Presetting and Controlling by the Heidelberg CPC-System

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Abstract: New technologies for presetting and setting ink keys in printing machines are described. Instrumental inspections of developed plates or printed sheets require optoelectronic and microprocessor means. Developing stages and present equipment are discussed. Calibration facilities due to so many plate surfaces common in graphic arts are briefly described. Calculations of zonal image area into duct sweep and ink valve openings and their parameters are mentioned. Examples of computer recommendations are given and the importance of the printer's decision is pointed out.

Technically seen, the printer must maintain the shape and the viscosity of an ink film on paper to a thickness of about 0.04 mil (1 µm) at a tolerance of about ± 1 % and that for the whole run.

This means that only precise and stable printing machines with low vibration levels can guarantee slur free production and correct register. In recent years in public we did not emphasize progress in this field. We, at Heidelberg think, TAGA is the right audience to learn about this engineering achievement.

Economically the printer must minimize make-ready time and paper waste.

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The CPC-System developed by consistent exploitation of opto-electronics and computer technology will help him reduce make ready by more than one third.

Microelectronic and computer technology may tempt the designer to complicate machine operating. He might be induced to balance the offset process by electronic means instead of trying to stabilize it by cheaper and more reliable conventional means.

Our principle is, to use only as much electronics as is necessary and only for safety and economical reasons.
Electronics and mechanisms are only auxiliary means for the printer to fulfill his production task. His knowhow and experience are the mainfactors in good printing.

In order to demonstrate technical achievements it is necessary to show you the equipment first:

the press control unit	CPC 1 in 3 options (Fig. 1)
the quality control unit	CPC 2 (Fig. 2) and
the plate image reader	CPC 3 (Fig. 3)

Fig. 4 shows the connections in between.

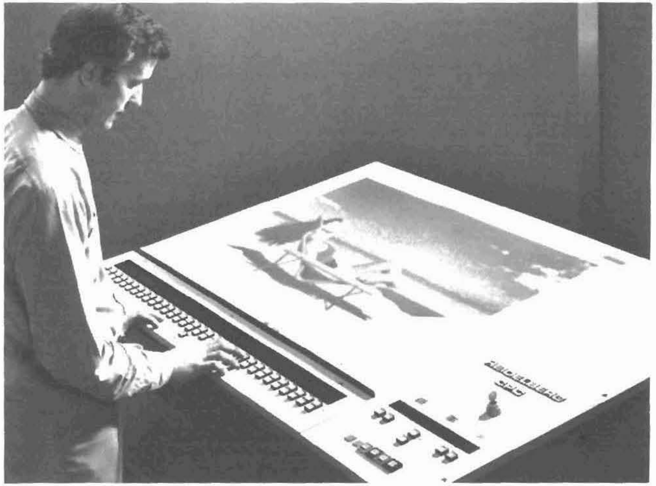


Fig. 1

Fig. 2

Fig. 3

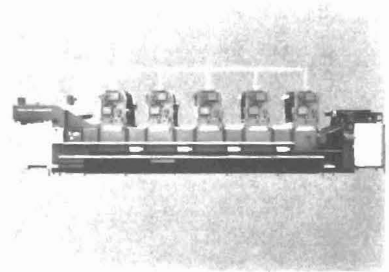


Fig. 4

New Technologies in Presetting

Since 1977 remote control has been common. What the printer needed was a quicker input to set the ink keys. Here it is:

- Light pen (Fig. 5) for quick presetting the ink keys according to the printers visual examination of the plate. Diodes flicker with high frequency, the pen senses the actual position. As far as we know it's the only one in the world applied to a printing machine.

- Tape cassette (Fig. 6) to store the ink profile of a previous run for a repeat run of the same job. (Cassette mainly because of safety against fingerprints and dirt.)

- A second memory, so that the profile of the next job can be put into the press control device during running of the machine. Now it's real pre-setting.

- Microcomputers (µC).

Indeed the µC controls a lot of additional features. For example it opens (or closes) for a short time the ink valves more than actually necessary when increasing (or decreasing) ink flow is asked for by the printer in order to achieve the shortest possible reaction time for densities to be changed.

This is really not new. It's what a printer does with his spatula *, when he adds or removes ink from fountain roller. The great

* It has been called a "Electronic Spatula".

