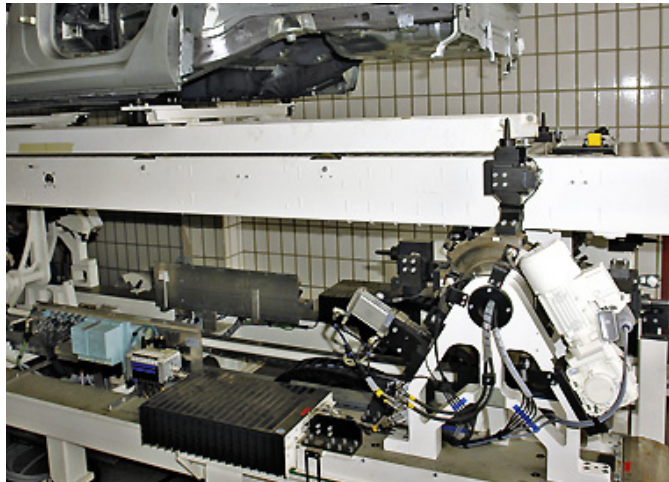


Keeping vehicle body shells on the move

Detail work on drive system during the development of a lift/drop conveyor for vehicle body shells leads to astonishing results

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Taking a lift/drop conveyor as an example, Remech Systemtechnik GmbH has demonstrated the advantages of modern drive technology: Further benefits can be exploited in the transport of body shells in automobile production using a new, distributed overall solution consisting of fail-safe frequency inverters with energy recovery and positioning functions together with highly efficient geared motors. As the project manager responsible for the program, Dipl.-Ing. Hartmut Martin, summed up as follows: "Our detail work paid off."



"Making body shell production more flexible while saving on transport times and energy is a hot topic in the automotive industry," says Dipl.-Ing. Hartmut Martin, project manager at Remech Systemtechnik GmbH, a Siemens subsidiary in Saalfeld in Thuringia. The company employs around 100 people and specializes in mechatronic system solutions for the automotive industry. The company has developed a lift/drop conveyor for internal conveyor systems in body shell production. It has been designed for payloads up to 1,000 kg and features a number of technical refinements.

For example, it has the versatility to alternate between up to four different types of body shell. The required multi-PSE clamping system with the corresponding arbors for precise positioning of the components is situated, for example, on four turrets at the corners of the lift/drop conveyor's clamping benches. These are positioned for each vehicle model using Siemens Simogear B29 geared motors with a power rating of 0.25 kW each. They are started with the aid of distributed ET200pro motor starters from the same manufacturer.

Hartmut Martin explains: "The high degree of accuracy in positioning afforded by our technology and the high speeds in all the motion profiles have led to a situation where our conveyor system is no longer comparable with solutions we know from the past." Thanks to his decades of experience in maintenance and the project business, he knows just how important innovative details can be: "As is so often the case, it is the small details in a solution that make it particularly smart and efficient."

The benefits and refinements are in the detail

The new lift/drop conveyor from Thuringia also boasts such details. In addition to the turret positioning drives described above, these include the drive technology behind the lifting and linear motion. For example, an energy-efficient Simogear Z39 geared motor is responsible for the linear motion of the skid. The motor is driven by a distributed Sinamics G120D frequency inverter. Hartmut Martin explains a vital aspect: "The skid is held in place by friction and moved horizontally. It may not slip out of position, which is why the acceleration and deceleration cycles make exacting demands on the drive system."

Within a typical cycle interval, the skid is accelerated from six to seven meters up to a maximum speed of up to around 180 m/min. This saves time which is needed in the actual overall work cycle. As a rule, the cycle time at one station should not exceed 60 seconds for vehicles that are produced in large numbers. That leaves a maximum of eight to twelve seconds for the change of cycle – that is to say, the time it takes the skid to reach the next workstation. That is why the G120D PN F frequency inverter with a rated power of three kW accelerates the two-stage geared motor to maximum speed and, gently and in a

controlled fashion, slows it down via a ramp when the positioning pin position has been reached.

Again, details play a vital role. In contrast to other solutions, a two-stage gearbox in the geared motor is sufficient for the job, saving up to two percent of the energy required for a solution with a three-stage gearbox. What is more, the frequency inverter is able to feed the braking energy required for the deceleration back into the grid, thereby keeping it in the system.

Energy-efficient dynamic lifting motion

The energy efficiency during the lifting motion, which covers standard distances of 600 and 800 mm, is particularly impressive. Corresponding tests in the factory of an automobile manufacturer clearly showed that energy savings of up to 40 percent are possible with this coordinated drive solution from Siemens. A look at the details revealed the following: the power requirement per cycle is 3.5 Wh, the power output is 1.4 Wh, the actual power consumption is therefore 2.1 Wh.

