Motion control for high-speed Precision movement

COMPLEX HIGH-SPEED PRECISION MOVEMENTS OF CRITICAL PARTS FORM THE HEART OF MORE AND MORE INDUSTRIAL MACHINES. BOB DOBSON LOOKS AT RECENT APPLICATIONS USING THE LATEST IN MOTION CONTROL TO ADVANCE THE STATE OF THE ART IN MACHINE DESIGN.

Supreme Plastics' new zip applicator for continuous motion vertical form-fill-seal and flow-wrapping equipment is based on an advanced linear motor system from Baldor. Two zip attachment heads running along the same magnet track allow the new Reseal 460X machine to achieve throughputs up to 120 packs a minute.

Reseal 460X applies 7mm zips across the web – typically the shortest edge of the pouch – saving material and allowing a higher fill ratio. The technique also eliminates risk of leakage at critical points because the zipper closure does not form part of a side weld.

To support continuous manufacturing, the machine uses a zip feed mechanism driven by a rotary servo motor, which is mounted on a fast-accelerating linear motor axis that tracks the speed of the film web. It then seals the zip into place using a heating element. For high throughput, two of these attachment heads travel – a pouch length apart – on the same linear magnet track.

In operation, the linear drive, which is based on a cog-free brushless motor for smooth operation, carries two forcers – each with a zip feeder and heating element.

The forcers sit on a home position until the controller senses the next registration mark. They then accelerate rapidly, and when synchronised with the web, the heating element is switched on to seal the zips in place. The forcers then accelerate back to the home position at over 1G, ready for the next cycle.

The machine's four axes of motion – two rotary BSM servomotors and two forcers on the LSS linear motor – are controlled by a Baldor NextMove BX motion controller and four FlexDrive servo drives.

This controller also incorporates the I/O required for the various sensing and actuation functions associated with the process, such as registration mark detection and zip position sensor. Using CANopen fieldbus communications, the motion control system links to a Baldor operator panel which allows the operator to define zip length, pouch size and so forth.

Baldor provides all motion, I/O and human-machine interface system components required for the new machine, and wrote the application software using the Mint motion language to divide the major control functions of the machine – controlling the zip feed, linear motor and man-machine interface as separate tasks.

Pressure sensitive stamps

Bristol's Stephen Mayer International specialises in application-specific machines for the philatelic and food industries.

The company's latest machine, the PAC-24, is a highly flexible system that has been designed and developed specifically for the United States Postal Service (USPS) in Kansas City.

It is the first machine of its kind that is capable of handling pressure sensitive self-adhesive stamps and accommodates a wide variety of stamp sheets – including booklets – and an even wider range of target materials, such as first day cover envelopes and presentation sheets. The machine automatically peels the stamps from their backing sheets and fixes them to the target material individually, in a line or in a grid, depending on the customer's particular requirements.

The PAC-24 makes extensive use of electrical and pneumatic actuation technology, and Stephen Mayer chose to use Festo components throughout.

In use, the machine picks up each sheet of stamps using an array of 60 vacuum cups. The backing sheet is peeled off and the stamps transported to the incoming envelopes or presentation sheet using X-Y tables driven by Festo electrical servo drives.

To ensure accurate and highly flexible place-

Applying stamps: *PAC-24 machine uses Festo drives to provide high accuracy positioning*

ment, the stamps are individually set – any stamp from any position on the sheet can be directed to any position on the envelope. A tamping cylinder then individually presses each placed stamp onto the envelope to attach it securely.

Finished envelopes are transferred via a camera checking station to a collating conveyor, and any unused stamps are placed on a recovery strip for stock control and auditing purposes.

In all, the PAC-24 is equipped with ten electrical servo drives forming a sophisticated motion control system. All of these, together with the system's four CPX valve terminals, are under Profibus co-ordination and control.

The machine has a throughput of 2400 stamps an hour and, although faster machines are available, their accuracy is lower and cannot adapt to applying single stamps, strips and blocks of stamps.

With this equipment, the accuracy of 'constant position' fixing will become standard, and lends itself to both single and multiple stamps attached to an envelope in the same position. This accuracy will also allow stamps to be cancelled much more quickly and efficiently.

The PAC-24 has been installed and beta tested at the USPS in Kansas City, and is now being rolled out to customers. It is anticipated that further machine orders will come from around the world.

High speed scribing

In another application that combines electric servos with pneumatics to create a motion system, Robotix in Rugby has developed a high speed production line for scribing traceability serial numbers onto wheel rims for earthmoving equipment. This uses a single Hoerbiger-Origa rodless pneumatic cylinder in the dual critical roles of positioning the scribing head and holding the rim steady in the workstation.

In operation, the wheel rims, which can vary in size from 24in diameter and 15in wide to 40in by 40in, are delivered by a conveyor to the scribing workstation, where V-shaped guides position them accurately.

A large and powerful rodless cylinder mounted above the workstation descends, positioning the scribing head just above the top surface of the rim to an accuracy of 0.01mm. Mounted on the cylinder and protruding beneath it is a pair of Hoerbiger-Origa's linear shock absorbers – these contact the rim with sufficient force to hold it steady during scribing.

The actions of the cylinder and other parts of the machine are controlled by a Mitsubishi PLC, the LCD display of which provides the operator with process and production messages.

Drive for screen print: *Mitsubishi Electric servos are being used by Thieme*

The scribing head is a proprietary system from Technifor in Germany that uses a micro-percussion scribing drive and x-y configured servos for letter/numeral forming.

The scribing is fairly deep so that it can be easily read even in muddy working conditions, which means there are high forces being transmitted through the rims during scribing and hence the decision to use larger bore cylinders.

Virtual transmission

With the help of an advanced motion control system from Mitsubishi Electric, German screen-printing machine builder, Thieme, was able to develop a completely new generation of screen printing machines, the Thieme 5000 XL, which achieve continuous availability of 95 per cent and – even more importantly – cut setup times to less than 5 minutes per print station.

Thieme's engineers set out to design a new generation of screen-printing machines with a large-scale printing format of up to 2000 x 3050mm, with high production throughput combined with economy.

However, they soon realised that with this format many of the components used in previous systems, such as the central drive system and the mechanical line shaft, would simply be too big. After analysing a number of alternatives, it became clear that the combination of a motion controller with servo drives was by far the best solution.

One of the biggest challenges for their new Thieme 5000 XL screen printing machine was that it should be possible to translate the existing mechanical solution as precisely as possible to the new system – both to keep development overheads low and to avoid losing the years of development invested in the tried-and-tested movement sequences.

To solve the problem, Thieme chose a Melsec System Q motion controller from Mitsubishi Electric. System Q's programming language has the capability to implement existing mechanical solutions with graphical representations. In addition to this, it combines motion control, PLC and IPC modules on a single platform, which means that it can also handle the other machine control requirements as well as the motion control.

This concept eliminates the need for duplicate system racks and the operators have complete and easy access to all the PLC and motion controller data. Every CPU in the system has access to all data via the common backplane bus, which means that there is no longer any need for time-consuming additional communications programming.

In the new system, the former main drive is programmed as a virtual servo motor connected to a virtual line shaft. The 30 axes (for a six-colour machine) are also placed in their proper positions with a simple drag-and-drop operation.

In addition to simple axes, the system can also program virtual equivalents of other mechanical components, including transmissions, roller feeders, linear axes and cam discs. This makes it possible to program the drives to perform complex movements that are precisely synchronised with one another. ■

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