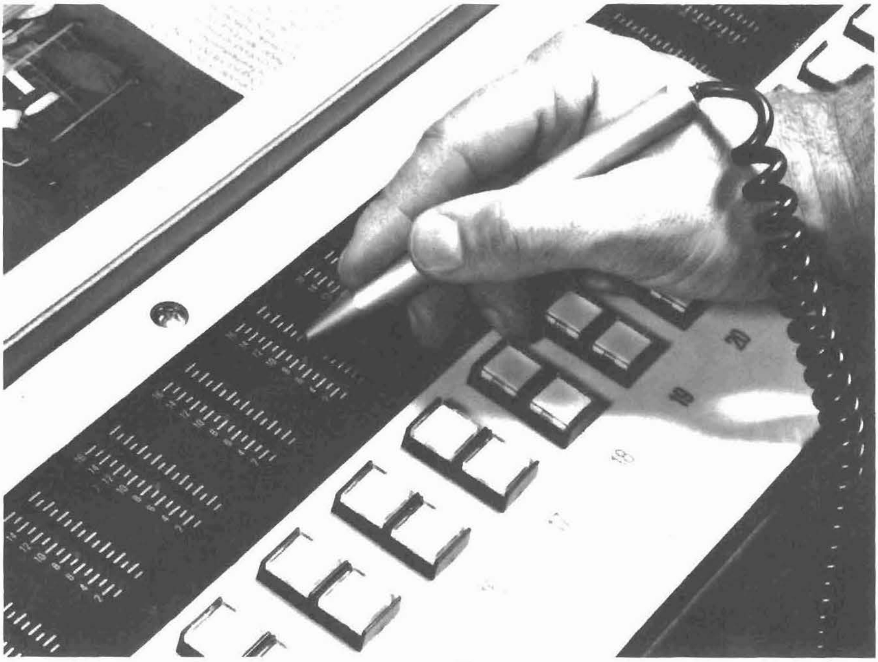


Fig. 5

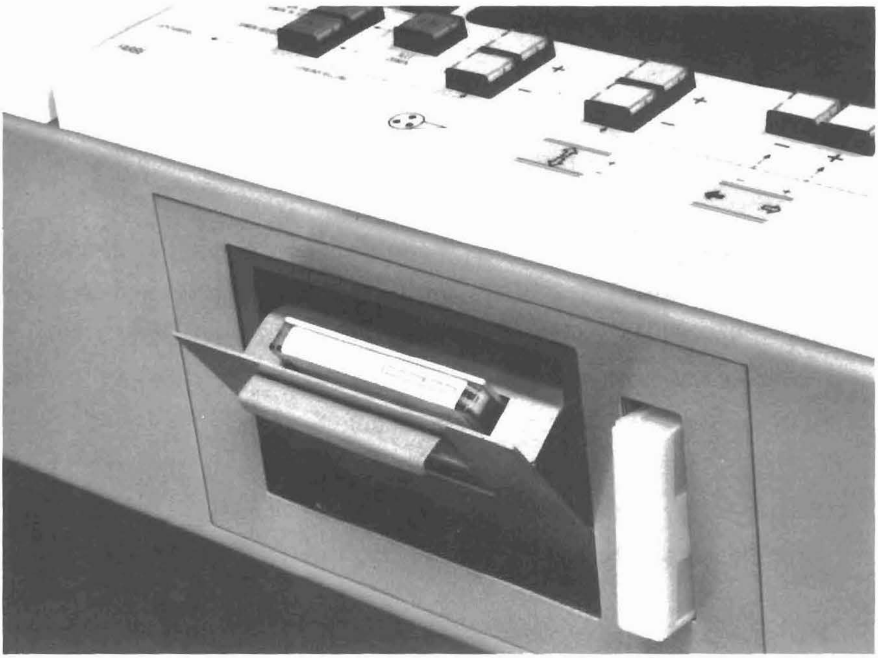


Fig. 6

advantage of electronics is to do it exactly with the right amount and separately for each ink zone. Another example is the "turn off feature". If the printer wants to wash the whole machine, the µC closes all ink valves and switches the duct sweep to full size.

Machine requirements for good controlling.

At the 1979 TAGA-Conference, John MacPhee gave us an excellent engineers analysis of the Lithographic Printing Process.

He pointed out how important the grade of emulsification of water and ink is to the printing process.

The Alcolor Dampening System is a good tool for the printer in order to fulfill the physics of litho offset.

Plates can be premoistened. Rolls a and b are tooth geared with each other and driven by an electronically controlled separate motor. In order to achieve the necessary emulsification quickly, before actual start of printing roll e bridges the ink and water system.

The Alcolor System (Fig.7) is one of the bases for the later mentioned "follow-up-mode" of CPC 1-03. The other important one is the sectional inking system.

At the TAGA conference in Kansas-City I used this slide to emphasize the drastic differences between the ink knife method and sectional inking like CPC (Fig. 8).

