On-Press Imaging for Offset Printing

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Abstract: The desire for short run printing and less skilled operators is generating interest in on-press imaging. On-press imaging requires daylight operation and no chemical processing, whereas most approaches are based on thermal (I.R.) technology. Imaging on-press requires special considerations due to press RPM limitations and other factors. The two main current approaches are imaging plates on the press (e.g. Heidelberg Quickmaster DI), or a reuseable plate (e.g. MAN-Roland DICO technology). Other technologies are being developed such as spray-on switchable polymers. The technology of the imaging heads and the materials involved in the imaged layer will be discussed.

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Objective and Background

One reason offset lithography reached dominance in the printing industry is the relatively fast changeover speed and relatively low changeover cost. It is cheaper and faster to generate and mount a new offset plate then a flexo plate or gravure cylinder. It is interesting to speculate on where will offset be if changeover can be made even faster and cheaper, but first a short explanation is required to show why offset is the primary candidate for rapid progress in fast changeover (or "make-ready" in printer's jargon) as well as a prime candidate for on-press imaging.

Figure 1 compares the three basic printing technologies used today. As can be seen, the offset press is more complex than other presses thus it is natural to raise the question whether offset is the natural candidate for rapid changeover. I am assuming that for a rapid changeover some form of laser writing of the masters will be used, and considering the trend to chemical-free preparation of masters (a trend only to get stronger by the year 2000), one can rate the potential of the three methods by the cost and availability of the laser required to make a new master. Table 1 shows a comparison of preparing the masters in a chemical-free process. In this case flexography and gravure, laser ablation is used. Considering the fact that the cost of "crude" (unmodulated) laser power is the same for near IR and CO_2 lasers (both are about $50/watt in volumes of 10,000 w/year), the different wavelength does not make a large difference. For simplicity and ease of comparison, the calculation is for preparing $1m^2$ of master. It is clear from this calculation that the large amounts of material which has to be removed in both flexography and gravure masters makes them a less likely candidate for

FIG. 1 PRINTING TECHNOLOGY

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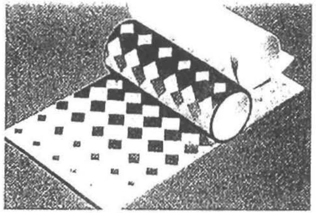
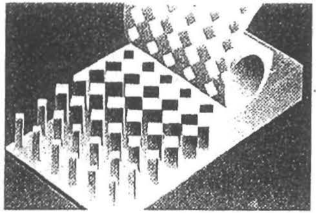
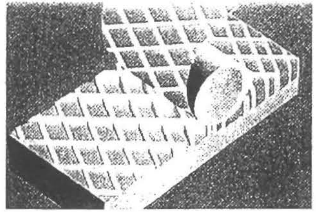
Litho Offset



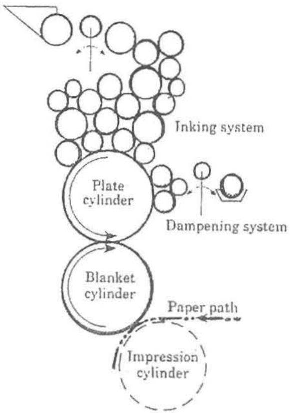
Flexo



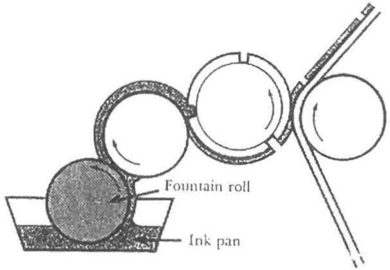
Gravure



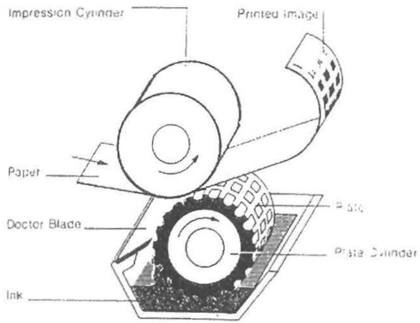
Press



Press



Press



rapid changeover, and makes on-press imaging of these master less likely. The most likely candidate after offset is polymer filled gravure, as demonstrated by MAN Roland at DRUPA 95 in their DICO-Gravure technology demonstration.

