Technological Peculiarities of Reproduction of the Monochrome and Colour Image in High-Speed Electrographic Printing Machines

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Abstract

During the last few years High-Speed Electrophotographic Printing Machines have won firmly their niche in efficient duplication of short run. Since the end of 80s besides analog high-speed equipment known as High-Speed Copier, digital equipment of the following types Copier, Copier/Printer and Printer has been appeared that is capable to read out computer data, as well as to reproduce component image with polytypic information.

The goal of this work is to analyze a technology of reproduction of images, and to analyze circuit and constructive design of high-speed equipment that has been classified as a separate class.

Introduction

High-Speed Electrophotographic Printing Machine use a world-wide NIP Technology (Non-Impact-Printing Technology) that is based on electrophotographic process of reproduction of the monochrome and colour image [1, 2].

It should be noted, that there is no great difference between conventional multipurpose electrophotographic equipment and High-Speed Printing Machines. A Copying Machine can be attributed to a category of printing machines if it meets the requirements below:

a) It is distinguished for its high-speed printing;

b) It is distinguished for its imaging of high quality (monochrome and colour);

c) It is adapted to print in a mode of long run (copying);

d) It combines a major variety of functional opportunities to control reproduction of image and its editing, and for a digital version - it is able to reproduce component polytypic image with its prepress processing in-line mode;

e) It is able to change image while a printing process is carried out (for a digital version);

f) It allows to produce duplex of printed products automatically;

g) It has the updated means of postpress processing of copies (sorting, laminating, binding, and etc.) that can be installed additionally.

High-Speed Electrophotographic Printing Machines are up-to date alternative to offset presses that are based on dry process of offset printing [3].

High-Speed Electrophotographic Printing Machines are designed to produce efficiently mould-free printed products of short run with a opportunity of their personalization and renovation (for a digital version).

High-Speed Printing Machines are applied in the following fields:

- efficient reproduction of the monochrome and colour document originals with postpress processing of run [4, 5];
- high-speed output of computer data (for a digital version) and its duplication [5, 6];
- Short Run Colour [7] of advertising letters, business information, and etc. issued in stitched and bound form and orientated an individual consumer of printed products;
- efficient digital multicolour printing with use of different sources of information including a telecommunication net, based on a principal "when and where it is necessary" [8];
- specialized application in the fields of cartography (for topographic provision of military forces), town-planning, and etc. [2, 9].

A development of High-Speed Electrophotographic Printing Machines is on the rise stage: amount of new models of the Machines continuously increases, the main parameters of the Machines are improved, and their application spheres are expanded.

High-Speed Electrophotographic Printing Machines can be classified conditionally as follows, Fig.1.

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In Monochrome High-Speed Electrophotographic Printing Machines it is used a well-known classical technology [10] of image reproduction in photoreceptor with subsequent transfer onto paper.

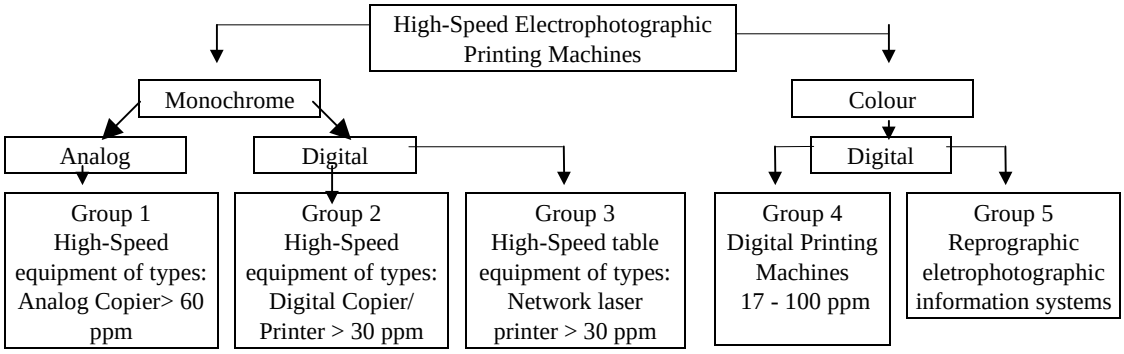

Figure 1. Conditional classification of High-Speed Electrophotographic Printing Machines

The technology of colour image reproduction is more sophisticated. In Colour Printing Machines the following are used:

A. A classical indirect electrophotographic process of reproduction of colour image [2] by repeated transfer from a photoreceptor onto paper.

B. A new electrophotographic process of reproduction of colour image on paper, known as Landa-process or a process of electrophotographic offset with liquid development and two-staged transfer.

