

Industrial tool convinces with low power-to-weight ratio

Turbine powers innovative angle-grinder

Turbine drive technology saves energy and gives high output power

Sparks fly and the shipbuilding worker perspires under his safety goggles. In his gloved hands he is holding an angle-grinder. With strength and stamina he smooths the bumps on the welded seams that join together the steel plates of the ship's hull. It is a difficult job for man and machine, and it is usually performed in piecework and multi-shift operations. The exhausting load created by the angle-grinder's weight and its vibrations place heavy demands on a man's strength. Any sign of fatigue in the worker has an immediate effect on the result of his work, and thus on productivity. That is why the ratio between weight and power in a tool comes into focus when selecting the right industrial tool. With their incredibly favorable power-to-weight ratio (kW/kg), the innovative turbine angle-grinders, powered by compressed air, score highly here, thus representing a convincing alternative to conventional devices.



For decades compressed air specialist DEPRAG SCHULZ GMBH u. CO has been dedicated to research into and the exploitation of compressed air as a drive system for quality industrial tools. The innovative products that emerge from the DEPRAG ideas mill always attract attention. In 2006, its 75th Jubilee year, DEPRAG once again demonstrated its capability for innovation in its completely redesigned generation of turbine angle-grinders. Since then, under the brand name of DEPRAG INDUSTRIAL, the compressed air tool specialist has extended the range of innovative turbine angle-grinders to include seven different types of tool.

The success story in compressed air tools began in the 19th century in the tunnelling and mining industries. In a potentially explosive atmosphere, where a single spark can have a dramatic effect, electrically-powered tools could not be deployed without risk, while compressed air tools could. Another advantage is that air-powered tools are 30 to 50 per cent lighter than their electrical counterparts. They cause less stress on the worker and productivity goes up.

Nowadays efforts in the sector are principally turned towards improving the efficiency of pneumatic motors. And it is at this extremely topical moment that the turbine angle-grinder has been developed. This is because the turbine is a fluid dynamics machine which exploits compressed air expansion characteristics to a very high efficiency level. It means that a turbo-driven grinder requires less air compared with a vane motor driven grinder with the same power. The balance of energy is just right.



The power-weight ratio (kW/kg) comes to just half of that of an air vane motor. Robert Pesold, design engineer at DEPRAG stressed: "Everything speaks in favor of a turbine drive over an electrical grinding machine. A comparable electric grinder with an output of 2 kW weighs in at a whopping 6.6 kg, while the turbine angle-grinder, with a higher output of 2.2 kW, weighs just 2 kg. The new 4.5 kW output DEPRAG turbine angle-grinder tips the scales at just 4 kg. Both power classes of DEPRAG turbine grinders achieve an unbeatable power-weight ratio of 1:1!"

DEPRAG turbine angle-grinders are in demand anywhere where robust high-performance grinders are used to roughen, cut and smooth cast iron, steel, stones and non-ferrous metals of every type. The turbine angle-grinder cuts through steel profiles "like butter". The innovative turbine work tools are ideally suited for all kinds of work in steel and tank construction, mechanical engineering works, foundries, shipyards and reinforced concrete construction.

A new addition to the range is an angle-grinder with a no-load speed of 10,000 rpm for roughing and cutting discs in diameters up to 150 mm. The existing 2.2 kw power machine for a 125 mm disc diameter is now also available for disc diameters of 115 and 180 mm.

Another new addition is the 4.5 kW grade product line, available in three different speed ranges. They can operate with 180 mm and 230 mm diameter grinding and cutting discs as well as with 150 mm diameter conical cup wheels.

In developing an expansion turbine the engineers at DEPRAG were themselves treading completely new ground. Their success came only with the exemplary and close collaboration between the University of Applied Sciences at Amberg-Weiden and DEPRAG. Professor A. P. Weiß, lecturer in turbo machines and fluid dynamics, who headed the calculation and turbo-design work for the Curtis turbine to be deployed in air-powered tools for the first time anywhere in the world. Multi-level reaction turbines are complex in structure and expensive, while single-level constant pressure turbines are not efficient enough to process the associated pressure gradients. For these reasons the engineers selected the double row structure of a Curtis turbine - developed originally for steam turbine construction. The design calculations were verified and confirmed in CFD (computational fluid dynamics) flow simulations. A test rig for compressed air drives and compressed air technology was constructed especially for the purpose at the Amberg-Weiden University of Applied Sciences making it possible to carry out tests on high-speed turbines in this performance class.



