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Servos across the board

Wire-rolling machines and traversing arms driven by servomotors

The dynamic performance of wire-rolling machines is increased and at the same time they can be very easily adjusted and changed over by using servomotors instead of stepping motors on all of the adjusting axes. Further, this new philosophy allows, for the first time, integrated and even more efficient remote diagnostics and maintenance down to each individual drive. As a consequence, the availability of machines can be simply maintained at a high level no matter where they are located in the world. An innovative motion controller for the traversing arm ensures optimum behaviour and results.

Cold and hot wire forming has been the speciality of Karl Fuhr GmbH & Co. KG from Horn-Bad Meinberg in Lippe (North Rhine-Westphalia), Germany since 1946. The core competencies of the company include the development, production (with a high level of vertical integration), installation and commissioning of complex rolling systems and individual units – such as trailing roll equipment, pay-off equipment and coiling machines.

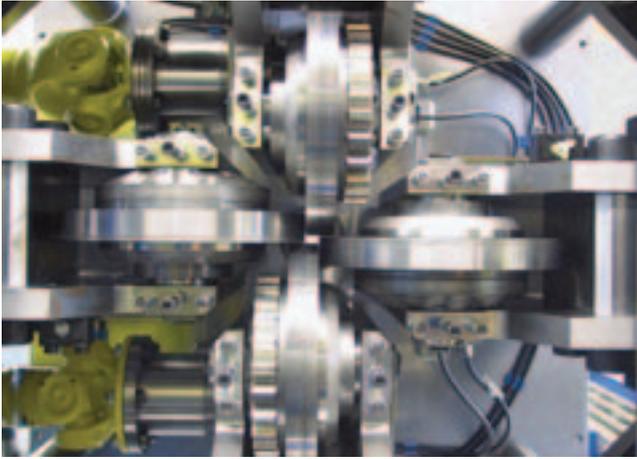
The business is strongly export oriented: Approximately 80% of the production leaves Germany – and a predominant percentage of this goes to the US and Japan. Leading companies in the automobile, electrical, foodstuff, textile and building industries worldwide produce shaped, flat and round wires from stainless steels as well as ferrous

and non-ferrous metals using rolling technology from Fuhr. These companies process these materials to produce the widest range of products – from HSS saw blades for belt and fret saws, through transformer windings up to piston rings for the automobile industry.

Wired for innovation

In principle, all of these products could be manufactured using one and the same rolling system. This is because flexibility is one of Fuhr's most important development goals in addition to precision and cost-effectiveness. The company repeatedly achieves the most decisive lead by employing the latest technologies, especially in the area of control and drive systems. The latest innovation step in this direction was substituting well-proven stepping motors by the modular series of SINAMICS S120 drives and 1FK7 synchronous servomotors from Siemens on all of the adjusting axes of the profile rolling machine. The most versatile and highest performance member of the Fuhr portfolio is the WST universal profile rolling machine – also known as the universal "turks head" type. All of its four cylindrical rolls can be positioned in both the axial as well as radial directions using servomotors, therefore with an associated high dynamic performance and high precision.

Answers for industry.



Universal turks head from Fuhr: for different square and rectangular wire profiles

This allows dimensions to be changed extremely quickly, without having to replace the roll sets each time. The dimension change time is also shortened by fully utilizing the rated speed of the servomotors (up to 1000 rpm) when pre-adjusting the rolls in rapid traverse. This also means that the twin rolling sets can be laterally traversed, which has a positive impact on the tool lifetimes (“traversing motion”, refer below).

When being installed, the rolls are automatically “measured” and the actual dimensions are transferred to the control system. In principle, the roll diameter is no longer important. Further, the possibility of using simple cylindrical rolls keeps tool costs low and, in turn, the associated maintenance costs. The operator can enter the required rectangular or square wire dimensions and also the air gap and its position on the visualization system – a SIMATIC Multi Panel MP277 or MP377 Touch (depending on the number of stands/axes in the line) – and the servomotors then quickly bring the rolls into the corresponding positions with respect to one another.

The adjusting and feed motion of the rolling stands is calculated and coordinated from a central SIMATIC S7-300 PLC (mostly equipped with a CPU 317-2 PN/DP), which communicates with the control modules (CU320 Control Unit) of the SINAMICS S120 drive system via PROFIBUS DP, which in turn, positions the individual axes. The PLC-based motion control has been consciously kept, as the well-proven function blocks and the existing knowhow can be further used – and development sped up.

The measuring system at the output of the last rolling stand continually acquires the actual wire dimensions and transfers these to the control system, which quickly and specifically intervenes for setpoint deviations. As a consequence, consistently high and always reproducible wire dimensions of $\pm 3 \mu\text{m}$ are achieved even at wire speeds of up to 500 m/min.