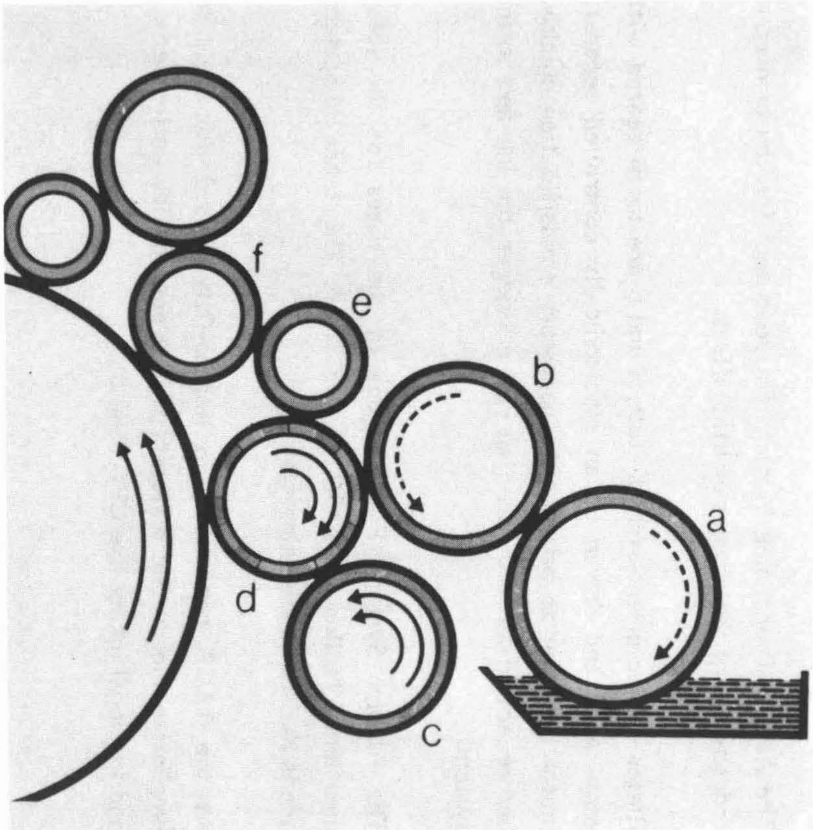

a
b
c
d
e
f

Fig. 7

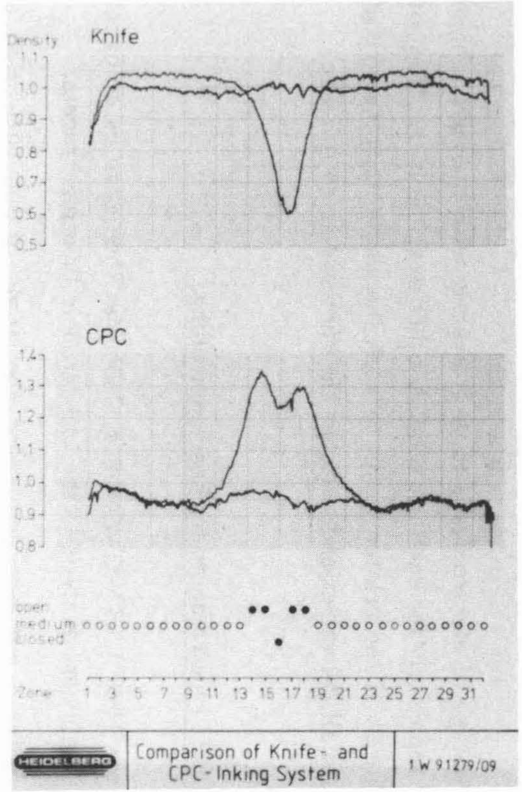

Density
Knife
1.1
1.0
0.9
0.8
0.7
0.6
0.5
CPC
1.4
1.3
1.2
1.1
1.0
0.9
0.8
open
medium
closed
Zone
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
Comparison of Knife- and CPC-Inking System
1 W 91279/09

Fig. 8

From where to get data and how to set ink keys

The printer may choose between two modes and four sources:

mode	**source**	**equipment**
visual inspection and guess of	printed sheet	
	developed plate	
instrumental inspection	printed sheet	CPC 2
	developed plate	CPC 3

He may put in ink setting values:

mode	**input equipment**	**options**
manually by fingertips into	Press Controll Unit with Microcomputers	CPC 1-01
manually by light pen into		CPC 1-02
via Cassette into - of previous run from CPC 1-02 - of plate from plate reader CPC 3		CPC 1-02
on line from CPC 2 into		CPC 1-03

In the following chapters the new CPC-technologies are briefly described.