In principle the torque/speed behaviour of a turbine does not differ from that of a conventional air vane motor. In the case of unregulated air motors, depending on the external load, the torque increases linearly from no-load speed to standstill. As a consequence maximum power is half of the no-load speed (nominal speed). Glass-fibre reinforced high-performance grinding discs have a maximum permitted circumferential speed of 80 m/s. To achieve the optimum removal rate on the workpiece, it is advisable also to operate the grinding disc at this circumferential speed.

This is not immediately possible for unregulated compressed air drives, because maximum power is achieved only at half the no-load speed. Conversely, exceeding the speed of 80 m/s can result in disc rupture due to centrifugal force. In practice this problem has been solved by installing a speed regulator.

The centrifugal force regulator principle has proved itself particularly well in that small changes in speed have a relatively large effect in changing the power. Since the compressed air quantity is reduced the no-load speed and the circumferential speed is restricted in a stable way, regardless of the air pressure. Design engineer Robert Pesold highlighted an additional welcome side effect: "A positive feature is that, at idling speed air consumption by the tool is over 50% less. Air consumption by the 2.2 kW turbine grinder when idling is a mere 0.7 m³/min and the 4.5 kW tool consumes just 1.2 m³/min. And consumption rates under load also look good: The

2.2 kW machine consumes 1.8 m³/min and the more powerful 4.5 kW grinder uses only 3.6 m³/m under load. Robert Pesold explained: "Energy efficiency is one of the major advantages of turbine angle-grinders in constant daily industrial use.

Turbines "live" off high speeds. So when we were designing this innovative turbine angle-grinder we realised that we needed a gear to deal with the required reduction ratio. We developed a completely new oil-lubricated, encapsulated and fast-running planetary gear with a downstream bevel gear, and optimised it for mechanical efficiency and lubrication. The maximum cutting depth for pipe cutting and profiles is 40 mm in the case of a 125 mm disc. This greatly increases the device's flexibility and economic efficiency.

The innovative DEPRAG angle-grinder does not good energy efficiency and ratio: DEPRAG designs attention on users' needs handling. In the everyday work the vibration created particularly stressful for DEPRAG angle-grinder an vibrations and enables ergonomic handles are and can be adjusted to tool can be restructured



INDUSTRIAL turbine only score points for its optimum power-weight also always focus for safe and comfortable harshness of industrial by the grinding process is operators. In the auto-balancer reduces fatigue-free working. The also vibration-resistant any desired position. The quickly and easily to suit

left-handed workers. The protective hood setting can be adjusted to the grinding job in hand, without the need for a tool, and the exhaust line is also adjustable. Changing the rough-cut or grinding disc is performed lightning fast at the press of a button and a spindle lock. The turbine angle-grinder is highly suitable for continuous duty operation; turbine drives have no wearing parts and the machine is extremely low-maintenance. Changing the gear oil too is very easy for any user to do with a simple oil drain and filling plug.

Particular attention has been paid to work safety. The safety valve on the right handle prevents the grinder from starting accidentally, and with its two-stage opening stroke, ensures low actuation forces; once released, it automatically reverts to the off position ("dead man's switch"). An integral, redundant operation emergency-off switch stops the machine if the

centrifugal force regulator fails, so that the worker and the environment are not at risk from rupturing grinding discs.

Design engineer Robert Pesold explained: "It's not just the energy-efficient turbine technology, but also the many other carefully thought out features and many competitive advantages that make the turbine angle-grinder the innovative industrial tool that it is."

DEPRAG SCHULZ GMBH u. CO. has its headquarters at Amberg in Germany. The company has more than 600 employees in more than 50 countries. As well as the compressed air tools division, its core skills also screwdriver technology, automation, air motors and Green Energy Technology.

For more technical specifications, please use the following [LINK](#) to view a product catalog.

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