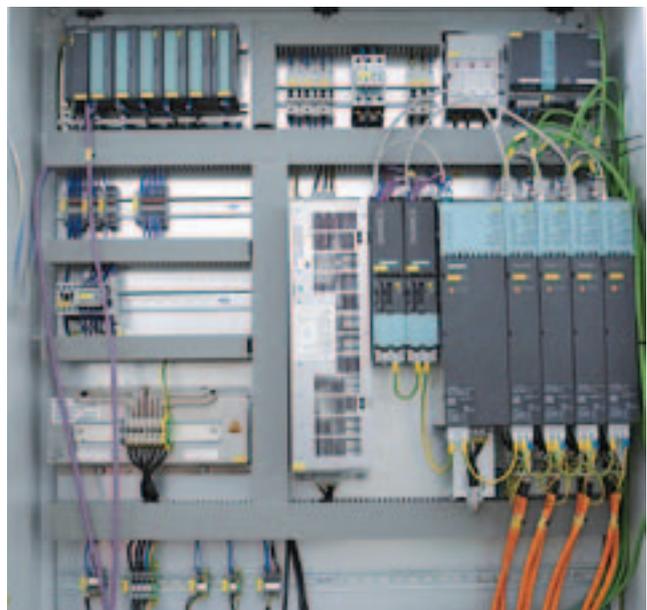
“With the exception of the rotary encoders in degree of

protection IP65 and servomotors that are dust-tight and protected against splashing water, today, we no longer have any sensors that are exposed to cooling-lubricant medium and/or abraded material”, emphasized Dipl.-Ing. Volker Gerth, CEO of Fuhr.