Table 1: Energy Required to Change Master

(For 1m^2 of master)

	Offset	**Flexo**	**Gravure**
Volume to be removed/modified:	<1 cm^3	typ 300 cm^3	typ 25 cm^3
Energy required	3000 joule	900,000 joule	75,000 joule
Laser type	Diode, YAG	CO_2	CO_2, YAG
Changeover time for 30w laser	100 sec.	30,000 sec.	2,500 sec

Narrowing the discussion to the most likely candidate, offset printing, there are two possibilities: a pre-coated plate advanced and imaged on the press or a re-usable printing cylinder. Both technologies were shown at DRUPA 95, one as a product (Heidelberg's Quickmaster-DI), and one as a technology demonstration (MAN Roland's DICOWEB). This is the point to compare these methods to a solution based on a computer-to-plate (CTP) plus automatic plate loading. For long print runs the CTP solution, even automatic plate loading, wins hands down. For short runs the situation reverses. Imagine printing runs of 1000 copies. Such a run only requires a few minutes of press time. Each run, if printed double-sided, requires at least 8 plates. It is easy to see that this will exceed the throughput of a CTP system and on-press imaging will have a better payback. Considering the potential of gapless printing and minimizing material handling narrows the choice even further, to a reusable printing surface. It is interesting to see how close it is to reality. The technology of reusable printing surfaces is linked closely to the technology of thermal processless printing plates. If a plate is thermal (i.e. responding to a threshold temperature and not affected by light) and processless (i.e. ready to print after imaging), it can be used for on-press imaging. If the same plate can be erased and re-used, the dream of on-press imaging of a reusable plate can be achieved. Processless thermal plates can be achieved by starting with a hydrophilic surface, selectively adding polymer to the areas required to carry ink, or pre-coating the whole area with a polymer which is selectively modified by a laser. The energy requirements of both methods are comparable. The first method was shown by the Polariod corporation (building on a much earlier technology using Lasermask film and an aluminum substrate). The second method is being developed by the 3M corporation and many other suppliers of printing plates. The discussion here is limited to processless plates that can be imaged on-press; if the scope is widened to thermal plates requiring processing, Kodak is the clear leader at present. The frequent comparisons based on the required laser power are important. Given sufficient laser power it is quite easy to devise an erasable printing surface as almost any material can be selectively cleaned off the cylinder by a sufficiently strong laser. After printing, all residues of ink and coating can be cleaned off as well using the same laser. Tests and calculations show that this requires over an order-of-magnitude increase in laser power compared to more chemically sophisticated methods. Plotting the progress in laser power it is not likely that the goal can be achieved economically by progress in laser power alone by the year 2000.

More practical is the on-press application of a polymer which can be switched, using a near IR laser, from a hydrophobic state to a hydrophilic state or vice versa. The preference to near IR wavelength, typically 830nm, over the 10.6 micron wavelength of the CO_2 laser comes from the availability of cost effective multi-beam laser writing heads at this wavelength. Multi-beam is a must since the press cylinders have a limited speed, typically under 1000 RPM, thus writing a cylinder 1000 dots/cm in one minute requires using hundreds of channels in parallel. The polymer can be applied to the reusable surface using methods such as spray or roller. This concept is shown in Fig. 2 and Fig. 3. Polymers that can be switched with a reasonably low laser energy exist today, for example in the 3M thermal plates and many more are under development for processless thermal plates. These polymers, together with ink residues, can be cleaned off using a device similar to a blanket washer. The existing polymers, however, still require a fairly good cleaning of the cylinder in order to achieve good adhesion and avoid degradation of print quality. A more desirable polymer would have the following properties:

1. Water based application (to avoid VOC and flame hazard);
2. Clean up with non-corrosive and non-poisonous chemicals using a unit similar to a blanket washer;
3. Run length of 50,000 copies (however 10,000 is a good start);
4. Sensitivity of better than $0.5 J/cm^2$;
5. Tolerance to residual contamination on the cylinder;
6. Wide press latitude (contact angle difference of over 40°).

The last item is required to achieve rapid ink-water balance on the press. This can be judged by the contact angle of a drop of water placed on the hydrophilic and hydrophobic part. A modified fountain solution may be used to increase the contact angle.

The financial rewards for perfecting this "switchable polymer" are major. The offset plate business today is about $4B world wide. By the year 2000, up to 10% of that can be in "switchable polymers", used both as pre-coated processless thermal plates and as on-press applications. Polymers meeting all of these requirements, as well as silicone-based sprayable polymers for waterless offset, are being developed by the major vendors of consumables for the graphic arts industry.

