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Motion Control Solutions
Success Story

G.D.; Bologna (Italy)

Motion Control Accelerates Cigarette Packaging

The SIMOTION Motion Control System is now gaining a foothold in the cigarette manufacturing industry. Reliability and versatility are paramount in the cigarette manufacturing industry. Processing speed and price play an equally important role. What is required of the machines with modern motion control technology based on the SIMOTION system is demonstrated by G.D in a cigarette packet reservoir and in a stamp/coupon applicator.

TaskG.D, located in Bologna, Italy, is a machine construction company which specializes in complete making and packaging lines for cigarettes. When G.D was searching for an innovative automation and drives solution for its new Packet Reservoir PB15 and Stamp/Coupon applicator AN, Siemens offered a concept based on the new SIMOTION control platform. G.D was convinced of the idea to use independent drives regulated electronically and to concentrate drive control and machine automation in one system and equip both machines with SIMOTION.

SIMOTION is the basis of a customized automation solution for making and packaging machines for cigarettes. With this solution, Siemens is completely revolutionizing the SMD (Secondary Manufacturing Department) sector.

Packet Reservoir PB15

The PB15 is a packet reservoir which is located between packer and packet wrapper. Its job is to keep the packer running during wrapper downtimes, by loading the PB15, which permits the packer to work till the reservoir is full. Conversely in case of a packer downtime the PB15 provides packets to the wrapper till the reservoir is empty. To this end, the PB15 stores more than 1500 packets.

To meet the requirements of the customers for tracking and tracing of the product, the design principle of the PB15 is FIFO (first in, first out). The PB15 also depends fully on mechatronics, meaning that the PB15's five axes are no longer mechanically coupled, but rather electrically.

Stamper/Couponer AN

The Stamper/Couponer AN is a device which is coupled with the G.D packet wrappers for applying revenue stamp and coupon. The stamp and the coupon can be applied simultaneously, otherwise the device is available only with the stamper section or only with coupon section The coupon can be inserted beneath the packaging film or outside of the film. The AN is a stand-alone device which can supply as many as 600 packets per minute with revenue stamps and coupons. The idea behind this device is to supply every cigarette packet with a package coupon for advertising purposes. Even more

remarkable is the fact that G.D depended completely on mechatronics in the construction of the Stamper/Couponer AN - just as it did with the Packet Reservoir PB15. The four axes of the Stamper /Coupon AN are electronically coupled, no longer mechanically. Packet Reservoir PB15 and Stamper/Couponer AN meet the main demands of the cigarette industry: shorter set-up times, increased throughput, and new ways of advertising. Because of a huge increase in product variety, cigarette manufacturers are demanding increasingly flexible machines. Such machines are distinguished by an ability to handle a wide range of products, but most of all by particularly short set-up times, such as those incurred because of a format change. Short set-up times are a merit of the mechatronic construction and SIMOTION.

In addition to increasing product variety, cigarette manufacturers must also cope with growing cost pressure, caused in part by a thriving market in discount brands. For the manufacturers of cigarette machines, this means that their machines must bring higher throughput without increasing operating costs. This is possible only when machine downtimes can be further reduced and when the machines can be operated with fewer personnel. Because the Packet Reservoir PB15 is equipped with low-maintenance electronic drives technology it contributes substantially to smooth production operation and reduced downtimes.

Cigarette manufacturers are always looking for new ways to advertise their products. And package coupons are suitable for this. They are also permitted, if tobacco advertising is otherwise subject to restrictions. Package coupons can be separated from the packet and passed on from one smoker to another. This concept has already proven itself in the food industry. Cigarette manufacturers now also have good reason for equipping their plants with this device and G.D has honored this need by launching the Stamper/Couponer AN.

Customized with standards

The demands of end users - i.e. the requirements for versatile, customized solutions based on reliable and inexpensive standard products - set the latest trends in machine construction. Mechatronics is the interaction of mechanical components, electrical engineering and software. Replacing mechanical solutions with mechatronic solutions means replacing inflexible mechanical components with new functional units. In order to satisfy demands for more flexible production machines, machine constructors are replacing traditional mechanical solutions to an increasing extent with mechatronic solutions. In more concrete terms, this means, for example, desynchronization, replacing mechanically coupled axes with electronically coupled axes. Another example is the use of electronic gearing instead of mechanical gearing. This immediately results in a number of advantages. The machine becomes more versatile, while set-up times decrease dramatically. Finally, set-up requires no intervention in the mechanical components (such as cam replacement), but only the modification of a few parameter values, which are stored in the control system.

Machine performance can be improved by a mechatronic solution because the friction and moments of inertia inherent in mechanical solutions are no longer applicable and axis movement can be further optimized. Moreover, construction and commissioning are simpler, faster, and thus more cost-effective in a mechatronic solution. For example, standard software modules can be used for typical (sub)tasks. The machine has fewer wearing parts, which increases reliability and reduces operating costs. The Packet Reservoir PB15 and the Stamper/Couponer AN closely follow this mechatronic approach, and profit accordingly from its benefits. ModularityModular machine concepts make it possible to create a

number of different machine versions within only a few modules, to adapt individual modules more easily to special customer demands or to innovate, and to put machines into operation more quickly. It is, of course, important that the individual modules can be easily combined with one another. In addition, each machine module must bring along its entire functionality, including servo drives and motion control intelligence. The motion control software must cover the functionalities of all modules, support stand-alone modules, including testing / diagnostics and commissioning, and provide a simple interface between the individual modules. Modular machine concepts thus lead to more flexible machines, faster construction and commissioning, and thus to shorter delivery times - all of which result in lower costs. In this sense, PB15 and AN are a module in a production line.

