INTEGRATED WEB-OFFSET INKING CONTROL SYSTEM

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Abstract: The development of the web-offset inking control for the Technical Research Centre s trial press has progressed so far that we have now constructed a fully automated printing production sequence beginning with presetting and continuing through the sequences for start up increase of press speed. closed-loop density control during the production and stopping the press on completion of the edition All these production sequences are accomplished under the control of the process computer of the system. Other components of the system are the plate-scanner for presetting the inker. the web densitometer and the remote control console. This paper is a continuation of our TAGA papers of 1979 1981.

Introduction

The production economy of the 16- or 32- page heatset offset presses is seriously affected by the typical disturbances in the lithographic printing process. As a result. the waste figures are high during the starting period. and also during the production printing. and there are great variations in the quality A typically Finnish example is a 16-page printing press doing 500 . . 800 jobs annually This means a total waste of up to 10 . 20% of the annual turnover of the press. Poor production efficiency is another form of waste. Improvements in the mechanical construction of heatset presses will hardly bring any radical changes in the near future. The very fast progress in the new LSI-electronics and process control technology has made it possible to improve the controllability of offset printing by means of modern control systems The very complicated lithographic printing process calls for effective. yet low-priced solutions in control systems.

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Progress reports on the relevant development work carried out at the Technical Research Centre of Finland have been presented to the TAGA Conferences from 1979 on /1.2. 3.4/ and also elsewhere /5.6.7/ The purpose of the development work is to construct an integrated control system for the web-offset printing press Control system components such as web densitometers /1.2.7/ a remote control system /2/. and a plate scanner for presetting /4/ have been constructed Process identification studies have been made for control algorithms. Identification of the inking process /3.5/ and identification of the ink/water balance /4.6/ process have been the main goals of the research. The successful tests with the first generation closed-loop inking controller have been reported before /3.4.5.6/.

The integrated control system discussed in this paper is a further development of the prototype system. It is an integrated pilot control system for a single-unit full-scale web offset Besides the closed-loop inking control it includes some other important control sequences of the usual production printing. The controls of presetting. starting. speed change. closed-loop controlled production and finnishing are the main control blocks of the system The system is now being tested for inking controls. Soon the control of the ink/water balance will be adapted to the system

Configuration of the control system hardware

A block diagram of the control system has been given in Fig. 1. The system includes the following components:

A remote control console and a process control station to transmit the control commands of the printer. or of the control system. and to inform them about the modes of the actuators and the sensors of the printing press. Details of our digital remote controller have been given in a TAGA report /2/

A plate scanner for presetting the ink screws was reported for the TAGA Conference last year /4/. It is a device which measures from the printing plate the relative printing area corresponding to each ink screw zone. This makes it possible to adjust the screws in accordance with the ink consumption in the corresponding plate zones.

Rather complicated computation algorithms are needed before the measuring results can be used to compute the inker presetting parameters:

- thin-drawn lines rounded out of the result of the plate scanner readings but to be printed needing ink feed
- the optical variations of the non-printing areas of the plates

These difficulties have now been solved. We have also found a Finnish electronics manufacturer for commercial production of the plate scanner. which will be brought on the market in a couple of months

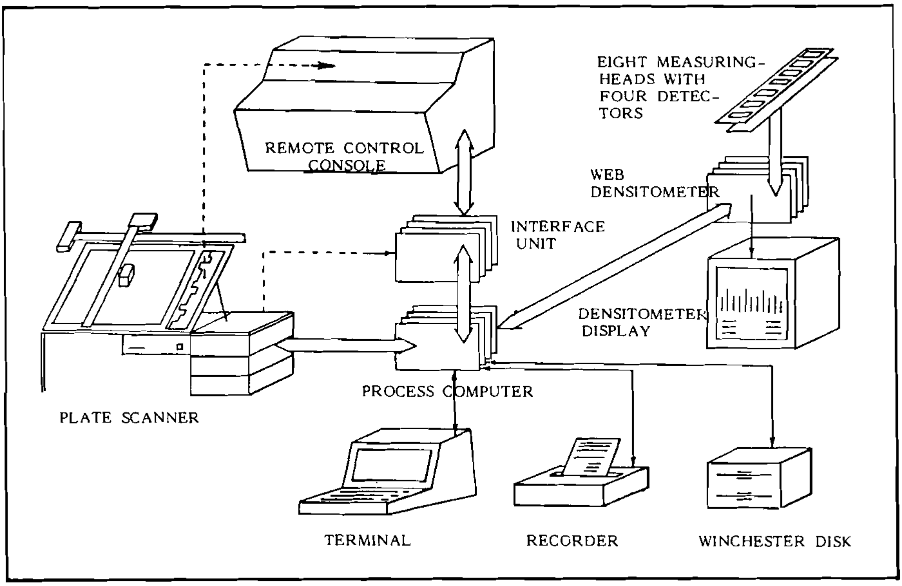

Figure 1. A block diagram of the control system controller for a web-offset press