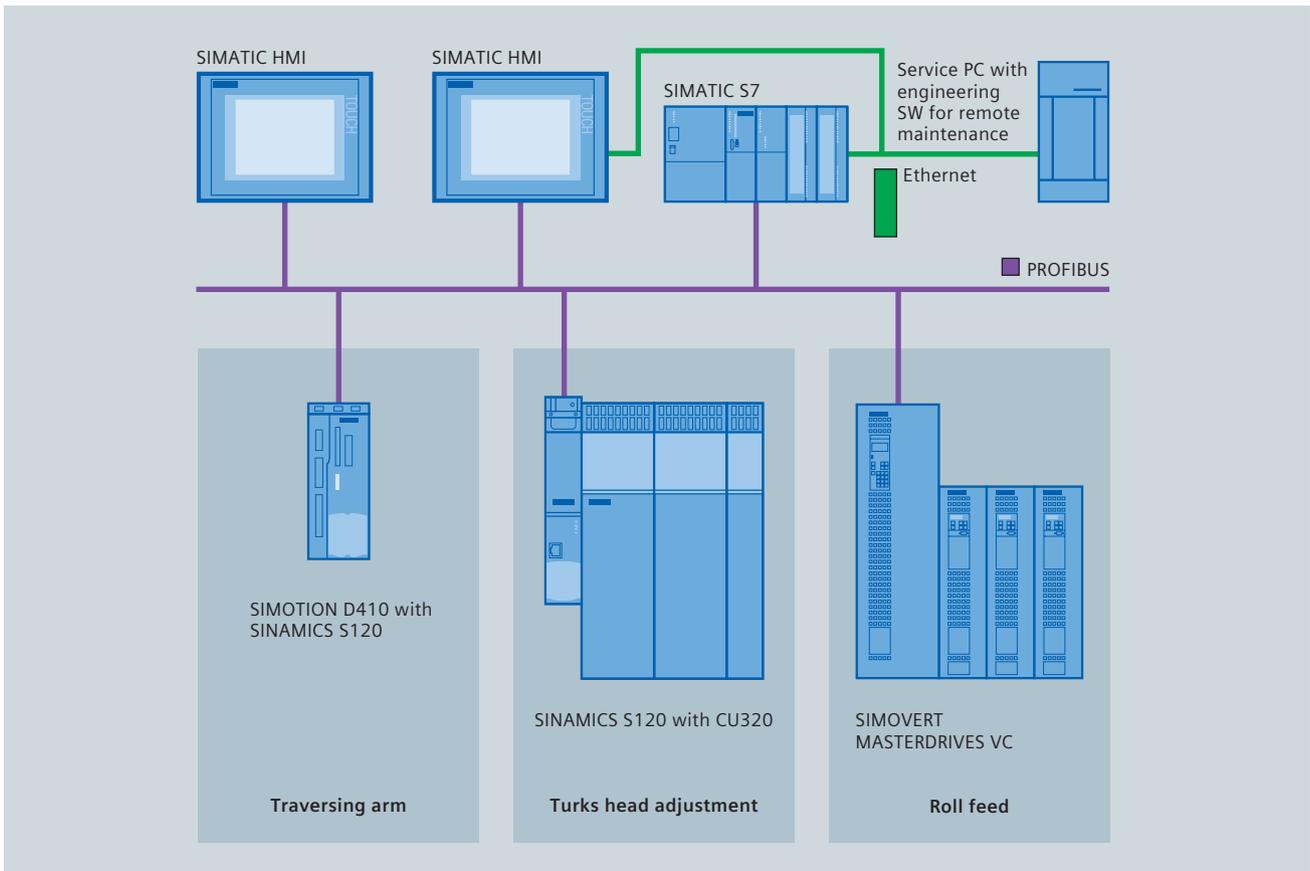
Flexible through modularity

The modular design of the SINAMICS S120 with separate infeed, closed-loop control as well as single-axis and double-axis motor modules supports Fuhr’s modular machine design. As a consequence, drive line-ups precisely tailored to each rolling stand can be simply configured in separate control cabinets, e.g. with a SINAMICS Control Unit CU320 and two double-axis motor modules for four axes for the simpler rolling units, or twice the number for the universal turks head machine with eight servo/adjusting axes. This means that the control cabinets can be standardized and simply combined to create individual rolling lines. The main control cabinet and central control are connected via PROFIBUS, which means that wiring time and costs are kept to a minimum.

Separate drives for each individual roll also allow various operating modes to be selected. This means that a universal turks head machine with the appropriate forming rolls can also be used for profile rolling or, after the side rolls have been removed, as simple twin-roll rolling stand. In the last mentioned case, the upper and lower rolls can be continuously traversed laterally in the axial direction. This minimizes “running marks” on the rolls, which would otherwise have a negative impact on the wire quality. As a consequence, the service life of the rolls is significantly increased and the frequency with which they have to be reground and polished is significantly reduced. In turn, this reduces the changeover and associated downtimes.



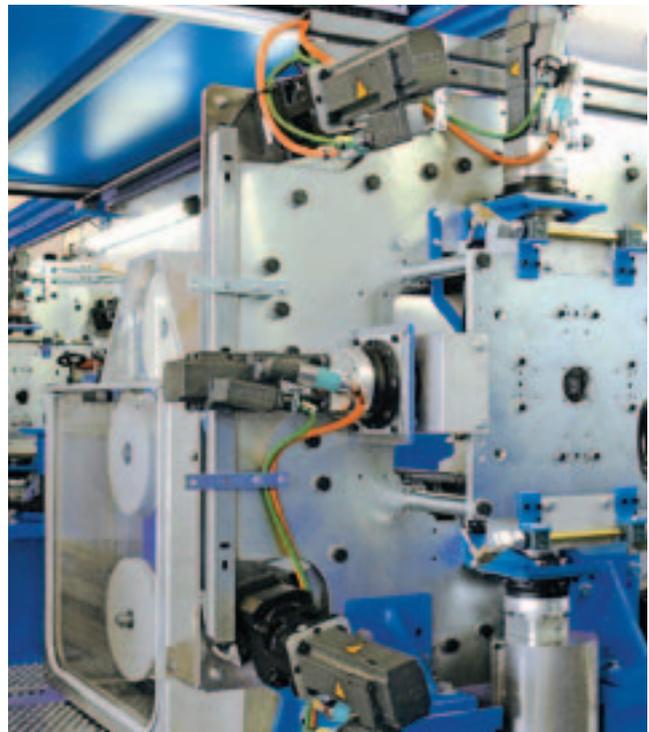
Control cabinet with customized drive solution for the rolling units



From a single source: automation company EW-Tec prefers to use control and drive technology from Siemens, as this is accepted around the world and is quickly available no matter where you are.

Teamwork for an optimum solution

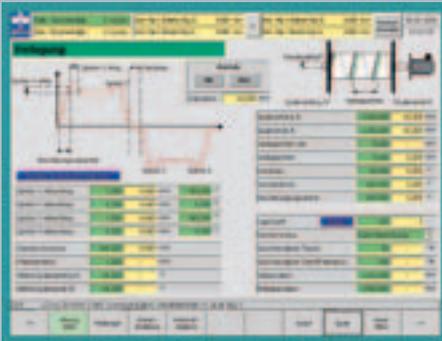
EW-Tec Industrieservice & Anlagentechnik GmbH from Nettetal, Germany designed and implemented the new automation solution. This company, headed up by Wilfried Weyers, specializes in electrical engineering and the implementation of complex automation solutions, including building control cabinets, data acquisition and integrating systems into networks. Manufacturers of rolling systems, coating machines, calenders and special machines are just some of his customers who are active worldwide. Ew-Tec is also active in electrical and automation retrofits in the specified sectors and areas. "We always prefer to use automation technology from Siemens where our customers give us a free rein", explained Wilfried Weyers. This is because we have already gained some great experience with Siemens and they provide us with the optimum support in each project phase and from every perspective. "This is also reflected in the fact that after some brief instructions and occasional telephone support from Siemens on specific points, this first SINAMICS application was able to be successfully completed in a short time. Control and drive components that are harmonized and coordinated with one another from a single source mean a high degree of functional security and reliability from the word go. Further, the machinery construction OEM profits, because Siemens, as global player, is represented practically everywhere around the globe – and when necessary, end customers can be directly provided with spare parts and support.