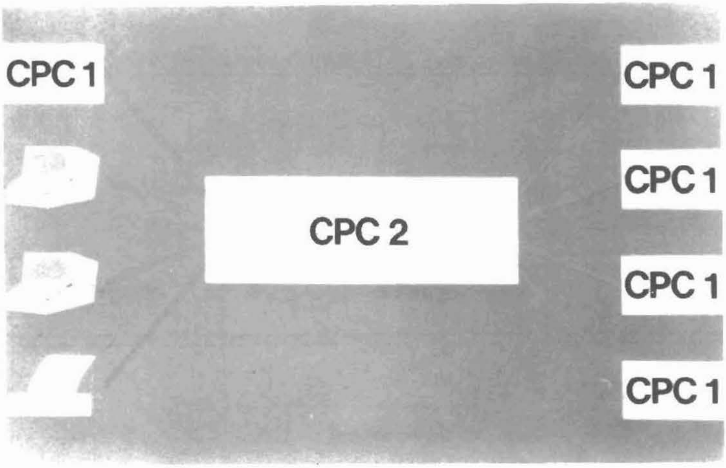


Fig. 9

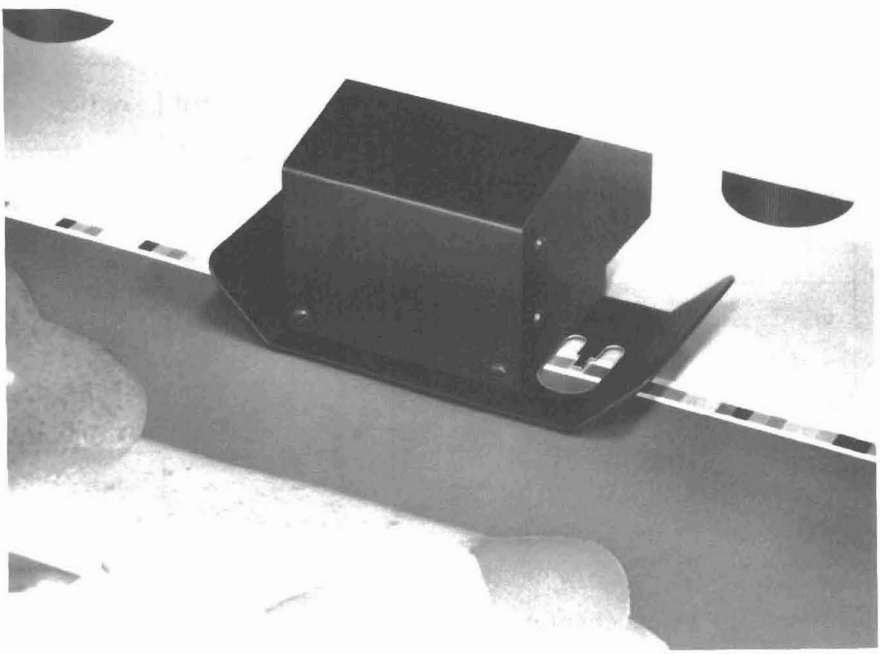


Fig. 10

"The new quality control device CPC 2"

Why do we need a new scanning densitometer (Fig. 2) ? The only reason is flexibility. It scans any strip at any position on the sheet. For new, unknown test strips not yet fed in, the µC can be programmed by the printer.

The Quality Control unit may serve up to 7 machines (Fig. 9) , depending how often it is used by the different operators. Common are 3...4 machines. With a written record any number of machines can be served.

The short measuring time of only 8 sec. for 208 single patches could be achieved by using a multichannel measuring head (Fig. 10), which is able to measure up to 6 colors in one scanning run. An additional head for special colors is planned. The right filters have to be selected.

When for several printing machines used, certain datas have to be fixed: the identification of each one in printing size, sequence and number of printing units, kind of test strip used, desired tolerances, reference values, etc.

Therefore at the beginning, special data have to be keyed in by a machine dialogue (Fig. 11). They are stored on a separate floppy disk, one for each machine (Fig. 12).

For further measurements during the run, the disk is the easy key to the quality control unit, because all reference values and the desired tolerances are stored on that floppy disk.

Fig. 11

Fig. 12

Densities of solids in one and more colors and of different screens are measured. Contrast, ink trapping, hue error and grayness can be calculated by an integrated minicomputer.