A diagram of the technology of colour image reproduction according to "**A**" version is shown in Fig.1. A laser ray in the first recording cycle is to expose four data files (sections 1, 2, 3 and 7) with colour codes: red, yellow and black accordingly. After developing of the exposed sections ("negative-positive" scheme) with yellow toner, it will be formed the first component for a subtracting synthesis of red, yellow and black colours, as well as there will be yellow colour in a monolayer (section 4). The first component will be transferred onto the receiving base, a photoreceptor, after cleaning, will be back for the second recording cycle. In the second recording cycle four data files (sections 1, 2, 5 and 7) is to be exposed again, then they are developed with purple toner and will be transferred onto the same receiving base, where there is already the first component of image. The same procedure takes place during the third recording cycle by developing with blue toner. In the fourth recording cycle just the only one data file corresponding to black colour is exposed. When it is developed with black toner and is transferred onto the receiving base, where there are already three components of image, optical contrast of black components is increased. Black toner is used when it is also necessary to reproduce only monochrome documents. Colour balance change of colour image is achieved by changing of a recording mode or developing in I, II and III cycles.

A process of electrophotographic offset ("**B**" version) is based on link between a conventional electrophotographic process and an offset printing process, using liquid toner for it, that is called “electroInk”. The advantages of the toner are composition and configuration of particles, that are in the shapes of balls with 30 mkm diameter and form a homogeneous film during a reversible developing. To expose an organic photoreceptor a semiconductor laser rule is used. After developing, the image is transferred onto an intermediate rubber covered, so called, offset cylinder. Transferring onto the offset cylinder, and from it onto paper is done by a contact method. Adhesive properties of a developer, heated thermostabilized condition of the offset cylinder and gentle pressing provide practically the complete toner transfer onto paper. When the transferred toner is drying natural fixing of image is done. Colour synthesis is carried out by a conventional triad method according to a diagram shown in Fig.2 below. The only difference is that the transfer is two-staged.

The closest analog of High-Speed Electrophotographic Printing Machines are printing machines operating according to a dry offset principle [3, 11]. It may be printing machines GTO-DJ or Quickmaster-DJ manufactured by the German Company "Heidelberger Druckmasschinen AG". It is based on, so called, Direct Imaging technology (DJ-technology). A layer, that is not wetting with ink, is burnt out by a powerful laser ray on a master plate, directly in a machine, and a printing plate of high quality is produced. Further the printing technology does not differ from the offset one. Parameters comparison of an electrophoto-graphic technology with an offset technology, when a multicolour printing is done, is shown in Fig.3. Whence it appears, that the electrophotographic technology is inferior to the offset technology in maximum resolving power and efficiency when long run of printing is produced. However it is more effective when short run of printing is produced. And what is the most important, operating in-line mode it provides personalization of the printed products, and any changes can be made in every copy on the go of printing.

