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(54) Title: METHOD OF AND SYSTEM FOR HIGH QUALITY REPRODUCTION OF IMAGES

(57) Abstract

A method of and system for reproducing images combines stochastic screening techniques with thermal imaging and waterless printing or proofing to achieve a favorable improvement in reproduction quality.

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# METHOD OF AND SYSTEM FOR HIGH QUALITY REPRODUCTION OF IMAGES

## Technical Field

The present invention relates generally to reproduction of images, and more particularly, to methods and systems that create high quality image reproductions.

## Background Art

In a conventional color lithographic printing process, an original image is scanned through color separation filters to produce film separations. These are then used to expose printing plates, one for each of the process inks to be applied to a substrate. Each printing plate includes a printing surface having a photosensitive coating thereon which, in a water-based form of lithography, is developed to produce hydrophilic and hydrophobic portions. An emulsion of oil-based ink and water-based fountain solution is applied to the printing surface and the ink and fountain solution are attracted to the hydrophobic and hydrophilic portions, respectively. The plate is then applied directly to the substrate or is brought into contact with a blanket which thereafter applies the image to the substrate.

A further type of lithographic printing process, referred to as waterless printing, utilizes printing plates each having a photosensitive printing surface which, after exposure, is developed to produce oliophilic and oliophobic portions. An oil-based ink alone, rather than an emulsion of ink and fountain solution, is then applied to the printing surface and is attracted to the oliophilic portions and is repelled from the oliophobic portions. The plates are then used as in the conventional lithographic process to apply the ink to the substrate. This process

minimizes or eliminates the disadvantages of the water-based process, including problems relating to dot gain, washing of inked areas, maintenance of proper ink to water balance under static and dynamic press and ambient conditions, and the like. Further, waterless printing can create reproductions having increased resolution, clarity, color accuracy and intensity.

Further improvements in reproduction quality can be obtained through the use of recently-developed screening techniques. In conventional reproduction processes, a continuous tone original is "screened" to create a halftone comprising a series of dots. The dots are formed at the intersections of screen grid lines which are regularly spaced over the image area so that the dots are also regularly spaced. In order to minimize Moiré effects, the grid lines of the various separations are angled with respect to one another when the separations are overlaid. While this technique is effective to reduce visual Moiré effects, it does not fully eliminate such effects, and hence, limits the reproduction quality that can be achieved. In order to overcome this problem stochastic screening processes have been developed. Such processes attempt to create non-regular dot patterns in one or more of the separations so that interference between dots of different separations is not visually observable. The dot patterns such processes produce are sometimes referred to as random dot patterns, although this terminology is somewhat imprecise because truly random dot patterns are not useful to reproduce an image. Stochastic screening processes can result in improved resolution as well as complete elimination of Moiré.

Recently, techniques have been developed to eliminate film in the printing process. One of these

techniques, called "computer-to-plate," (or "CTP") utilizes a series of plates each of which can be directly imaged in accordance with digital image information under control of a computer. Typically, this imaging is accomplished by a CTP platesetter having a green or infrared laser imager. In the latter case, the imager is said to be of the thermal type which is capable of still further improvement in image definition as compared with visible light imagers. Cost may also be reduced as compared with such imagers.

Stein, U. S. Patent No. 5,283,154 discloses a printing process which combines random screening techniques with waterless printing. In one embodiment, photosensitive printing plates are exposed through random pattern screens. In an alternative embodiment, the image to be reproduced is scanned by a scanner having software which generates a random pattern halftone image. The resulting electronic files are then used to produce printing plates. The plates are then used on a waterless press to reproduce the image.

Summary of the Invention

A method of and system for reproducing an image comprises a new combination of stochastic, thermal imaging and waterless printing which together achieve a remarkable improvement in reproduction quality.

More particularly, a method of reproducing an image includes the steps of converting the image into a halftone image version having at least one set of irregularly spaced halftone dots associated with a color to be printed, thermally imaging a waterless printing plate in accordance with the halftone image version and using the waterless printing plate in a waterless printing process to reproduce the image.