Contrast $$K\ \% = \left(1 - \frac{D_{80\ \%}}{D_s}\right) \times 100$$

Ink Trapping $$IT_{2,1} = \frac{D_{1+2} - D_1}{D_2} \times 100\ \%$$

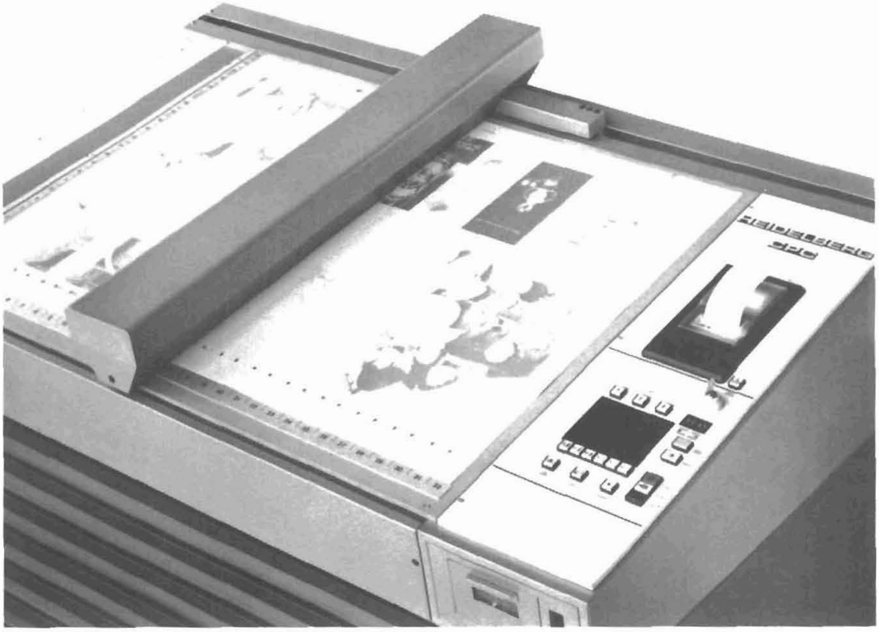
$$IT_{3,2,1} = \frac{D_{1+2+3} - D_{1+2}}{D_3} \times 100\ \%$$

Hue Error* $$HE\ \% = \frac{M - L}{H - L} \times 100$$

Grayness* $$GR\ \% = \frac{L}{M} \times 100$$

L,M,H Densities of same color with 3 different filters, low, medium, high.

* described in GATF Research Progress Report No. 81, Sept. 69
Index 1,2,3 mark color, D = Density.



In offset the necessary ink volume for a sheet depends on the size of the image area because the ink film thickness on paper is supposed to be constant as opposed to gravure. To summarize the dot area zonally on the plate or film is sufficient for control.

The plate is preferred because of good handling instead of a mounted film and the final dot size of the plate just before printing.

In reality ink splitting depends on the moisture content of ink. The moisture rate itself depends on the zonal throughput of ink. To complicate things, the throughput depends on the zonal size of the imaging area. This vicious circle together with blanket and paper causes some interdependencies in the printing process.

It is therefore uneconomical to determine the image area on a plate reader too accurately on one hand and - not accurately enough on the other hand. Since DRUPA where we exhibited our plate reader for the first time, we've gained a lot of experience. At TPG in Paris last month several new plate readers appeared and confirmed the trend.

At the first stage we studied the problem with a scanning television camera. We then switched over to the present equipment for economical reasons and because of the illumination problems and of the height of the unit.

We then designed a unit with even illumination (Fig. 14) and several sensors for each zone in a travelling bar. Each sensor sees an area of about 1 1/2 sqi.

