BHS's customer base include Atlas Copco Energas, MAN Turbo, General Electric, Siemens PGI, Voith. In most cases gear units are located between the drive assemblies, such as gas turbines, steam turbines and electrical motors, and the driven assemblies, such as generators, compressors and pumps. It goes without saying that BHS Getriebe is also having to grapple with the issue of systems business. "We do claim to be a systems supplier," commented Lothar Hennauer, "and as such our range includes couplings and rotor turning gear units in addition to gear units. These are important components used in the drive train."

Over 150 m/s on the pitch line Here are some statistics aimed at clearing up how big a gear unit made by BHS Getriebe can actually be. To start by allocating the costs to the dimensions: a small gear unit costs between 15,000 and 20,000 euros, so a large unit can reach the million mark. The comparison is facilitated somewhat by looking at the dimensions. While the distance

between axes on the smallest gear unit is 160 mm, the design drawing for large gear units might specify a distance of 3,000 mm between axes.

Rotor turning gear unit with SSS coupling for a free shaft end.




Director Hennauer adds, "You really need to imagine it. There's a three-metre toothed wheel built in a gearbox housing running on turbo principles. At 1,000 revs that's over 150 m/s on the pitch line diameter. Marine gear units can just about reach 25 m/s in comparison".



"I am particularly proud of our integral gear units with large wheel diameters."
Lothar Hennauer,
MD of BHS Getriebe

In terms of performance, the biggest project to date reached an impressive 85 MW, according to Hennauer. As a general rule, this type of gear unit is located between a gas turbine and a generator. The power range in integral gear units extends to 30 MW, with the majority in the 10 to 15 MW range. Likewise, the epicyclic gear units extend to 30 MW, but again most applications are centred around the 5 to 15 MW range. Glowing with pride, Lothar Hennauer referred to an epicyclic gear unit project which involved an output of 31.5 MW and for which a condition monitoring system was used for the first time. "Not only are we supplying classical mechanical engineering," commented the graduate engineer, "but we are offering the end user the additional benefit of the monitoring device". Performance limits breached The aspect of the project which really inspired Hennauer was the fact that the peak power had previously been set at 25 MW for epicyclic gears and, in view of the fact that certain machine elements reach their limits when even greater powers are to be transmitted, this project presented a particularly immense challenge. "We wanted to sound the depths of the performance limits. In this case we did not simply resign ourselves to the vibration characteristics, but we went one step further and simulated the sound radiation of this unit." Equally, another source of pride for the BHS manager is the development in integral gear units with gearwheels of up to 3 m in diameter for high pitch line velocities. The project highlighted quite specifically that the simulation technology used is really bearing fruit, according to the manager, who added that the 42 t jumbo is being used in the bulk chemical industry in China to manufacture PET plastics.

The rise of BHS Getriebe to world market leader in turbo gear units is also closely linked with the capital expenditure over past years. There is a great deal to show for the 12 million euros invested over the last four years, namely a new production planning and control system and CAD system, and gear cutting machines for the manufacture of external and internal toothing. Money has also been poured into restructuring, however, in terms of product line organisation and manufacturing cells in production and assembly. "We have learnt", said Lothar Hennauer, "to distinguish at all times between operations and strategies. When the time came to set up product lines we had to abandon the Taylor school of thought and form a team. Hence certain roles have been integrated in Design and Development which were previously unheard of in that context, such as planning engineer, purchaser or scheduler. Similarly, an Industrial Engineering section has been incorporated in Production where it can work unencumbered by operating tasks. Plainly speaking, Design is integrated in the respective product line and runs the operative business. Development is subdivided into Product Development and Design Analysis and plays a strategic part." Hennauer sums up the plans for the future as follows: "The expansion of the BHS brand, by which I mean Best in High Speed, will be achieved by expanding our core expertise in simulation and production".

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