In accordance with a preferred form of the invention, the step of imaging includes the step of using an infrared laser imaging apparatus. Also preferably, the image is in color and the step of converting includes the steps of developing separations of the image and processing at least one of the separations using a stochastic process. Still further in accordance with the preferred embodiment, the image is expressed by electronic data and the step of converting includes the step of subjecting the electronic data to a stochastic process.

In accordance with an alternative aspect of the present invention, a system for reproducing an image includes means for converting the image into a halftone image version having at least one set of irregularly spaced halftone dots associated with a color to be printed. Thermal imaging apparatus is responsive to the converting means for creating a waterless plate in accordance with the halftone image version and a waterless printing device is provided for printing the image using the waterless plate.

The present invention is effective to achieve the highly desirable improvements in image quality and can offer reduced reproduction costs as compared with other reproduction methods and systems.

Other features and advantages are inherent in the apparatus claimed and disclosed or will become apparent to those skilled in the art from the following detailed description in conjunction with the accompanying drawings.

Brief Description of the Drawings

Figs. 1-4 are block diagrams illustrating conventional printing systems and methods; and

Fig. 5 is a block diagram illustrating a printing system and method according to the present invention.

Description of the Preferred Embodiments

Referring first to Fig. 1, a conventional lithographic system 10 includes an imagesetter 12 which receives electronic information from one or more of three data sources 14, 16 and 18. The sources 14 and 16 provide electronic data representing regular screened images and stochastic screened images, respectively. Regular screened images are those having halftone dots on regularly spaced dot centers. Typically, the dot size varies with screen density. Stochastic screened images, sometimes referred to as random or FM screened images, typically vary the distance between dots to vary the screen density. Screening methodologies where both dot size and distance between dots are varied are also used (sometimes referred to as second order stochastic screening).

The source 18 provides electronic data representing the makeup of each page to be reproduced. The imagesetter 12 assembles the data from the various sources 14, 16, 18 and produces film 20 which is used to expose one or more lithographic plates 22. If necessary or desirable, one or more of the plates may be exposed using film 24 supplied by a customer.

After suitable development, the lithographic plates 22 are used in combination with ink and fountain solution (also sometimes referred to as "water") to print images on a substrate, such as a web of paper.

Fig. 2 illustrates a modification to the prior art system of Fig. 1 to accomplish waterless printing. Elements common to the various figures are assigned like reference numerals. In the system of Fig. 2, the films 20 and/or 24 are used to expose one or more waterless printing plates 30 which are thereafter utilized with specialized waterless ink to create impressions on a substrate. The

waterless printing process eliminates the water from the printing process, and thus eliminates ink emulsification, thereby minimizing distortion in the halftone dots. Further, reduced dot gain effects are obtained as well as high ink densities. Print contrast can thereby be increased and, since no water is absorbed by the paper, there is minimum paper stretch and register is more easily maintained. These, as well as other advantages, can outweigh the increased ink and plate costs, the relative difficulty in matching proofs to what comes off the press and the need to more accurately control press temperature as compared with non-waterless printing.

Fig. 3 illustrates a "computer-to-plate" (CTP) system 40 having a platesetter 42 which is responsive to the data provided by the sources 14, 16 and/or 18. The platesetter 42 includes a green laser which directly images one or more laser printing plates 44. The CTP system 40 of Fig. 3 is capable of increased production levels owing to the ability to quickly reimage the printing plates 44.

Fig. 4 illustrates a modification to the system 40 of Fig. 3 wherein the green laser printing plates 44 are replaced by printing plates 50 that are imaged by a thermal (i.e., infrared laser). The infrared imaging illustrated in Fig. 4 is capable of significantly better image definition than the visible laser imaging of Fig. 3.

Fig. 5 illustrates a printing system which incorporates the present invention. The system of Fig. 5 includes a CTP platesetter 42 which includes a thermal imaging laser that images one or more stochastic screened images on one or more waterless lithographic printing plates 60. The printing plates 60 are then used together with waterless ink to produce halftone reproductions of exceptional quality. This quality improvement is obtained

together with minimization of waste at start-up of the press and can result in ink savings. Still further, color control can be achieved and maintained better and films are eliminated. Reimaging is easily accomplished and the use of stochastic screens for one or more of the separations or color(s) to be printed or otherwise reproduced eliminates Moiré effects and results in improved resolution. The printing system can be used to reproduce black-and-white or color images, as desired.