A web densitometer with eight measuring heads is seen in Fig. 2. Each of the eight measuring heads measures all the process inks. The equipment consists of a two level microcomputer system (two MC 6809-microprocessors). a display-terminal (DEC VT 100). a pulse-tachometer and a serial interface to connect with the process computer The slave microcomputer takes care of the synchronisation of the measurements according to the pulse-tachometer pulses and pulses of the synchronizing measuring head. which triggers the measurement by reading a special target printed on the web. The targets to be measured on the web are selected by thumb wheels in the front panel of the unit. The slave microcomputer also takes the measurements, converts from analog to digital, performs some basic computations and sends the results to the master microcomputer.

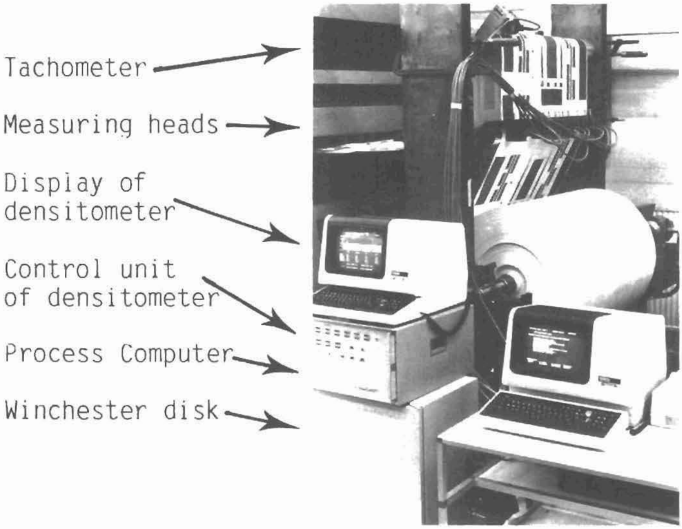

Figure 2. A web densitometer and a control computer with a 30-Mbyte winchester disk memory

The master micro does the final computation of the density values, filtrates the basic variation of the measurements, computes characteristic statistics and displays the measuring results on the screen in the form of bar graphs and numeric data. Fig. 3 shows the display of the densitometer. The web densitometer measures a test-strip row after every third revolution. The most important measuring results and the computed statistics as well as the number of printed revolutions are sent as a standard message by way of a serial online connection to the main control computer of the system.

The main control computer of the control system is a DEC LSI-11/23, a 16-bit computer with a 30-Mbyte winchester disk memory. It has a 256-kbyte multiuser RAM-memory and a real time disk-operating system RSX-11M, capable of multitasking. A DEC VT 100 video display terminal has been used as a communication terminal. The control computer is connected by a serial connection with the remote control console, the plate-scanner and the web densitometer. It is also equipped with a matrix printer for production reporting.

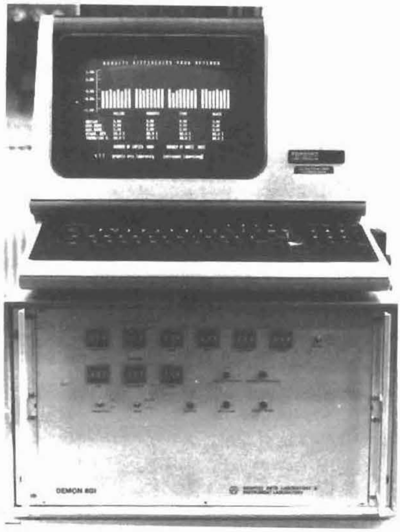

Figure 3. The display and the control panel
of the web densitometer

Configuration of the system soft-ware

The main blocks of the control program have been given in Fig. 4.

