Cutting chip-to-chip time saves money in tenths of a second

Hydraulic tool release makes machine tools more productive

Although the tool change takes only a few seconds, the machine is unproductive during that time. The shorter the changing operation, the lower the processing costs. High power, low pressure loss and flexible arrangement within the system are only some advantages of the special blocks for tool release made by HAWE Hydraulik. They can significantly cut the chip-to-chip time.
In machining centers, dozens of tools perform the job of turning a block of steel into a workpiece in double-quick time. For machining jobs, CNC-driven systems make use of planer-type milling machines, groove milling cutters, spherical cutters, boring machines and thread cutters, for example.

Rough turning, smoothing, drilling holes, applying threads and finishing often require repeated changes of tools within a minute: the spindle moves to the changeover position, the tension on the tool is released, and a changer arm collects the tool from the spindle while simultaneously fetching the next tool from the magazine and changes them over. The new tool is tightened into place and the spindle returns to the processing position.

This procedure takes just a few seconds, but for the duration, the machine is unproductive, and time is money. The faster the changeover, the lower the processing costs. Releasing the tool is an important part of the changeover process. It’s therefore worthwhile taking a closer look at the technical process involved.

What are the benefits of a hydraulic tool release?

The tools are tightly tensioned using hollow shank tapers with a spring washer set. The force needed to release the tool has to overcome both the spring force and the self-locking action of the taper lock. This can be done by either pneumatic or hydraulic means, although the hydraulic method offers major advantages: much higher pressure is available, which means the active areas used in applying the releasing pressure can be made smaller. This minimizes the amount of medium required to perform the loosening action. That’s why many manufacturers of machining centers are replacing pneumatic release systems with hydraulic options, even in more basic machines. The performance of machine tools is also assessed on the basis of “chip-to-chip time,” or the time between the end of processing using the first tool (the last “chip”) and the first action by the new tool (the next “chip”). State-of-the-art machining centers can achieve chip-to-chip times of between one and two seconds.

How can losses be avoided?

The optimized hydraulic system provides a large flow rate with the corresponding pressure in a very short timeframe and avoids pressure losses. So how can this be implemented? A hydraulic accumulator is ideal when it comes to making a large flow rate directly available. One advantage is that no major pump capacity is needed to fill the accumulator, since this happens while the machine is processing the workpieces. The hydraulic accumulator must be fitted as close to the spindle as possible, and the valve block and pipes must be structured to ensure that pressure losses are kept to a minimum.

Valve blocks from HAWE Hydraulik can be positioned close to the spindle. The hydraulic accumulator is fitted directly to the block, to ensure that the required hydraulic volume is available directly. The block can also be equipped with a pressure switch that monitors the release process and also the clamping process if necessary. The blocks are available in various sizes – the largest allows for a flow rate of over 60 l/min. Valve spools eke out the last hundredth of a second. It is possible to overexcite the valve spools, which reduces the switching time of the valves. This can further reduce the time taken to release the tool by up to 50 ms.

HAWE Hydraulik valve blocks in three different sizes for the “tool release” function with hydraulic accumulator and pressure switch.
How much money can be saved using this system?

To provide a simple calculation: in a machining center that operates 20 hours a day, with an average of three tool changes per minute, the “tool release” function will be activated 3,600 times each day. If an improved hydraulic release function can reduce the “chip-to-chip” time by 1/10 second, that’s a saving of six minutes per day. At an hourly rate of €90, that’s €9 every day, or more than €2,000 per year!

Since the hydraulic power pack provides the power, the hydraulic unit does not need to be particularly high-powered, and electric power consumption and physical size can be reduced accordingly. Thanks to its compact dimensions the power pack can be accommodated anywhere in the machine, and there are no line losses to the valve block with the accumulator that could affect the performance of the release function. The hydraulic power pack can also perform many other functions, for example clamping of axes or workpieces, or actuating the pallet changer. Hawe’s compact power packs with seated valve systems are ideally suited to all these tasks.
HAWE Hydraulik SE is a responsible development partner with application expertise and experience in more than 70 branches of mechanical engineering. The product range includes hydraulic power units, fixed and variable displacement pumps, valves, sensors and accessories. Electronic components that are exactly attuned to the hydraulic components provide an easy initial operation, precise control and condition monitoring. The intelligent system solutions reduce energy consumption and operating costs. Compact drives save space and allow an innovative machine design. Around 1,950 employees in 16 countries and more than 30 distributors worldwide support the customers locally, professionally and personally.

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