Karl Fuhr GmbH & Co. KG (Horn-Bad Meinberg) now equips its rolling machines for flat and shaped wires exclusively with control and servo drive technology from Siemens.

Traversing arm innovation

EW-Tec also innovated the wire traversing arm at the end of a rolling line – based on the “traversing arm” application example for the SIMOTION D motion control system. This was an application that was specifically developed for Fuhr. The objective was to achieve the simplest possible handling and operator control, but at the same time, with a high degree of user-friendliness: A system automatically measures the wire coils (either using a laser or light barriers), continually detects the coil core diameter at the rotating coil and the opening distance between the flanges. Further, it identifies possible ovality or flange bending, sets the appropriate start and end of coil and, if necessary, the changeover point – even while the system is operational. The operator only enters the wire width (traversing step).



Together with the automation company, Fuhr engineers packed all of the important process parameters into a mathematical model, which automatically determines and recommends the optimum parameters for spike length and angle, offset and acceleration angle. Programming in the high-level Structured Text language with the SIMOTION Scout engineering system crystallized out to be very simple and flexible – even when making changes, emphasized Hubert Kreft, a EWTECs programmer. Although extremely simple, the setting-up technicians have a wide range of options at their disposal to modify the rolling and traversing operations, e.g. when setting-up new or extremely sensitive products. However, the developers are of the opinion that this will be more the exception, as the automated approach, up until now, always resulted in extremely good settings right from the very start. A SIMOTION D410 DP motion controller from Siemens is the core element of the traversing arm. The device, designed for precision single-axis applications, was selected as a result of its integrated synchronous operation and cam function. It very quickly calculates the axial traversing motion of the traversing head to obtain an optimum winding profile, and precisely synchronizes this to the rotary motion of the main traversing arm axis. The lateral motion of the traversing head can either be realized using a linear motor or a servomotor and ballscrew. For specific applications, the machinery construction OEM developed an additional

pre-traversing function – also driven by a servomotor and controlled from the central PLC: A sturdy wheel that can be positioned in a controlled fashion in the axial direction, precisely guides the product down to the base of the coil and in the lateral end positions, alternating to the left and right. Even for extremely small wire dimensions, this guarantees an absolutely clean, stable winding profile, and in turn, the best prerequisites for subsequent processing at the end-user. The traversing arm can be optionally operated and monitored: at the central mobile panel that can be traversed along the machine (preferably in operation) or via an additional SIMATIC Touch Panel TP177, directly at the traversing arm (especially when setting-up). Once settings are optimized, they can be saved as “recipe” in the central operator panel (using the standard functions of WinCC flexible), and when required, exported and archived via the network connection, e.g. on the “service PC”, which Fuhr always recommends.

Remote-access down to the last detail

The transition from stepping motor to servo drive technology makes remote diagnostics and maintenance significantly more user-friendly and efficient for the machines that are in operation around the globe. To achieve this, all of the engineering tools required, such as Step 7, Scout, WinCC flexible and Drive ES, are installed on the service PC so that when remotely accessing the machine, the service technician always has the right software versions available to him. The service PC is connected to the SIMATIC control and the Multi-Panel of the rolling system on which the Sm@rtService for the WinCC flexible visualization system runs. Authorized service technicians can quickly and automatically access all functions of the rolling system via the network connection using this option package – down to the drive parameterization. “Up until now, especially the latter was a time-consuming affair; the reason for this was that you simply couldn’t route through to each individual stepping motor, but always had to first establish a direct connection and then download the tailored drive software motor for motor”, explained Wilfried Weyers. As a consequence, this new approach significantly speeds up the first commissioning as well as subsequent changes.

Tailored innovation

The changeover to servo drive technology from Siemens went quickly and smoothly. The results that have thus been able to be achieved have been positively evaluated by all operating companies up until now – a unanimous summary of everybody involved. Presently, the SIMOVERT MASTERDRIVES VC converters used for winding/unwinding and for transporting the wire are being replaced by SINAMICS – the new drive generation from Siemens. As a consequence, an integrated, more efficient overall solution has been implemented at a more favorable cost.