In order to meet the needs of on-press imaging, Creo has developed a multi-channel thermal (830nm) head. The head is currently used in our computer-to-plate system (where its image quality earned it the GATF nomination for achieving the highest resolution in the CTP study conducted in January, 1996). The current head is based on a 240 channel light valve and delivers 10W to the plate surface. A 20W head is under development. This head is designed for 1 minute imaging for a typical 4 page press. For short makeready the imaging sharpness of the head is critical, as the sharper the imaging the more stable is the screen density against process variations. the reason for that can be seen in Figs. 4 and 5. It can be easily shown that in order to hold the screen density to about 2% in the presence of 10% process variation, the sharpness of the imaging has to be such that the transition time from no laser power to full laser power should be narrower than one pixel.

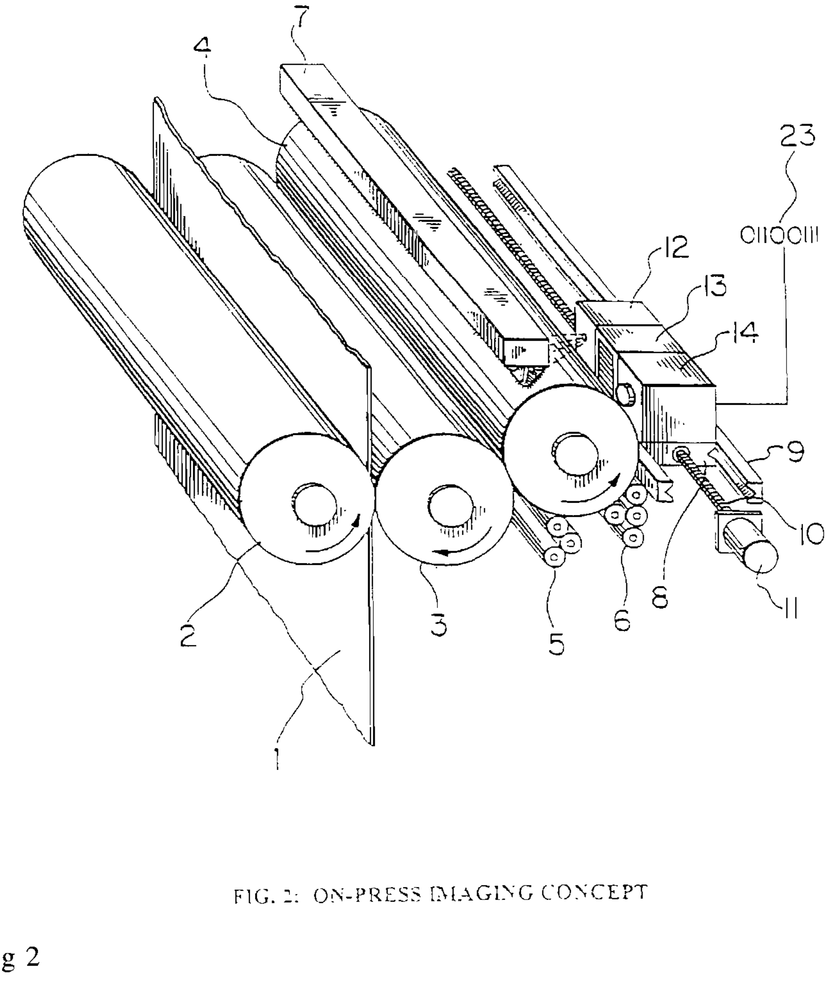


FIG. 2: ON-PRESS IMAGING CONCEPT

Fig 2

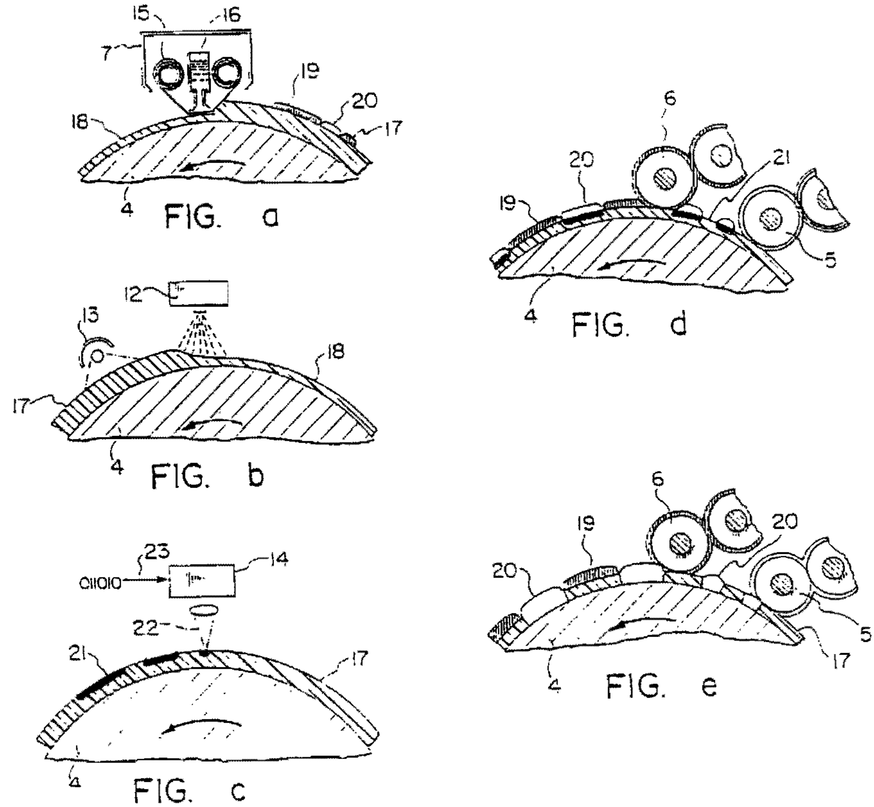


FIG. 3: ON-PRESS IMAGING SEQUENCE

Fig 3

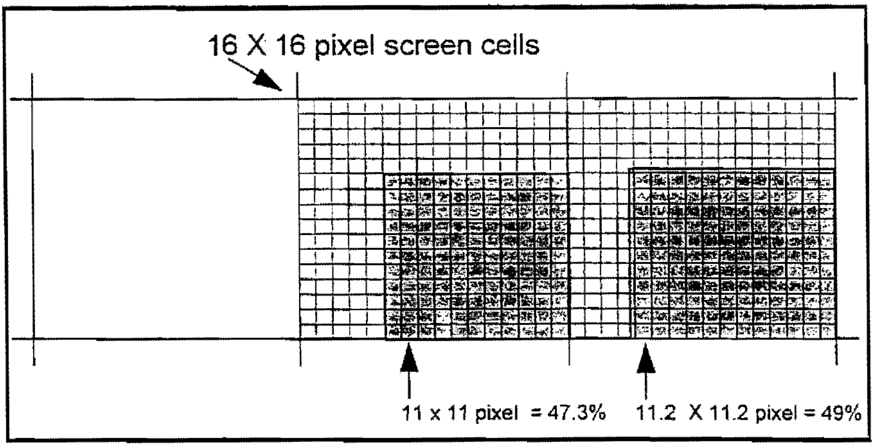


Fig. 4: SCREEN DENSITY CHANGE CAUSED BY 0.1 PIXEL EDGE SHIFT

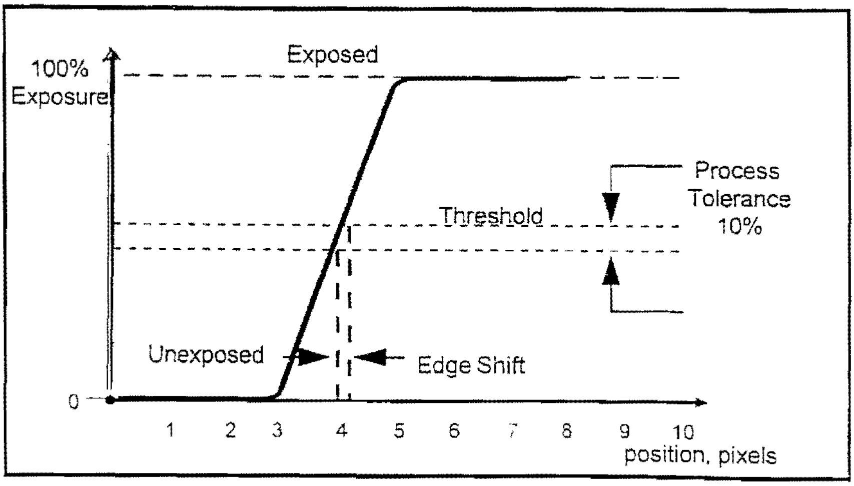


Fig. 5: TRANSITION DISTANCE VS. PIXEL EDGE SHIFT