In the preferred embodiment, the platesetter is manufactured by Creo of Vancouver, Canada while the thermal waterless printing plates are manufactured by Presstek of New Hampshire. Of course, other manufacturers' products can be substituted for the platesetter and the plates, if desired. Still further, the stochastic screening process for creating the stochastic image data is disclosed in Xie et. al. U.S. Patent No. 5,335,089, entitled "Electronic High-Fidelity Screenless Conversion System and Method Using a Separable Filter," owned by the assignee of the present application and the disclosure of which is hereby incorporated by reference herein. Alternatively, any other stochastic or random screening process could be substituted therefor, for example, that disclosed in Xie et al. U.S. Patent No. 5,331,430, entitled "Electronic High Fidelity Screenless Conversion System," also owned by the assignee of the present application and the disclosure of which is hereby incorporated by reference herein.

While the foregoing description has been directed to the use of a waterless press to create printed reproductions, it should be understood that other output device(s) might alternatively be used. For example, a proofing medium of the dye sublimation or thermal transfer type (e.g., Kodak Approval) may be imaged by a thermal

imaging device, such as the thermal imaging laser noted above, in accordance with stochastic screened image data.

Numerous modifications and alternative embodiments of the invention will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the best mode of carrying out the invention without parting from the spirit of the invention, and the exclusive use of all modifications which come within the scope of the appended claims is reserved.

CLAIMS

1. A method of reproducing an image, the method comprising the steps of:

converting the image into a halftone image version having at least one set of irregularly spaced halftone dots associated with a color to be printed;

thermally imaging a waterless printing plate in accordance with the halftone image version; and

using the waterless printing plate in a waterless printing process to reproduce the image.

2. The method of claim 1, wherein the step of imaging includes the step of using an infrared laser imaging apparatus.

3. The method of claim 1, wherein the image is in color and the step of converting includes the steps of developing separations of the image and processing at least one of the separations using a stochastic process.

4. The method of claim 1, wherein the image is expressed by electronic data and wherein the step of converting includes the step of subjecting the electronic data to a stochastic process.

5. A system for reproducing an image, comprising:

means for converting the image into a halftone image version having at least one set of irregularly spaced halftone dots associated with a color to be printed;

a thermal imaging apparatus responsive to the converting means for creating a waterless plate in accordance with the halftone image version; and

a waterless printing device for printing the image using the waterless plate.

6. The system of claim 5, wherein the thermal imaging apparatus includes an infrared laser imager.

7. The system of claim 6, wherein the image is in color and is separated into separations and wherein the converting means processes at least one of the separations using a stochastic process.

8. The system of claim 5, wherein the converting means incorporates a stochastic process.

9. A method of reproducing an image, the method comprising the steps of:

converting the image into a halftone image version having at least one set of irregularly spaced halftone dots associated with a color to be reproduced; and

operating a thermal imager in accordance with the halftone image version to create a proof of the image on a proofing medium.

10. The method of claim 9, wherein the step of operating includes the step of using an infrared laser imaging apparatus.

11. The method of claim 9, wherein the step of converting comprises the step of developing separations of the image and processing at least one of the separations using a stochastic process.

12. The method of claim 9, wherein the image is expressed by electronic data and wherein the step of converting includes the step of subjecting the electronic data to a stochastic process.

13. A system for reproducing an image, comprising:

means for converting the image into a halftone image version having at least one set of irregularly spaced halftone dots associated with a color to be reproduced; and

a thermal imaging apparatus responsive to the converting means for creating a proof in accordance with the halftone image version.

14. The system of claim 13, wherein the thermal imaging apparatus includes an infrared laser imager.

15. The system of claim 14, wherein the image is in color and is separated into separations and wherein the converting means processes at least one of the separations using a stochastic process.