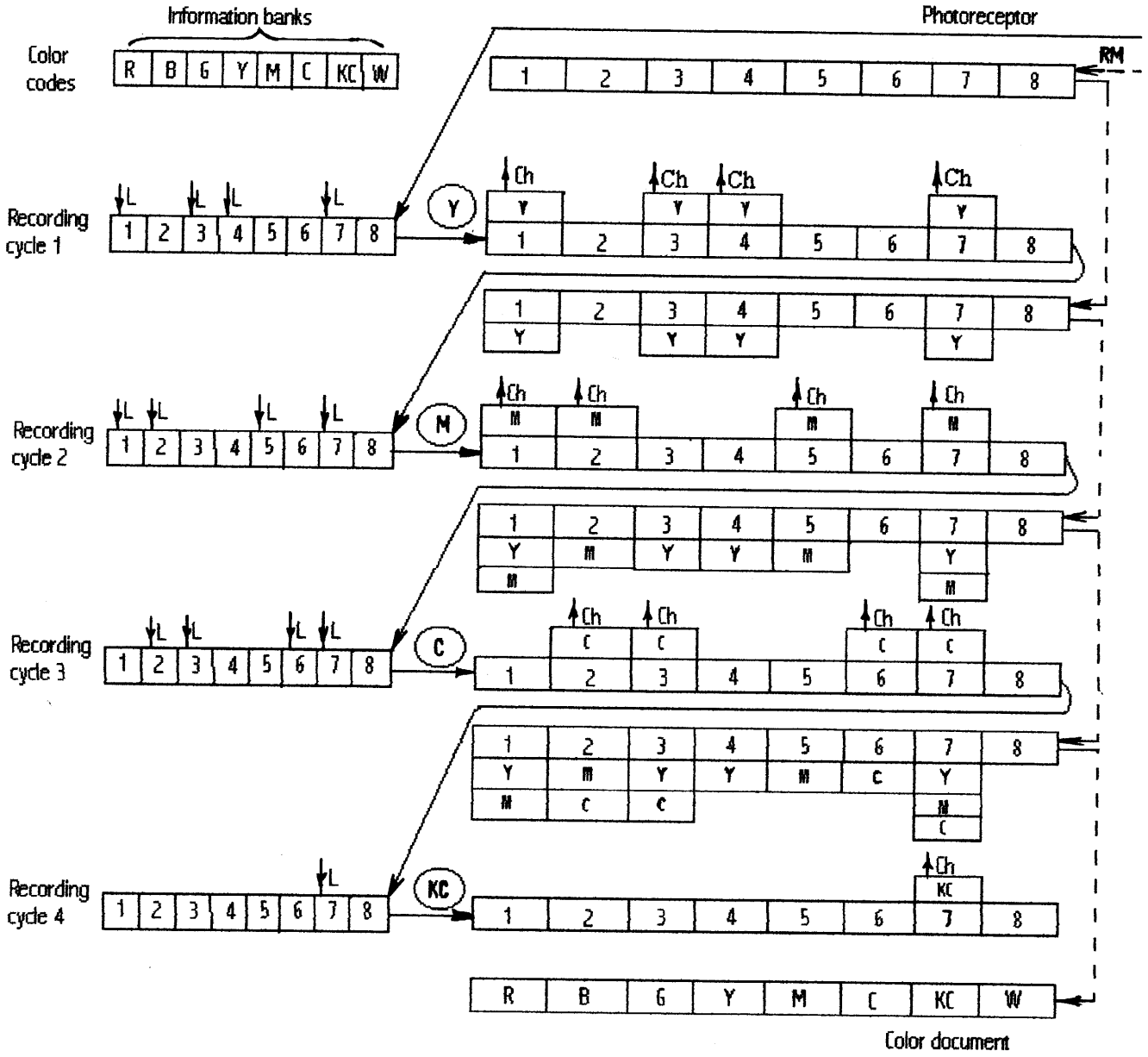

Figure 2. A diagram of color documents reproduction by a subtracting color synthesis method ("negative-positive" development). ↓ - laser radiation; R - red, B- blue, G- green, Y- yellow, M- magenta, C- cyan, KC - black; W - white; 1...8 - photoreceptor sections and receiving bases corresponding to many-color components of image [1- Data file; 2- Color codes; 3- I recording cycle; 4- II recording cycle; 5- III recording cycle; 6- IY recording cycle; 7- Photoreceptor; 8- Color documents].

Parameters or functions	Technologies		Comments
	Electrophotographic	Dry offset Compurter to press	
Run profitableness	1 -500	400 - 2000	
Maximum resolving power, dpi	800	2540	
Amount of colours being printed	1-4 or 6	1 - 5	
Speed, ppm	17 -100	330	
Operation Output, prints/hour	1800 - 6000	20000 - 40000	For one sided printing
Functional opportunities:			
-Printing on both sides	Yes	Yes	
-Operation in-line	Yes	No	
-Electronic adaption (selection)	Yes	No	
-Component document production	Yes	Yes*	* Opportunities are worse
-Editing opportunities	Yes	Yes*	* Opportunities are worse
-Personal of prints	Yes	No	

Figure 3. Comparison of the opportunities of the electrophotographic imaging technology with the offset imaging technology

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Summary

The above information shows that there is no great difference between equipment that is widely adopted and high-speed printing machines. It is offered a group of parameters that are specified the belonging of duplicating output equipment to a category of printing machines. It is selected conditionally the limits of speed for some categories of printing machines: 60 ppm - for analog printing machines and 30 ppm - for digital printing machines; it is specified the fields of application of printing machines.

It is shown the opportunities of electrophotographic technology that are realized in high-speed printing machines and the advantages of this technology in comparison with the alternative dry offset technology.

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Biography

Oleg R. Kharin graduated in 1978 from the Vilnius's (Lithuania) State Technical University. 1965-1984 – researcher at the Institute of Electrography in Vilnius.

1984 – 1997 - chief of the departament of Institute of Electrography in Vilnius, since 1997 Deputy Director General on Science – Scientific Research Phototechnical Institute on Slavich Co. Director (Nifti – Slavich, Pereslavl–Zalessky).

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