

Producing multiple heads requires automation

Assembling cylinder head components. For Liebherr Machines Bulle, Insys has developed an assembly cell that for lights-out production of up to fourteen cylinder head types. Schunk gripping system components are used for handling the parts and positioning the cylinder heads.



In the nitrogen bath, valve guides and seats are handled by two PGN-plus universal grippers. (Photos: Schunk)

Liebherr Machines Bulle have been expanding distribution of motors since 2007. In the process, they have also been added to their product selection. More and more customers are requesting customized adjustments to their once standard equipment, resulting in a wider variety of cylinder heads, among other things.

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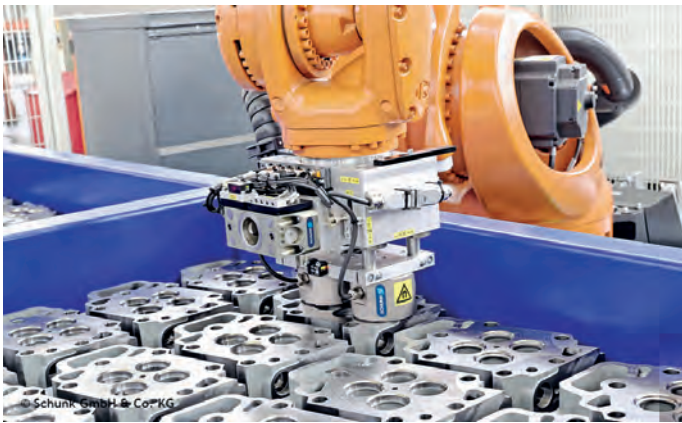
The manual labor, the ergonomic strain on the workers, the potential hazards involved in handling liquid nitrogen and the urgent staff shortage in other areas of production - everything pointed to a fully automated solution. "Our goal is to take operations that are always identical and automate them," explains Project Engineer Sebastien Bussard. "What this means for automation is that we need more and more flexible solutions that we can then expand individually and that allow us to parameterize new types ourselves." The program already includes fourteen cylinder heads, and that number is expected to rise.

In response, Insys Industriesysteme in Münsingen has developed a robot cell capable of fitting fourteen cylinder head types with valve guides and valve seat rings fully automatically from start to finish.

All the operator has to do is place the cylinder heads on pallets and scan the job order. The system takes care of the rest. The robot depalletizes the cylinder heads one by one by, places them on workpiece carrier pallets and passes them on to a pressing station. An additional robot is responsible for infeeding the valve guide and seats after they've been cooled to minus 200 degrees Celsius. It takes the parts out of a cooling system and deposits them precisely in the cylinder head, where various pressing tools are used to press them in, applying up to a ton of force. There are eight parts to install per cylinder head, sometimes from one side, sometimes from both, requiring the cylinder head to be rotated. Finally, the fully assembled cylinder head is taken off the workpiece carrier pallet and set down. The cycle time for a complete cycle is 15 percent shorter than the time previously required by Liebherr.

According to Urs Künzi, Application Engineer and project manager at Insys, the biggest challenge was the wide variety of parts. "To reproduce the variety of parts, we mainly used the automation. To handle the different infeed parts, which vary in diameter from 40 to 50 millimeters, we went with a single set of jaws, so no clamping chuck changes at all." Thanks to Schunk-PGN-plus universal grippers with multi-tooth guidance, the process is highly reliable. The continuous temperature variations are no problem for the parallel grippers, as the cold disperses quickly across the wide surfaces of the gripper fingers.

When it came to handling the cylinder heads, Insys went with a two-stage concept. We start with two Schunk EGM magnet grippers, used for palletizing and depalletizing the different cylinder head types, which weigh between 20 and 25 kg. Then, the cylinder



Using the two EGM magnet grippers, the robot depalletizes the cylinder heads.
(Photos: Schunk)

heads are placed on type-specific workpiece carrier pallets, and the NSR-A robot coupling feeds them into the pressing station.

Why use this two-stage handling method? The tightly packed components cannot be accessed from the outside for depalletization. And the boreholes of the cylinder heads are also off limits to the gripper fingers. Ultimately, they decided on two EGM-M magnet grippers with a pole face of 50 mm², positioned so as to leave the sensitive boreholes of the cylinder heads open. The medium size is already designed for payloads of up to 32 kg. Since the magnet face extends all the way to the outer edge, there is no interference contour to worry about. The grippers can be positioned on the workpieces however necessary and can be combined flexibly into larger units. EGM series magnet grippers work with energy efficient permanent electromagnets. All they need is 300 milliseconds of current to activate and deactivate them. Other than that, no power supply is needed. The grippers hold the parts reliably, even in the event of an emergency stop or sudden power failure.

As soon as it is depalletized, the cylindrical head is gripped by the magnet gripper. With the help of a camera, it is placed on an individual workpiece carrier pallet, which has already been taken out of a carrier pallet magazine. The carrier pallet is attached to the robot by an NSR-A robot coupling and guided to the pressing station. The compact robot coupling, which allows for flexible and reliable parts handling, has already proven itself in Liebherr machine tools where carrier pallets are placed on the Vero-S zero-point clamping system for processing.

In the pressing station, Insys takes things one step further. Instead of first being clamped in the zero-point clamping system, the cylinder heads are positioned and fixed in place exclusively by the robot throughout the entire process. "The robot coupling is extremely stable and precise," notes Urs Künzi. "And

it has to be, because it takes a lot of precision to press in the valve guides and seats. This coupling lets us manage with just a small space and remove the parts selection at any time," explains Künzi.

The NSR-A quick-change module allows the robot to manoeuvre directly at the assembly/machine table. With a net weight of just 1.6 kg (size 160,) the NSR-A is an extremely rigid system generating a locking force of 14,000 N. It reliably handles pallets weighing up to 350 kg (measuring 400 by 400 mm.) The secret to managing these large dimensions is a locking system developed by Schunk with a patented fast and clamping stroke. The system is self-locking and creates a form-fit connection.

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