16. The system of claim 13, wherein the converting means incorporates a stochastic process.

FIG. 1
PRIOR ART

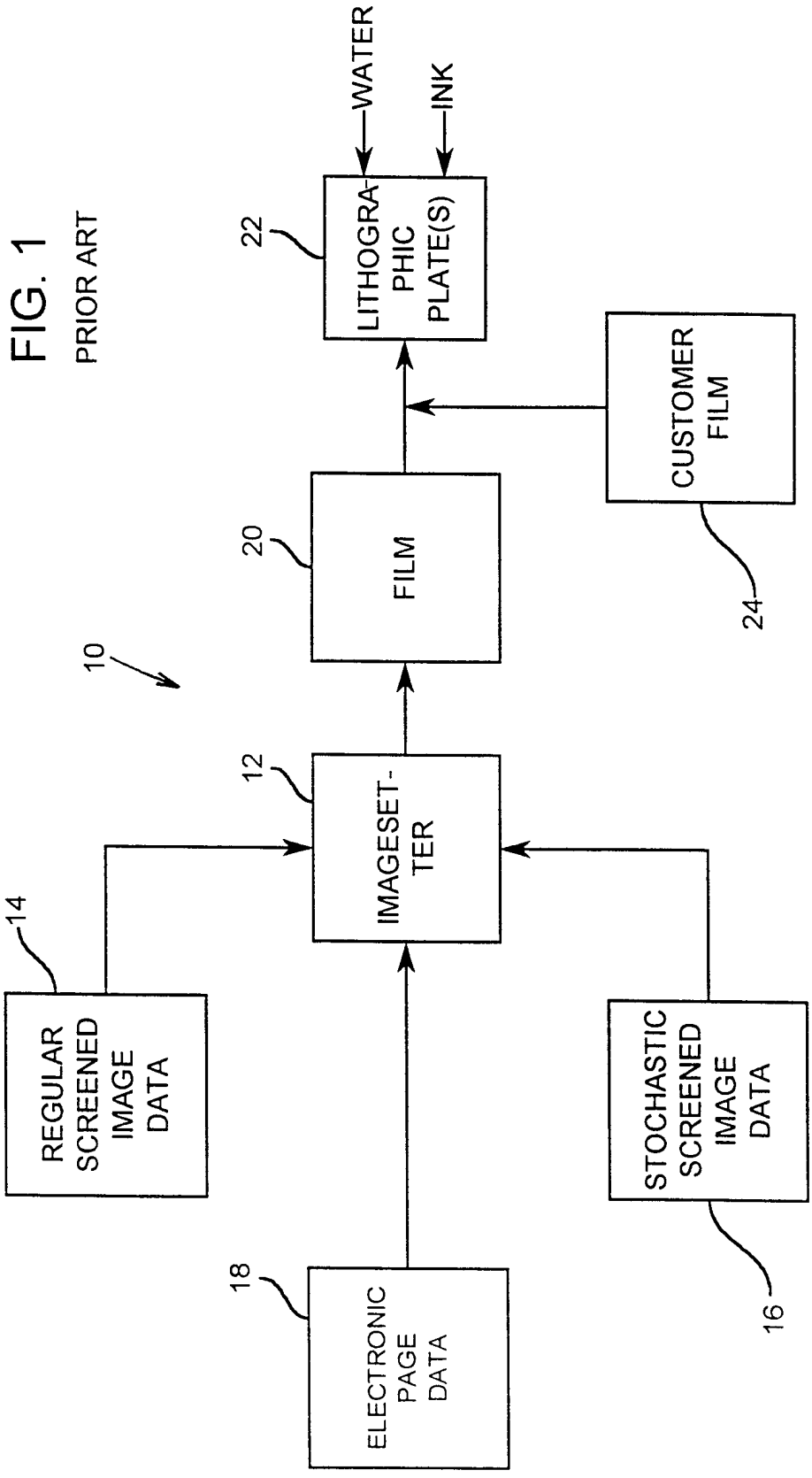
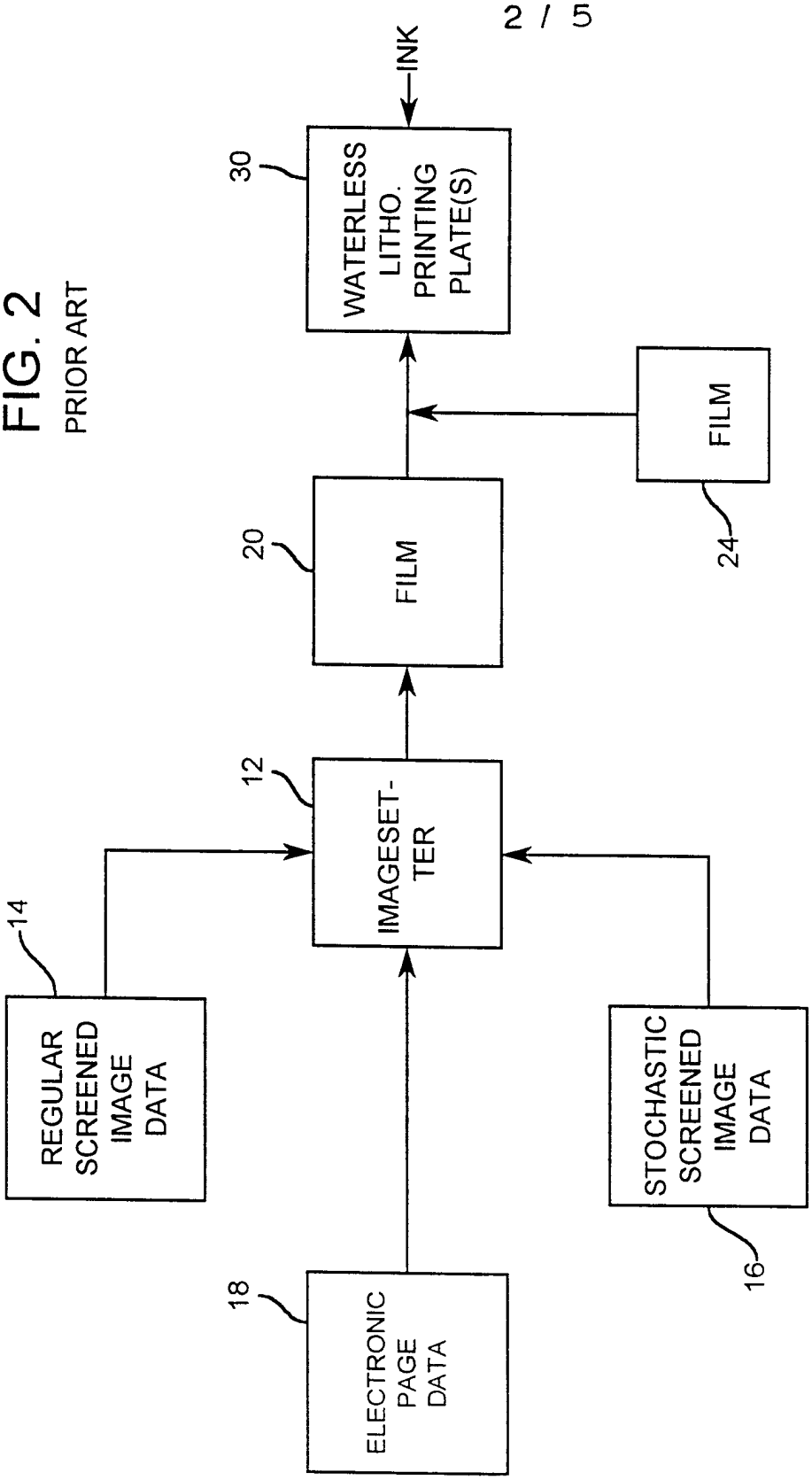