CPC 3 Druckplatten-Leser
CPC 3 Plate image reader

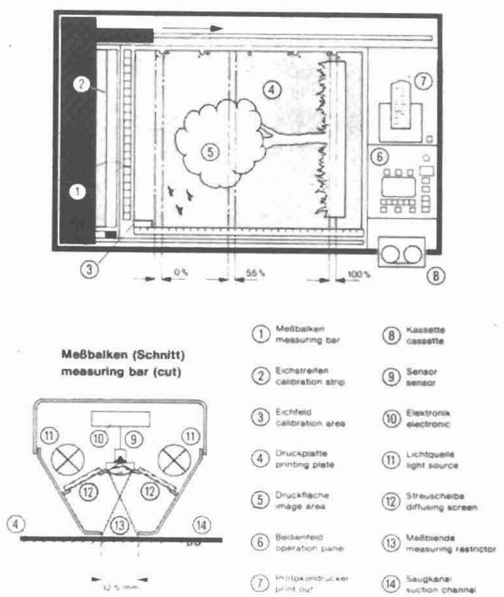


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Fig. 14

Fig. 15

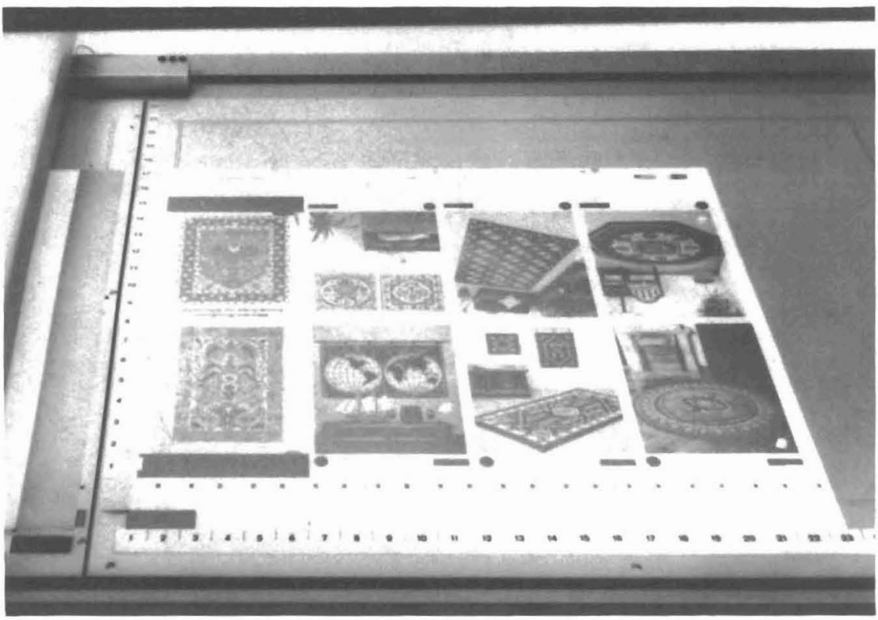

Fig. 16

Plate Surfaces

The wide range of different plate surfaces in graphic arts were a challenge for our engineering efforts. Non-printing areas of monometal plates are white, on multimetal plates they are dark. We got glossy plates and brushed ones, anodized and polished ones with rough and with fine grain, positive and negative plates. Printing areas can be of different color, dark and light. We solved it by having the printer to put a calibration strip of his own plate on the reading table. So the printer using different kinds of plates can store a calibrating strip of each type of plate (Fig. 15). Strip and plate of same type can be placed in measuring position and then the travelling bar sensors the strip first in order to calibrate all sensors (Fig. 16). If the printer wishes to consider even developing differences between the image layer of printing plate and that one of the calibration strip he may use an additional feature. A small calibration area of the individual plate, situated at the edge of the plate (Fig. 17) is measured by a special sensor which recalibrates the others accordingly.

Waterless plates with even coloring may be treated like monometal plates.

The summarized image area of each zone is written onto a cassette for further treatment in the Press Control Unit CPC 1. Plate size and Color are keyed onto the magnetic tape as well (Fig. 18).