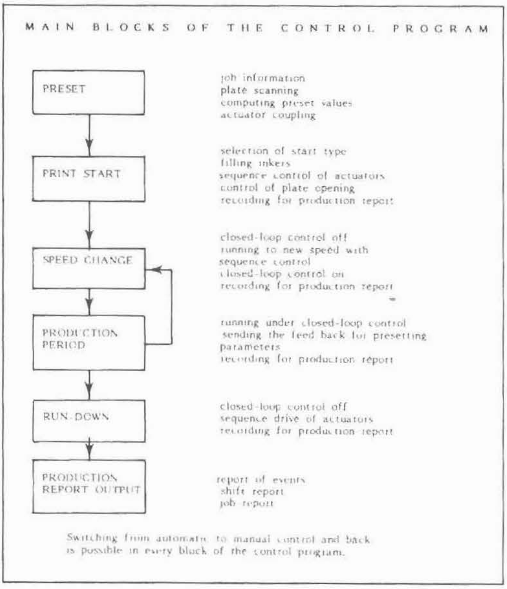

Figure 4. The main blocks of the control program.

A simplified flow diagram of the presetting block of the control program is seen in Fig. 5. After measuring. the scanner sends the measuring results. the inker code. the job code etc. to the main computer. The computer computes. according to the presetting algorithm. the ink screw position and the speed values for the ink and dampening duct rollers. The information is recorded in the disk memory for later use. The plates may be measured in an arbitrary order and independently of the job going on in the press.

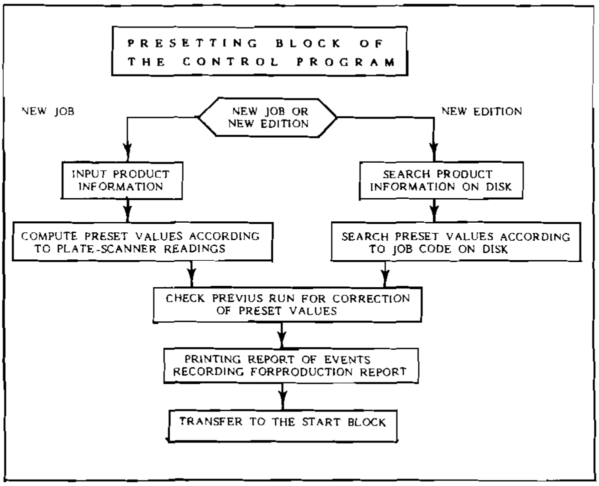

Figure 5. A simplified flow diagram of the presetting block of the control program.

The presetting algorithm accounts for the following items:

- blade bending
- variations of the offset and gain of the ink screw position sensors and displays
- non-linearity factors of the relation between the image area and the ink screw position
- various speed ratios of the duct roller for different ink consumption averages of the plates

The computed set values are stored and called for use in the starting block of the control program. In the starting sequence the results are used to preset the ink screw positions and the ink and dampening duct speed ratios. and to adjust the parameters of the closed-loop controller.

After the accepted print has been achieved. the set values for the screw positions and duct speed ratios are fed back to the computer; it then corrects the parameters of the presetting algorithm according to the differences between the preset values and the values producing the accepted print.

During the presetting period the starting information of the jobs is given as well.

The simplified starting block of the control system is given in Fig. 6.

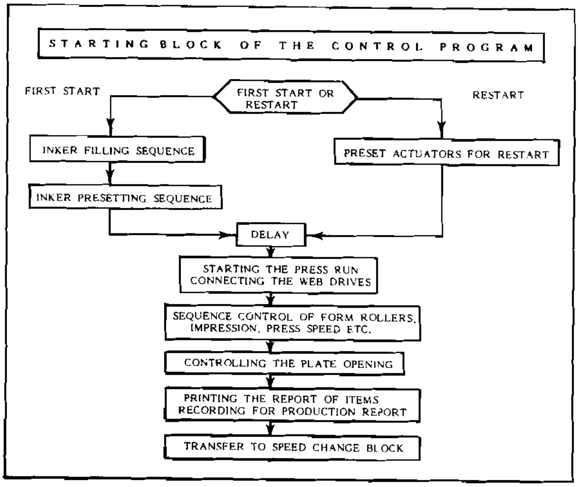

Figure 6. The simplified starting block of the control system

The control program gives special consideration to the following varying starting situations:

- filling of the inker. when starting the printing
- presetting the ink screws. the duct roller and the dampening roller with due consideration of the previous run
- sequence control and timing of the actuation of the inking and dampening form rollers. printing impression and paper web controls
- control of the appearance of tinting by means of the web densitometer and extra watering of the plate to

complete the plate opening as fast as possible

During the starting period the printing speed is accelerated to the level that gives the fastest opening of the plate. Acceleration to production speed is performed in the following control block.