Industrial standards save investment

In recent years, important standards have been developed for industrial automation because end users want to see integrated solutions used in their plants. Operating system and programming standards include MS Windows, PLCopen, IEC1131 and OPC. Programs based on standards have the advantage of being able to be used on other systems (portability). This makes it possible to keep engineering overhead down over the long term and ensure that the investment made in programming is not lost. Communication standards, such as Industrial Ethernet or PROFIBUS, enable easy plant integration.

The Packet Reservoir PB15 and the Stamper/Couponer AN are required to fulfill all these standards and to be integrated into the plant over PROFIBUS and Ethernet. Thanks to SIMOTION, the Packet Reservoir PB15 and the Stamper/Couponer AN conform to all these standards, and can be integrated in the plant either via PROFIBUS or over Ethernet. Demands on automation are obvious from the information presented above, the automation solution must fully support the mechatronics approach, i.e. the automation system must not only control the machine, but must also control the complex movements of the electronically coupled axes and electronic gearing. In order to do so, the control system must, of course, provide the necessary functionality and performance capabilities. In order for the advantages resulting from the simpler construction of a mechatronic solution to be maintained, the control system must have excellent usability. This also means that the machine constructor must be able to control the system in his own language, such as to simulate cams at the drawing board. It must be possible to network the controls for the individual machines without breaks, including those with drive components and HMI (Human Machine Interface). In addition, each individual system must fit seamlessly and homogeneously in the higher-order IT structure, for instance in order to support a comprehensive tracking & tracing system.

The automation system must not require a lot of training and must be reliable, and spare parts must be available within a short time anywhere in the world.

Custom-made solutions with off-the-shelf technology

For the (tobacco) secondary process, Siemens offers an automation concept which is perfectly tailored to machines for making and packaging cigarettes (secondary) and fully satisfies the requirements described, while providing a considerable savings potential compared with conventional concepts. The basis of this automation concept is the new SIMOTION motion control system. SIMOTION is a motion control system for applications with complex motion control which integrates motion control and control functionality in a single unit. Machine constructors can fully convert the advantages of mechatronic

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solutions into reality. With SIMOTION, motions can be controlled and optimized and new motions can be easily implemented. In addition, SIMOTION also takes over control of the machine. The fusion of motion control, PLC functionality, and technology functions has considerable advantages. Machine constructors need no longer concern themselves with integrating drives and controls of different manufacture or from different product lines or with overcoming costly technology breaks. SIMOTION eases the burden of the considerable costs of integrating heterogeneous product worlds in a functioning system.

The SIMOTION system consists of two basic components, namely engineering system and hardware. The Scout engineering system makes it possible to solve motion control, control, and technology tasks in an integrated system, and provides all the tools with which to do so, from those for programming over those for assigning parameters, testing, and commissioning to those for diagnostics. MCC (Motion Control Charts), CSF, LAD is used for graphical and ST (Structured Text) for textual programming.

The hardware platforms complete the SIMOTION system. The application created with the engineering system and the associated runtime environment can be used on different hardware platforms, namely controller-based SIMOTION C, PC-based SIMOTION P, or drive-based SIMOTION D. The hardware also includes the runtime environment, which provides the various motion control and technology functions. The base functionality to IEC1131-3 provides commands for logic, motion control, program control, timers, I/O access, and the like.

Technology packages expand the functionality by various technologies. For example, the "Position" package provides all the functions for a precise positioning motion, the cyclic setpoint and actual value exchange with the drive, position control, calculation of the motion profile, homing, axis enable, status information, and so on. Other technology packages are "Gear" for gearing and "Camming" for cams. The graphical cam editor Cam Tool makes it easy to configure cams simply by entering interpolation points and specifying the transient response between these points. In addition to the curve, or path, it is also possible to represent speed, acceleration and jerk. By shifting the interpolation points with the mouse, the curve can be modified until the optimum values have been found.

When a technology package is loaded, its functions are made available to the user over the IEC1131-3 programming interface in addition to the basic functionality and for the same user program. In addition to the technology packages, function libraries are also available which provide added higher-level functionality. For example, PLCopen function libraries are available for motion control, standard applications such as flying shears, and the like. The C230 controller-based version of SIMOTION was used for both the Packet Reservoir PB15 and the Stamper AN. The programs for the two machines are written in part in MCC and in ST, depending on the concrete technical subtask. In addition to the basic system, the Cam package and the Gear package were also used.

As a permanent "member" of TIA (Totally Integrated Automation), SIMOTION uses components from the TIA family for HMI, communication, and process interfacing as well as for drive tasks, and is fully compatible with other Siemens systems, such as SIMATIC, as regards data management, configuration, and communication. For its PB15 and AN, for example, G.D makes use of the field-tested SIMODRIVE 611 universal drive system and 1FT6/1FK7 servo motors from Siemens. The SIMATIC HMI TP270-10 visualization system is linked via PROFIBUS.

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A complete success

The solution based on SIMOTION C was a complete success. The best proof of this are the orders which have been placed by cigarette manufacturers for the Packet Reservoir PB15 as well as for the Stamper/Couponer AN. In order to both integrate further and enjoy the full advantages of the new SINAMICS drive system, G.D is considering changing to the drive-based SIMOTION D solution and SINAMICS S120. Due to complete compatibility between the SIMOTION variants there are nearly no changeover expenses. Because of its positive experience with the Siemens automatic concept and SIMOTION, G.D is planning to equip additional machine types with SIMOTION. In the end, the objective is to be able to offer a complete line - with all required machines - based on SIMOTION.

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