It has been calculated that, thanks to the energy recovery capability, such an energy-efficient conveyor system can save around 75 MWh based on annual production with 124 lift/drop conveyors, each with a total cycle time of 58 seconds operating on 250 days of the year. As project manager Martin comments: "The sums that accumulate show just how worthwhile it can be to examine the details."

The lifting and lowering motion accounts for around 5.4 seconds of the total cycle time. The load torque is at a maximum at the bottom dead center but the greatest effort only needs to be expended for around 10 ms. Energy is recovered as described above in the top dead center as well as during a large part of the lowering procedure.

Service-friendly, low-cost all-round solution

The design of the lift/drop conveyor from Thuringia is based on an eccentric lever with a push-pull connecting rod. The advantages over other solutions are the service-friendly and low-cost design as well as the very dynamic movements that can be realized with the equipment. However, all this would not be possible without a drive system that delivers the required performance. Further benefits of the 7.5 kW Sinamics G120D frequency inverter are that it takes up little space and that the purchase price is 30 percent lower than that of the previously used product from Siemens' competitor.

The lift/drop conveyor is driven by a size D148 geared motor. At 87 Hz and in combination with the two-stage gearbox, the drive delivers an output torque of 5,520 Nm and a speed of around 16 rpm. "The interesting thing about Siemens' new range of geared motors is that, in addition to the high level of efficiency and the compact, energy-efficient design, the dimensions of the connections are the same as those normally found on the market," mentions Hartmut Martin. What is more, as in all other types of plant, users can choose exactly the right product for their needs thanks to the small increments in performance categories and the choice of grey cast or aluminum housings.

Distributed frequency inverters with safety integrated

An absolute encoder situated on the motor shaft of the gear unit ensures the exact positioning of the lifting unit. The encoder transmits displacement signals to the frequency inverter. Remech Systemtechnik reported that the procedure could be repeated with an accuracy of ± 1 mm, a result which met the requirements demanded by the company. Such a solution is particularly practical in the rugged conditions that prevail in the processing of car body shells.

As Hartmut Martin stressed: "This positioning capability is a further highlight of the Sinamics frequency inverter alongside its ability to feed energy back into the grid." Here, it is also worth mentioning a further special feature - the integrated safety functionality. The automation specialist confirmed that such functionality currently cannot be found elsewhere in distributed solutions comparable to the one applied in this project. The devices can realize different safety scenarios for different applications. The project engineer emphasized that, once again, the detail work done by the equipment developers was of tremendous importance. "The emergency stop ramps that we program for our lift/drop conveyors are

incredibly demanding."

Integrated safety functions promote reliability and plant safety

With safety functions already installed, there is no need for additional circuits for fail-safe operation of the drive system. That saves engineering time, space and wiring work and, last but not least, also cuts down on maintenance in the plant. Additional possibilities arise in connection with the Profinet system used in the equipment: The distributed frequency inverters with positioning capability also support the so-called shared device functionality. This means the devices could be operated by a normal PLC controller for all control functions and by a separate safety controller for the safety functions.

However, Remech has both – standard automation and safety system – on the same fail-safe controller (here: Simatic S7-319F 3PN/DP from Siemens). The Media Redundancy Protocol (MRP) supported by the Sinamics G120D basic positioner delivers additional reliability and availability as it can be used to realize redundant Profinet communication in a ring topology. In other words: if one communication channel in the ring is interrupted or defective, data is exchanged in the opposite direction.

"Symbiosis" leads to energy efficiency, enhanced performance, safety and flexibility

With its love of detail described here, Remech Systemtechnik GmbH has developed a highly dynamic lift/drop conveyor that offers its customers numerous technical and economic benefits. Its energy efficiency is a particularly cost-effective aspect, realized here by straightforward energy recovery in Siemens' Sinamics G120D frequency inverters.

When combined with the new Simogear geared motors from the same manufacturer, whose connection dimensions are the same as those of most others available on the market, the result is coordinated drive units that can be ideally integrated into machinery and plant designs. They assist users in developing designs optimized to suit the task in hand.

With the new lift/drop conveyor - which can be raised up to 870 mm via an eccentric lever with connecting rod - it is possible to save a great deal of energy during horizontal travel and the lift/lower procedure. Highly accurate positioning can also be realized with the distributed frequency inverters - a fact proved by the gentle transfer of components with a motor speed of almost zero. Safety is also an integral part of the drives, a benefit which simplifies engineering and increases reliability. As far as project manager Martin is concerned, the love of detail he shares with his project team has once again been justified: "High-tech components are the best prerequisite for sophisticated overall solutions."

Thanks to the high degree of accuracy in positioning combined with the dynamic turret fixed point mount, the conveyor has the flexibility to alternate between four different types of body shell.