Sercos interface, virtual master axis for shaftless press drives

After an “incubation” and development period of 25 to 30 years, shaftless drives for rotary printing presses (see newspaper techniques, April 1996, Pages 6-19) have become standard features of nearly all new newspaper press installations. A trend is now emerging also to equip commercial web offset presses this way, with rotogravure, packaging printing as well as, sooner or later, multi-colour sheet-fed offset presses destined to follow suit. For this reason, it is undoubtedly of interest to our readers, besides the familiar manufacturers of printing presses and controls, to become acquainted with the components’ manufacturers who are behind these interesting and quality-improving developments.

Indramat, the company for Industry Rationalisation and Automation, was founded in 1958 in Neuwied am Rhein, Germany, taken over in 1965 by the firm of Rexroth, a well-known manufacturer of hydraulic controls that was itself incorporated later into the Mannesmann group (123,000 employees, DM 32 billion annual turnover). The takeover in 1965 was accompanied by a move to Lohr am Main, where in 1986 a large-sized industrial site located on the outskirts of the city was occupied (Fig. 1). The 1500 Indramat employees generate a turnover of more than DM 400 million worldwide. The Rexroth parent company has 19,000 employees and achieves an annual turnover of DM 3.8 billion with hydraulics, power transmission equipment, pneumatics and linear motors as well as NC drives.

Indramat attracts printing press customers

In the course of time, Indramat specialised entirely in the production of drive systems for NC machine tools (NC = Numeric Control), i.e. its specialty is high-precision, digitally controlled electrical motors. Initially, these were analog/thyristor-controlled D.C. servo drives whose low resolution was greatly enhanced in precision and speed by the development of digital/frequency-controlled AC servo drives. The world’s first maintenance-free A.C. servo drive for machine tools was presented in 1979, though this was apparently before its time as it found little echo among
European machine tool manufacturers. The reaction in the United States was different, where the Ingersoll Machine Corp. had to develop new transfer lines for the Ford Motor Company and used the new drives with success.

This marked the breakthrough for A.C. technology, and Indramat was inundated with orders. Between 1983 and 1990, the company turnover increased from DM 52.4 to 338 million. But then came the major economic recession in 1991 that had especially serious consequences for machine tool manufacturers, and therefore also Indramat. During this period, Indramat invested in new developments and gained new customers, including the printing press industry.

Sercos Interface – an open standard created by the industry itself

Around the same time, under the auspices of the Association of German Machine Tool Manufacturers (VDW) and the Central Association of the Electrotechnical Industry (ZVEI) in Frankfurt am Main, a standardisation concept was developed and given the name of Sercos (Serial Realtime Communication System) to which all important manufacturers of machine tool drives and controls subscribed. Indramat claims to be the third-leading player (after Fanuc and Siemens) in its sector of industry, i.e. NC drive engineering. To be more precise, the development concerned is more a standardised, open interface, which is why it is referred to as the Sercos Interface.

The Sercos Interface exchanges data between the CNC control of a machine tool (one talks in terms now of computerized numerical control = CNC) and the converters or actuators respectively of the main drives and feed drives via glass fibre optic transmission cables. In practice, up to 40 drives are usually connected to the fibre optic ring, although the original definition for machine tool construction only provided for eight drives, and are supplied with data in a fixed cycle of two milliseconds. Data transmission speed is 2 Mbits/s. Actual and target values can be transmitted for torque, speed, and position, with a selectable resolution or precision respectively of 32 or 16 Bits. This has now been standardised internationally under IEC 1491 (IEC = International Electrotechnical Commission).

The virtual master axis determines the ideal master motor

In broader terms, it is possible to term a printing press as a machine tool, which is why the application of this technique to press construction did not require any major adaptation. In imitation of the machine tool with its main motor built as an asynchronous motor and the various service motors as synchronous motors, it was originally thought necessary to introduce a “master” motor at the press folder that would set the pace for all printing couple and draw roller “slave” motors, but this proved to be a mistake. In this case, the master motor would not give an error-free signal and in addition, due to the folding strokes, would be located at the most unfavourable position in the press. For this reason, the computer model of a virtual master motor with ideal running behaviour is cited as a reference and referred to as a “virtual master axis” that all other “axis”, or motors respectively, must follow as
precisely as possible. The “virtual master axis” is calculated in the controls (CNC) of the Indramat Synax system and transmitted as target position values via Sercos glass fibre optics to the drive boosters and motors.