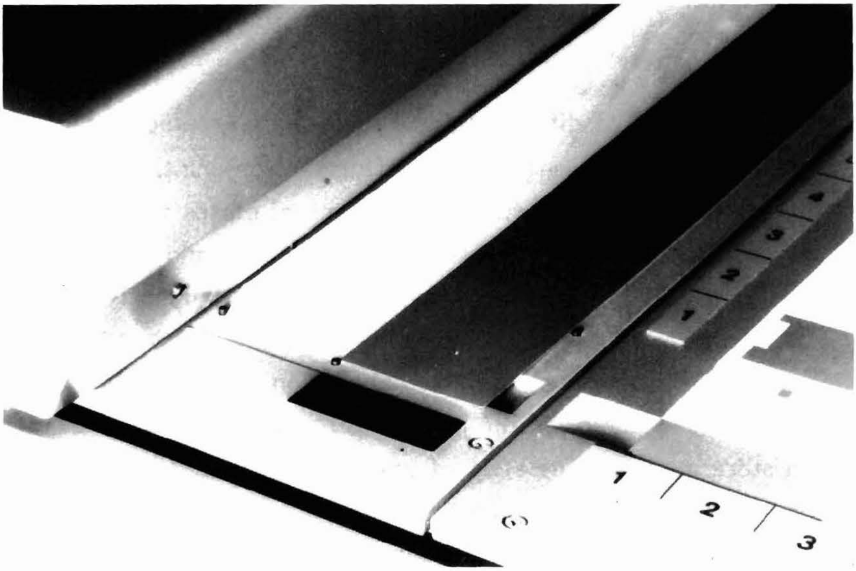

Fig. 17

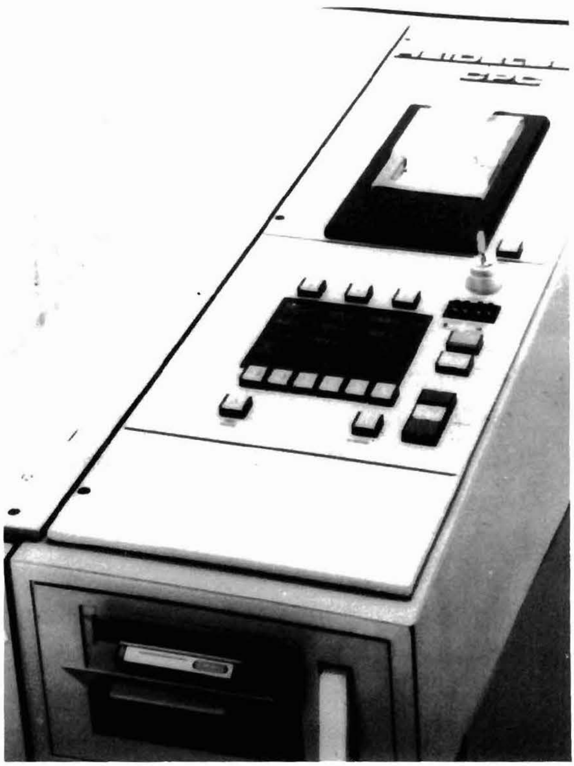

Fig. 18

Image area and ink valve opening.

Ink volume V is determined mainly by two parameters: duct sweep b_F and valve opening s_F (Fig. 19).

$$V \sim (b_F, s_F)$$

But machine speed, viscosity of ink, pigment in ink, blanket, paper and others influence the inkfilm thickness on paper.

What we really need to know is not the inkfilm thickness but the desired optical appearance, usually but not quite correctly measured in terms of density (in bel).

Therefore the actual diagramm is more complicated as shown here.

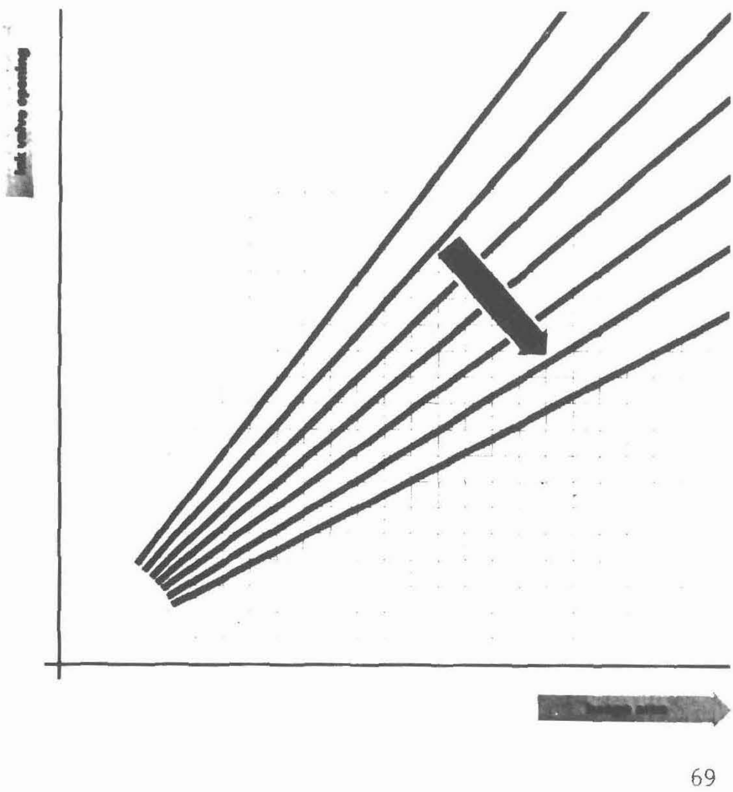

Fig.19

The follow up mode from Quality Control Unit

Let's summarize. The printing machine gets data by

finger tips
light pen
cassette and
finally online.

What does online mean ?

The Quality Control Unit CPC 2 as described above might be electrically connected to several Press Control Units CPC 1-03 (Fig. 20).

The printer may release the density values per pushbuttons for electrical transport to the Press Control Unit CPC 1-03.

The unit CPC 1-03 converts density deviations into recommended valve openings and duct sweep angles. A lot of parameters are involved: rheology of ink (tack, viscosity, grade of emulsification etc.) paper, machine speed and temperature, and others.

Because of this variety of different parameters we thought a fixed program might not be sufficient. Therefore our system has learning capabilities to simulate the actual machine and job situations.

An important feature of our system is that the printer has the opportunity to override the computer. The printer and not the electronic circuit is the heart of the printing process.

