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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 smoothes 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 usually performed in piecework and multi-shift operation. 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. 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 nine different types of tool.

DEPRAG Turbine Grinder used in a Foundry

The success story in compressed air tools began in the 19th century in the tunneling and mining industries. In a potentially explosive atmosphere, where a single spark can have a dramatic effect, electrically-powered tools cannot be deployed without risk, while compressed air tools can. 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.

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The power-weight ratio (kW/kg) comes to just half of that of an air vane motor. And Robert Pesold, design engineer at DEPRAG stressed: "Much 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 2.6 kW, weighs only 2.2 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 thus achieve a power-weight ratio of over 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 2.6 kW and a no-load speed of 8,500 rpm for roughing and cutting discs in diameters up to 180 mm. The existing 2.2 kW power machine is available for disc diameters of 115, 125 and 150 mm.

Grinder equipped with a cup wheel

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.

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In principle the torque/speed behavior 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-fiber 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 thus 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 grinders when idling is a mere 0.56 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 2 m³/min and the more powerful 4.5 kW grinder uses only 3.3 m³/m under load." Robert Pesold explained:""Energy efficiency is one of the major advantages of turbine angle-grinders in constant daily industrial use."

DEPRAG Turbine Angle Grinder

Turbines "live" off high speeds. So when we were designing this innovative turbine angle-grinder we realized that we needed a gear to deal with the required reduction ratio. We developed a completely new oil-lubricated, encapsulated and fast-running high-powered bevel gear. The maximum cutting depth for pipe cutting and profiles is 38.5 mm in the case of a 125 mm disc. This greatly increases the device's flexibility and economic efficiency.

The innovative DEPRAG INDUSTRIAL turbine angle-grinder does not only score points for its good energy efficiency and optimum power-weight ratio: DEPRAG designs also always focus attention on users' needs for safe and comfortable handling. In the everyday harshness of industrial work the vibration created by the grinding process is particularly stressful for operators. In the DEPRAG angle-grinder an auto-balancer reduces vibrations and enables fatigue-free working. The ergonomic handles are also vibration-resistant and can comfortably be adjusted in two rotary axes to any desired position. The main handle can be rotated in 90° increments. The tool can be restructured quickly and easily to suit left-handed workers.

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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 main 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").

DEPRAG Turbine Drill

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."

Additional Turbine tools now also include a heavy-duty Turbine Drill Model No. DPT 450-011BXOEX with a capacity of 42-mm (1.650") and a speed of 1,100 rpm; this tool is particularly designed for the use in explosion hazardous environments. Another turbine operated tool is the DEPRAG-Industrial Polisher Model No. PAT 220-085BX, which can be mounted with an up to 7-inch disk and runs at the high speed of 8,500 rpm.

DEPRAG Turbine Polisher

Please read more about our Turbine operated products:

Grinders - Catalog Link

Drills - Catalog Link

Polishers - Catalog Link

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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.

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