**The three levels supplied for shaftless presses**

*Figure 2* shows a schematic representation of a shaftless-driven newspaper web offset press with four, four-high towers and two folders, illustrating the offer of components and controls of the supplier. Indramat, as a component supplier, in all cases makes available the A.C. motors and drive boosters with the Sercos Interface, but supplies the CLC controls and can also offer the cross-communication that is redundant here and therefore indicated with a double loop. However, the equipment supplied by the press manufacturer, or its controls manufacturer such as ABB, EAE, Harland Simon and Honeywell to name a few, always includes the press control system below this, indicated by a data bus connection. Consequently, the name of the components supplier nearly always disappears in the overall equipment of the controls manufacturer; in other words: Indramat supplies companies such as ABB, EAE, Harland Simon and Honeywell. In the case of

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**Fig. 3**: The three concepts for adding A.C. motors and encoders to the impression cylinder, or blanket cylinder respectively: with toothed wheel pinions (or toothed belts) on top, with couplings in the centre, and with hollow-shaft motors stacked directly on the blanket cylinder axle below.
ABB, only the drives are concerned, as the group has abandoned this area of activity (machine tool drives). Baumüller in Nuremberg also acts as a components supplier in the above sense to the press Manufacturing industry. In addition, a smaller company called AMK (Anton Müller in Kornwestheim) supplies drives for ABB and Wifag.

The optimal positioning of A.C. motor and encoder

There was much talk in the past about how the A.C. motors and the optoelectronic encoders can be connected to the impression cylinders. Figure 3 shows three different designs: with toothed wheel pinions (or toothed belts), with couplings, and with hollow-shaft motors stacked directly on the impression cylinder axis. All three designs have been realised already in practice: toothed belts from Wifag, toothed wheel pinions and couplings from Koenig & Bauer-Albert, and hollow-shaft motors from MAN Roland. Therefore all have already proven their practicality. The position of the encoder still remains to be settled. Usually the manufacturer automatically integrates the encoder into the motor in a torsionally rigid manner and without additional couplings. In the case of the designs with toothed wheel pinions or toothed belts and with flexible couplings, it is recommended to add-on an optional encoder to the impression cylinder or blanket cylinder respectively, as indicated in the diagram. But it should not be forgotten that it is the flexible paper web between the printing couples that represents the greatest attenuator.
from the control engineering point of view, which is why, besides the register control integrated into the CLC, it is recommended to add an external register control. IFRA Special Report 3.23 informs about the method of operation of these electronic register controls.

State-of-the-art manufacturing

A tour of the Indramat plant in Lohr am Main revealed a state-of-the-art manufacturing operation, with quality checks carried out after every manufacturing step. We were especially impressed by the screen printing presses for applying glue to the printed conductors of the printed-circuit boards, followed immediately by the automatic insertion machine for the electronic modules and chips on the printed-circuit boards (Figure 4) as well as the climatic test chambers for the drive boosters (Figure 5) in which they are tested under extreme temperature conditions.

In conclusion, Klaus Peters, Head of Printing Press Applications in the Development Department of Indramat, showed us a test model for press drives in the development laboratory (Figure 6) as well as numerous machine tools and armed robots.

Indeed, it may be considered a stroke of good fortune that, due to a crisis in the machine tool sector, the progressive development potential of this sector came to be applied to printing press construction. It is now a matter of taking full advantage of it to improve our products (better register) as well as to obtain more compact, lower-maintenance and more flexible printing presses. – Boris Fuchs

CIE in Lausanne uses the Betz ColorMix N system

With a daily production output of 500,000 copies, the Centre d’Impression Edipresse Lausanne (CIE) in Bussy- ny, near Lausanne, is one of the largest newspaper printing operations in Switzerland. Each night, three daily newspapers are produced in parallel on a Wifag OF 7 press. In order to be able to purchase the printing inks at more favourable prices and economise on disposal costs, CIE has now put into operation the Betz ColorMix N system. CIE is part of the Edipresse group and is one of the three largest Swiss printing and publishing companies. Annual consumption totals 20,000 t of paper and 300 t of ink, of which more than half are colour inks.

In view of its annual requirement of 35 t of special inks, CIE set out to lower the costs of ink buying. According to its calculations, the new ink mixing system should have paid for itself by two-and-a-half years at the latest. CIE began by investigating several of the ink mixing systems obtainable on the market and had the opportunity to inspect the system in operation at the Druck- und Verlagshaus Frankfurt am Main. Cited as an additional advantage is the fact that the software of the ColorMix N system is open for network connections, as it uses the Windows 95 operating system. This was an important point, as CIE uses it in conjunction with the Gretag colour-matching system.

The database of the mixing system contains the necessary basic colours for each of the Pantone system and in-house CIE colours. Upon receiving a mixing order, the computer of the mixing system calculates the amounts of basic colours as weights and communicates this data to the terminal of the scales on which the ink bucket stands. The basic colours are pumped into the container via the metering valves until the required weight is reached.

The Betz mixing system is reported also to play a central part in the CIE project that is aimed at minimising the amount of residue inks to be disposed of by re-mixing: the residues of the Pantone inks are collected from the ink fountains (at least 2.5 kg per ink fountain) in 45 kg containers and separated roughly according to colour tone. From this mixture, a proof print is made and analysed with the spectrophotometer.