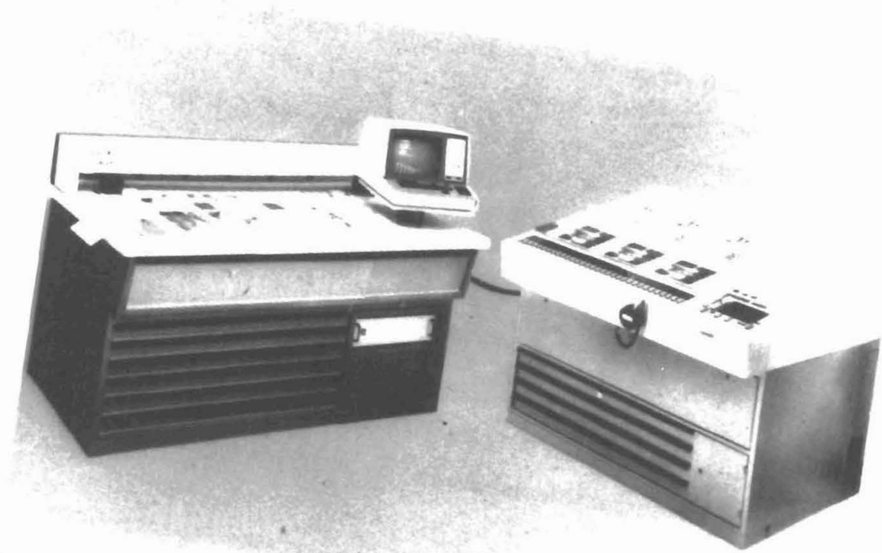

Fig. 20

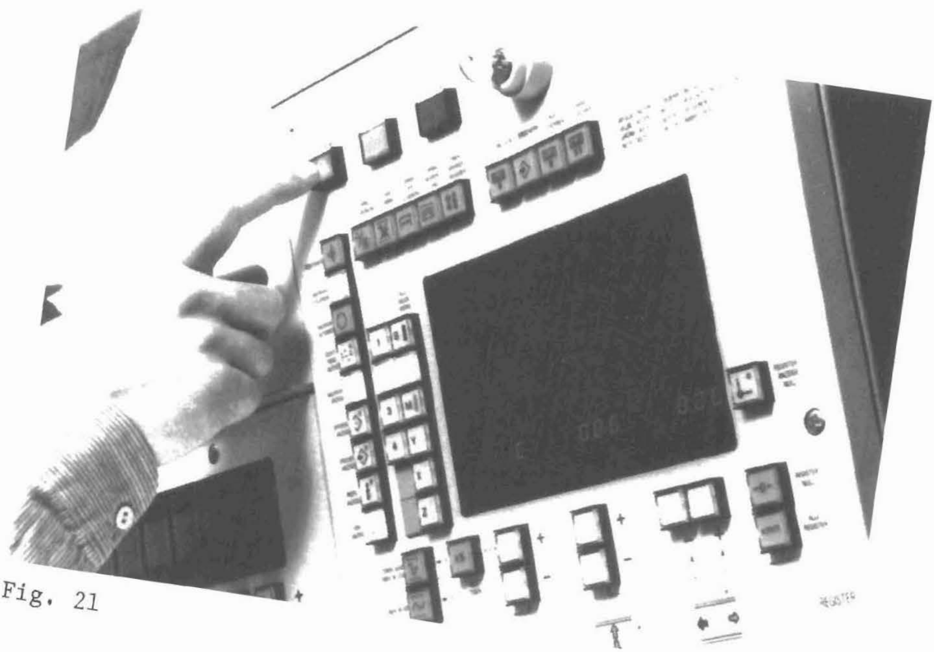

Fig. 21

Under certain circumstances the printer may decide to let the data, released at the Quality Control Unit CPC 2, flow directly into the machine by pressing the "follow up" button at Press Control Unit CPC 1-03.

To operate the three units, Plate Reader CPC 3, Quality Control Unit CPC 2 and Press Control Unit CPC 1 is simple to learn.

There is no need for the printer to become a printing physicist or a computer technician. A big effort was made to guide the printer to make the correct decisions and to press the right keys (Fig. 21).

For example when "read cassette" is pressed, an additional key saying "attention !" flickers up. When the "attention" key is operated "write cassette" flickers, reminding the operator to save stored values (if necessary) otherwise they will be replaced by new values read from the cassette.

Many problems had to be solved:

Compatibilities and interfaces had to be specified, a lot of software engineering had to be done apart from the hardware engineering. -Details would be beyond the scope of this paper and might be discussed later.

Although trained and based in mechanical engineering we Heidelberg engineers have been obliged by CPC to step into the age of optoelectronics and computer technology in order to provide the printer with a well balanced and harmonic system from a single source.

This marriage of mechanical engineering and electronics promises further developments which we will enjoy presenting to you at future TAGA meetings.