The control block for speed changes is called when the plate is opened and the printer has given the acceleration command to the system. Fig. 7. The same control block is used when other speed changes are required during the printing

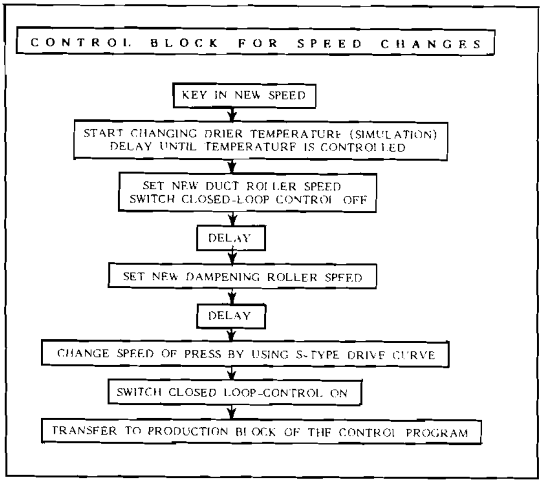

Figure 7. The simplified control block for speed changes.

This control program adjusts the delays between the speed changes of the duct rollers and the other parts of the press to minimize the effects of the changes on the density variations. This program feature has been tested by the prototype controller and the results have been most satisfactory /3.6/. A provision has been made for including the ink drying device in the press and under the control system.

When the control program for speed change is called. the closed-loop control of inking is called off. and it is turned on again after the speed change algorithm has been completed.

The control block for the closed-loop control of inking is first called after the printing speed is accelerated to the production level. A simplified block diagram is shown in Fig. 8. The main phases of this control block are

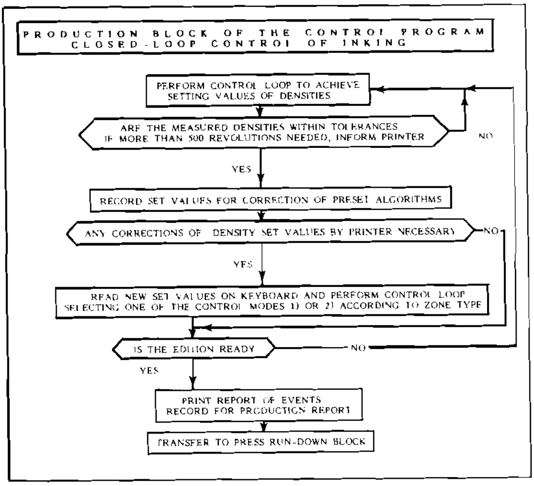

Figure 8. The simplified control block for the closed-loop control of inking

A Control of the densities of the test strips to achieve the constant (given) density profile

B Fine adjustment of the quality by the printer giving new setting values for the inking zones

1) adjustments are made in the inking zones of the density measuring heads (two sensors per one of the four adjacent pages

2) in the inking zones between the zones of the density measuring heads

Phase A is needed to allow the printer to evaluate the print quality and to decide whether or no to make any quality adjustments. If adjustments are not necessary. the set density values are accepted and production printing may be started.

During Phase A the system adjusts the densities of the test strips in the zones of the measuring heads to a given constant level. The ink screws in the zones between the density sensors are controlled simultaneously by keeping the preset ink screw position profiles unchanged.

Phase B allows to adjust the print quality by giving new corrected setting values for some of the inking zones. This may be necessary because of an error in the reproduction of some of the pictures to be printed, or in the grey balance, etc. Two kinds of control algorithms are needed depending on the positioning of the zone to be controlled: one for the zones having a measuring head, another for the zones situated between the density sensors.

Like in presetting, the bending of the duct blade is controlled to allow only a given difference of position between two adjacent inking screws.

Production is continued under the closed-loop control of inking until the given edition is completed, or the printer gives a command to run down the press.

The stopping control block of the control system is actuated when the edition is ready. The press is run down by the sequential control program corresponding to the starting block of the system but in a different sequence and with different timing. After stopping the press the matrix printer gives a production report including the most important statistics of the production period just finished.

Future developments

By the time of the Conference we shall have tested the system components and the control blocks of the control system. The control algorithms have been simulated as reported in the other Conference paper presented by our Institute. During the summer test trials will be carried out to adjust the control parameters in order to optimize the control. These test trials will also give information about the real reduction of waste achievable by the system. We expect to receive rather high figures and substantial savings.

The control system described in this paper has been used in the single-unit pilot web offset of the Institute. The next step will be adaptation of the system to a production web-offset press. Negotiations are carried out with a Finnish printing house and a Finnish electronics manufacturer and we hope to be able to start cooperation and construction this year.

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