FIG. 2
PRIOR ART



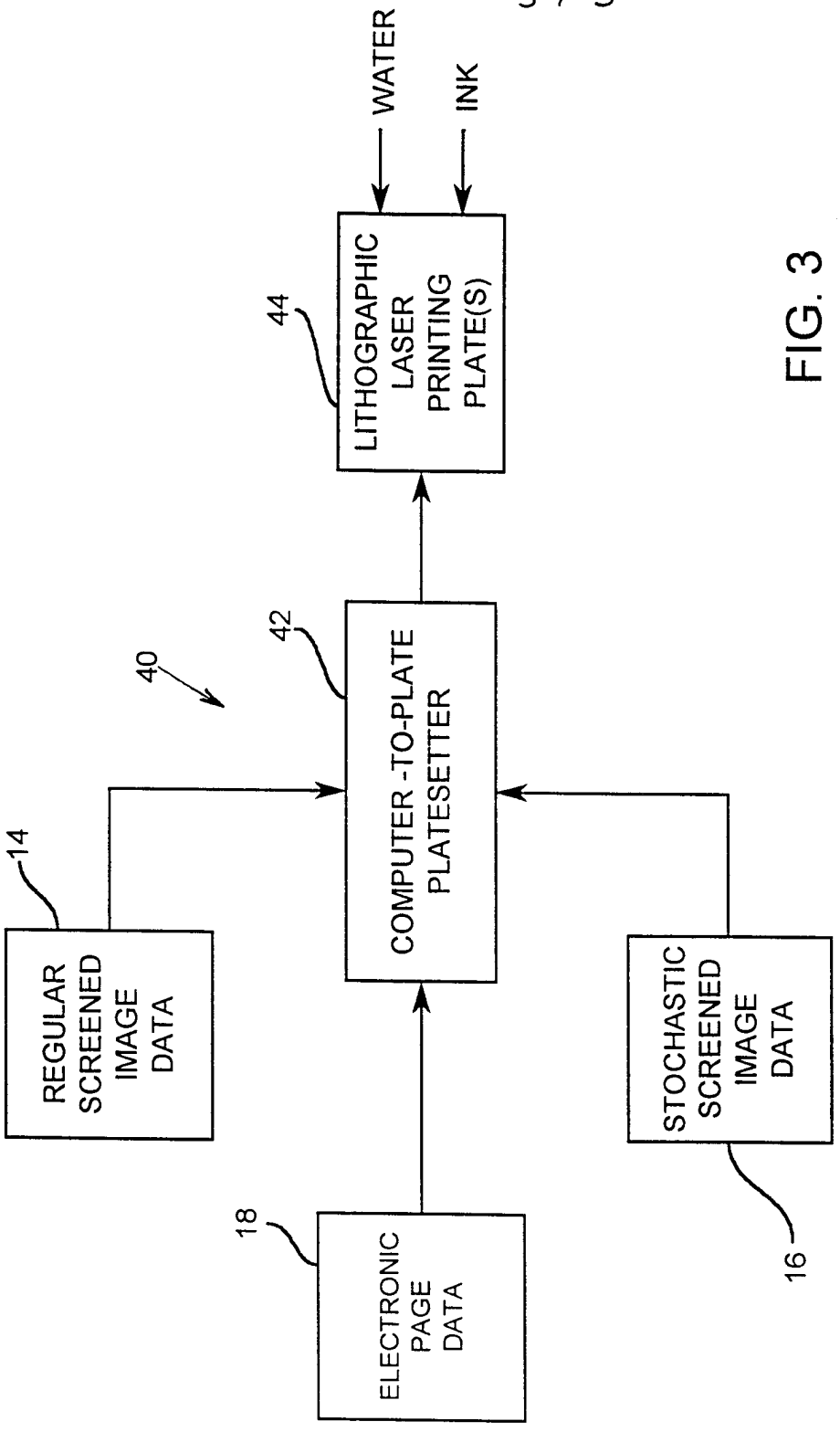



FIG. 3
PRIOR ART

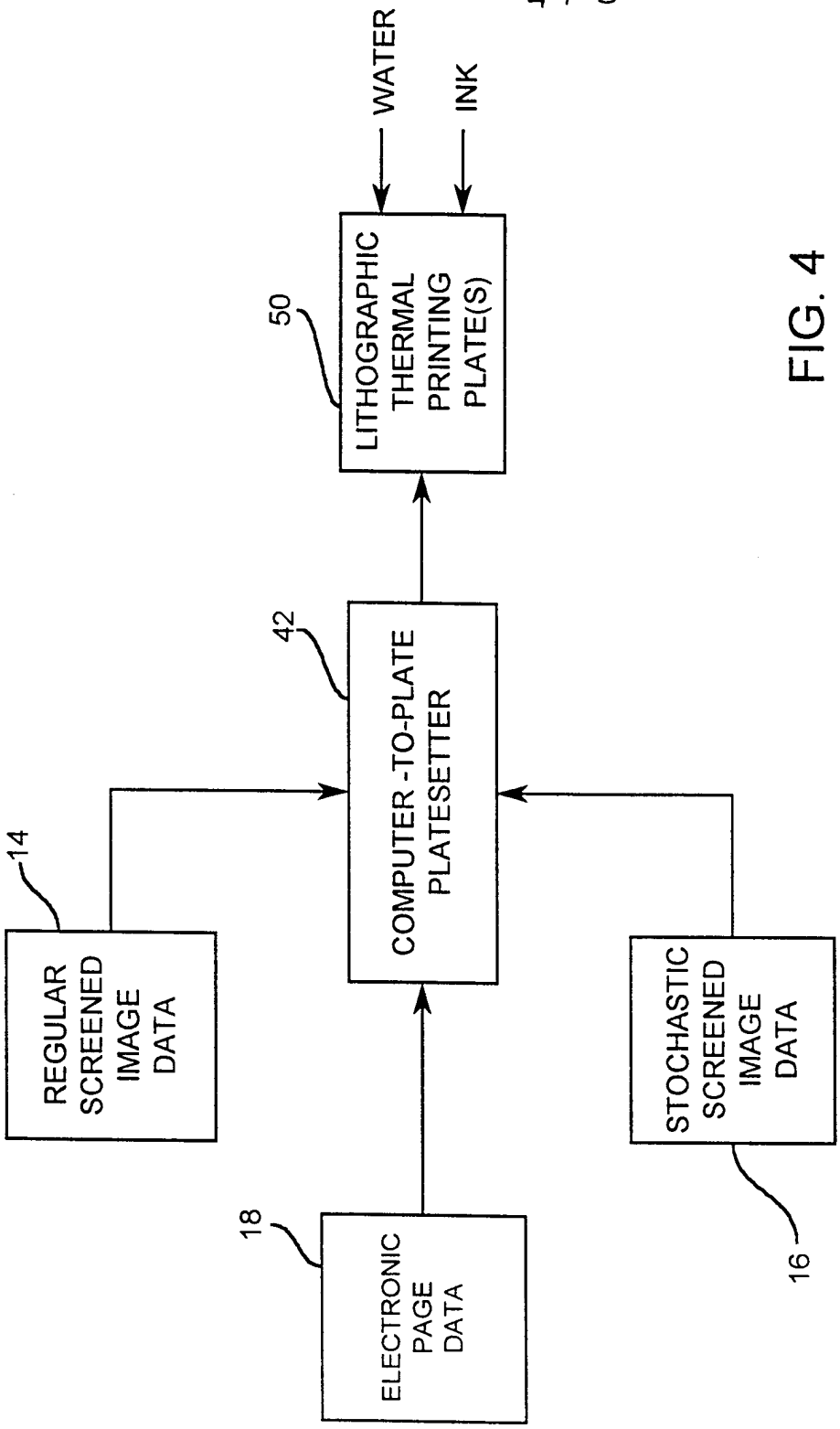



FIG. 4
PRIOR ART

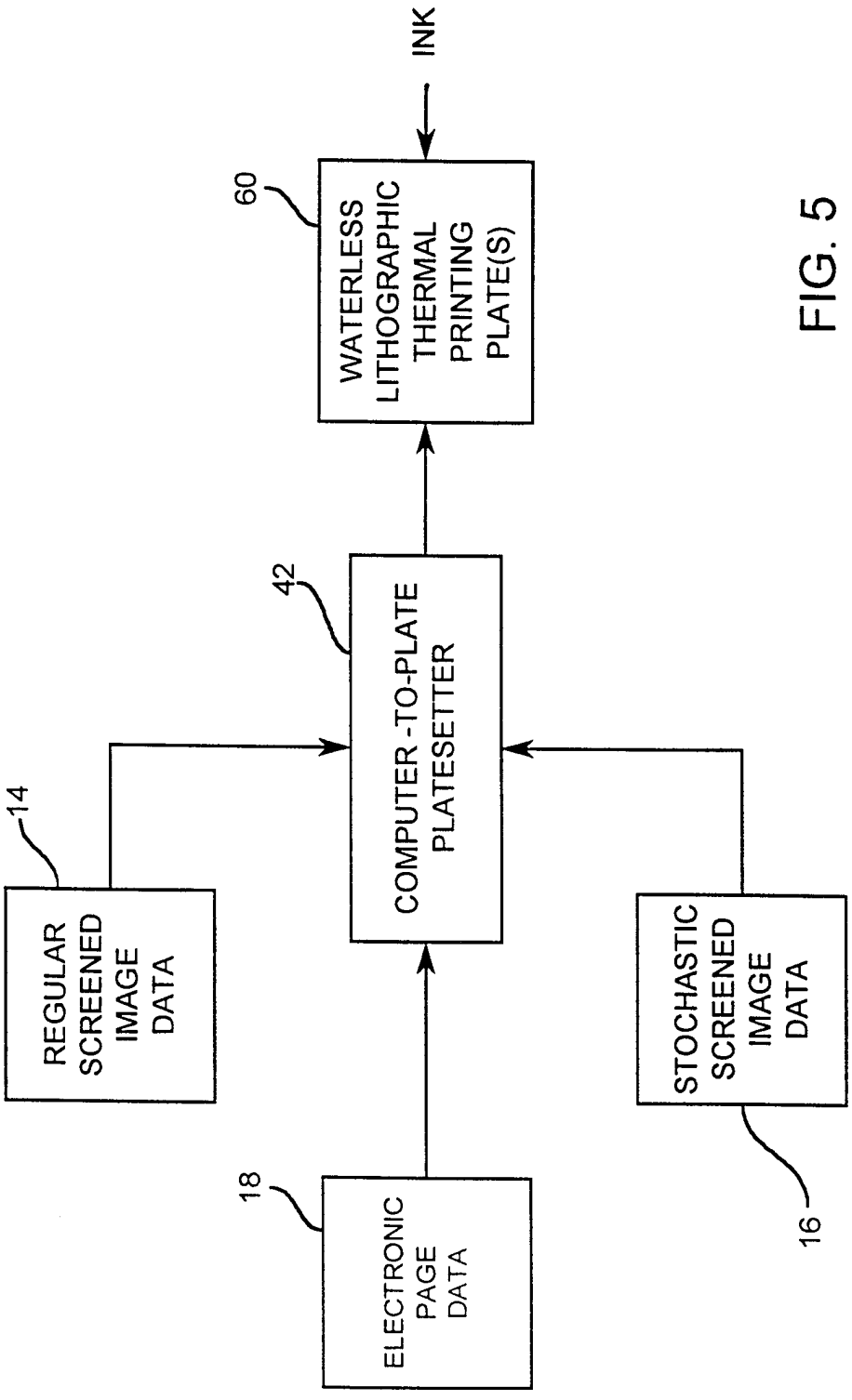

INK
60
WATERLESS LITHOGRAPHIC THERMAL PRINTING PLATE(S)
42
COMPUTER-TO-PLATE PLATESETTER
14
REGULAR SCREENED IMAGE DATA
18
ELECTRONIC PAGE DATA
STOCHASTIC SCREENED IMAGE DATA
16

FIG. 5

# INTERNATIONAL SEARCH REPORT

Inte. onal Application No
PCT/US 98/08093

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B41C1/10 H04N1/40 G03F5/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B41C H04N G03F B41M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| Y | US 5 283 154 A (STEIN RICHARD E) 1 February 1994<br>cited in the application<br>see the whole document | 1-8 |
| X | WO 96 02868 A (NOUEL JEAN MARIE) 1 February 1996<br>see the whole document | 1-10 |
| X | EP 0 734 147 A (AGFA GEVAERT NV) 25 September 1996<br>see column 13, line 28 - line 41 | 1-10 |

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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